

ELECTRONIC DESIGN

MARCH 1, 1957

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IRE National Convention
March 18-21

FREED

MINIATURE COMPONENTS

(MEET MIL-T-27A SPECIFICATIONS)

MINIATURE AUDIO TRANSFORMERS

Catalog No.	Input Coupling	Power Level	Balanced DC Current		Impedance Ohms	60,000 center tapped
			MA	MA		
PMA-1	✓	+8	0	0	50/200/500	
PMA-2	✓	+8	0	0	4/8	
PMA-3	✓	+8	0	0	50/200/500	
PMA-4	✓	+8	0	0	15,000	
PMA-5	✓	+8	2	2	15,000	
PMA-6	✓	+8	0	0	15,000	
PMA-7	✓	+8	2	2	15,000	
PMA-8	✓	+8	2	.25	30,000 ct	
PMA-9	✓	+8	0	0	60,000	
PMA-10	✓	+8	0	0	50/200	

All units ± 2 DB 30 to 20,000 \sim ; PMA 5 and 7 ± 2 DB 200 to 10,000 \sim . Case size 15/16" D x 1 1/2" high, Ranges 1 1/2" long.

TRANSISTOR TRANSFORMERS

Catalog No.	200 to 15,000		Unbalanced DC Current	Max. Power Out	Impedance Ohms	
	DB	DB			pri.	sec.
TMA-1	+1	0	.25	500	500	
TMA-2	+2	3	.25	50K	500	
TMA-3	+2	3	.25	50K	6	
TMA-4	+3	1	.25	100K	1.2K ct.	
TMA-5	+2	3	.25	25K	1.2K ct.	
TMA-6	+2	3	.25	50K	1.2K ct.	
TMA-7	+1	4	.25	600/150	1.2K ct.	
TMA-8	+2	3	.25	25K	600	
TMA-9	+1	1	.25	4K ct.	600/150	
TMA-10	+2	10	.25	2K	3.2	
TMA-11	+1	1	.25	4K ct.	3.2	
TMA-12	+2	4	.25	20K	50	
TMA-13	+2	8	.25	1K	50	
TMA-14	+2	0	.10	100K	1K	
TMO-15	+2	1	.04	20K	50	
TMO-16	+2	1	.04	20K	600	
TMO-17	+2	3	.06	1K	50	
TMO-18	+2	0	.10	100K	1K	
TMA-19	+2	20	1.	1K	3.2	

Case size 1"D x 1.5" high, Ranges 1 3/4". Specify TMO for open, TMC for encapsulated units.

MINIATURE HIGH Q TOROIDS

Cat. No.	Ind. MHY	Cat. No.	Ind. MHY	Cat. No.	Ind. MHY	Cat. No.	Ind. MHY	
F2050	1.	F2100	0.1	F2140	0.1	F2180	0.1	
F2051	3.	F2101	0.2	F2141	0.2	F2181	0.2	
F2052	5.	F2102	0.3	F2142	0.3	F2182	0.3	
F2053	10.	F2103	0.4	F2143	0.4	F2183	0.4	
F2054	15.	F2104	0.5	F2144	0.5	F2184	0.5	
F2055	30.	F2105	1.0	F2145	1.0	F2185	0.6	
F2056	50.	F2106	2.0	F2146	2.0	F2186	0.7	
F2057	75.	F2107	3.0	F2147	3.0	F2187	0.8	
F2058	100.	F2108	4.0	F2148	4.0	F2188	0.9	
F2059	150.	F2109	5.0	F2149	5.0	F2189	1.	
F2060	200.	F2110	7.5	F2150	7.5	F2190	2.	
F2061	300.	F2111	10.	F2151	10.	F2191	3.	
F2062	400.	F2112	15.	F2152	15.	F2192	4.	
F2063	500.	F2113	20.	F2153	20.	F2193	5.	
F2064	750.	F2114	30.	F2154	30.			
F2065	1,000.	F2115	50.	F2155	50.			
F2066	1,250.	F2116	75.	F2156	75.			
F2067	1,500.	F2117	100.	F2157	100.			
F2068	1,750.	Encapsulated 1"dx7/8" h. When ordering hermetically sealed units add H.						
F2069	2,000.	encapsulated units MR to Cat. No.						

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ACCESSORIES AVAILABLE:

- 1140-A Null Detector
- 1210-A Null Detector - V.T.V.M.
- 1170 D.C. Supply and 1180 A.C. Supply.



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NULL DETECTOR AMPLIFIER TYPE 1140-A USES

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

DESCRIPTION

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

SPECIFICATIONS

Input Impedance: 1 megohm in parallel with 25 mmf. GAIN: 98 db. with 1 megohm load (6 mmf. shunt capacity), down 1.5 db. at 25,000 cycles, down 5 db. at 50,000 cycles, down 2 db. at 20 cycles. Null Detector Sensitivity: At 1 kc. 100 microvolts will give a 15% meter deflection. Selective Amplifier: 26 db. second harmonic attenuation at 60, 400 and 1000 cycles. Power Supply: 105-125 volts, 50-60 cycles, 35 watts consumption. Dimensions: 13 1/2" x 8 1/2" x 10".

Send for NEW 48 page transformer catalog. Also ask for complete laboratory test instrument catalog.

TELEMETERING COMPONENTS

BAND PASS FILTERS

Catalog No.	Catalog No.	3DB Bandwidth per cent of F ₀	Center Frequency F ₀ (KCI)				Catalog No.
			9%	19%	0 1/2	1.5	
FBP-10	FBP-34	✓	4	✓	✓	DST-10	
FBP-11	FBP-35	✓	56	✓	✓	DST-11	
FBP-12	FBP-36	✓	73	✓	✓	DST-12	
FBP-13	FBP-37	✓	96	✓	✓	DST-13	
FBP-14	FBP-38	✓	1.3	✓	✓	DST-14	
FBP-15	FBP-39	✓	1.7	✓	✓	DST-15	
FBP-16	FBP-40	✓	2.3	✓	✓	DST-16	
FBP-17	FBP-41	✓	3.0	✓	✓	DST-17	
FBP-18	FBP-42	✓	3.9	✓	✓	DST-18	
FBP-19	FBP-43	✓	5.4	✓	✓	DST-19	
FBP-20	FBP-44	✓	7.35	✓	✓	DST-20	
FBP-21	FBP-45	✓	10.5	✓	✓	DST-21	
FBP-22	FBP-46	✓	12.3	✓	✓	DST-22	
FBP-23	FBP-47	✓	14.5	✓	✓	DST-23	
FBP-24	FBP-48	✓	22.0	✓	✓	DST-24	
FBP-25	FBP-49	✓	23.0	✓	✓	DST-29	
FBP-26	FBP-50	✓	30.0	✓	✓	DST-25	
FBP-27	FBP-51	✓	30.0	✓	✓	DST-30	
FBP-28	FBP-52	✓	40.0	✓	✓	DST-26	
FBP-29	FBP-53	✓	40.0	✓	✓	DST-31	
FBP-30	FBP-54	✓	52.5	✓	✓	DST-27	
FBP-31	FBP-55	✓	52.5	✓	✓	DST-32	
FBP-32	FBP-56	✓	70.0	✓	✓	DST-28	
FBP-33	FBP-57	✓	70.0	✓	✓	DST-33	

DISCRIMINATORS

DISCRIMINATOR LOW PASS FILTERS

Catalog No.	Center Frequency F ₀ (cps)	Catalog No.	Center Frequency F ₀ (cps)	Catalog No.	Center Frequency F ₀ (cps)	Attenuation	
LPO-10	6	LPO-19	81	LPO-28	790	.05 DB at 9% F ₀ .30 DB at third 30 DB at fifth Harmonics	
LPO-11	8	LPO-20	110	LPO-29	900		
LPO-12	11	LPO-21	160	LPO-30	1,050		
LPO-13	14	LPO-22	185	LPO-31	1,200		
LPO-14	20	LPO-23	220	LPO-32	1,600		
LPO-15	25	LPO-24	330	LPO-33	2,100		
LPO-16	35	LPO-25	450	LPO-34	7,200		
LPO-17	45	LPO-26	600	LPO-35	10,000		
LPO-18	60	LPO-27	660				
Characteristic impedance of all—330!!							
INPUT							
LPI-10	400	LPI-17	3,000	LPI-23	14,500		Characteristic impedance of LPI-10 thru 23—30,000!! at LPI-24 thru 28—5,100!!
LPI-11	560	LPI-18	3,900	LPI-24	22,000		
LPI-12	730	LPI-19	5,400	LPI-25	30,000		
LPI-13	960	LPI-20	7,350	LPI-26	40,000		
LPI-14	1,300	LPI-21	10,500	LPI-27	52,500		
LPI-15	1,700	LPI-22	12,300	LPI-28	70,000		
LPI-16	2,300						

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ELECTRONIC DESIGN

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BPA



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TYPICAL CHARACTERISTICS

TYPE	DESCRIPTION	Vibration Output* (maximum) mVac	Vibration Output** peak to peak mV	Heater Volts mA	Plate Volts mA	Cathode Bias Resistor ohms	Screen Volts mA	Amplification Factor	Mutual Conductance μ hos	
CK5702WB	Video Amplifier, Pentode	50	240	6.3 200	120 7.5	200	120 2.6	—	5000	
CK5703WB	High Frequency Triode	10	50	6.3 200	120 9.4	220	— —	25.5	5000	
CK5704†	High Frequency Diode	—	25	6.3 150	Max. inverse peak = 460 volts; max. I_b = 10 mA					
CK5744WB	High Mu Triode	15	75	6.3 200	250 4.2	500	— —	70	4000	
CK5783WB	Voltage Reference	50	—	Operating voltage approximately 85 volts between 1.5 and 3.5 mA						
CK5784WB	RF Mixer Pentode	75	300	6.3 200	120 5.5	230	120 4.1	—	3200	
CK5787WB	Voltage Regulator	50	—	Operating voltage approximately 98 volts between 5 and 25 mA						
CK6247WA	Low Microphonic	2.5	25	6.3 200	250 4.2	500	— —	60	2650	
CK6533WA	Low Microphonic Triode	1.0	—	6.3 200	120 0.9	1500	— —	54	1750	

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†Type number for improved CK5704 not assigned.

*15g, 40 cps, fixed frequency

**15g, 30 to 1000 cps sweep

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Editorial

May We Save Your Time?

The IRE National Convention and Show this year promises to be the biggest ever held. There will be more technical papers and more exhibits. Those of you who have attended in the past may wonder how you will be able to "cover" it all in the limited time you have available. May we make some suggestions to help you save time?

► Check the technical sessions you want to attend in advance and note their locations. Those that will be held at the Coliseum are shown on page 27. All others will be held at the Waldorf-Astoria Hotel, 20 minutes away. Plan to tour exhibits while at the Coliseum for technical sessions.

► New products to be on display at the Show are all illustrated and described in this issue of ELECTRONIC DESIGN. The company name, together with the booth number where the product will be on display, is given for each new product. We suggest you check these over carefully in advance of arrival and make a list of those products and booths of special interest to you.

► To find the products of special interest when you arrive it will only be necessary to note whether the product is a component, an instrument, a basic material or tool, or a complete equipment, and go to the appropriate floor at the Coliseum. The exhibits are so arranged that complete equipments will be found on the first floor, components on the second and part of the third, instruments on the third, and basic materials and tools on the fourth.

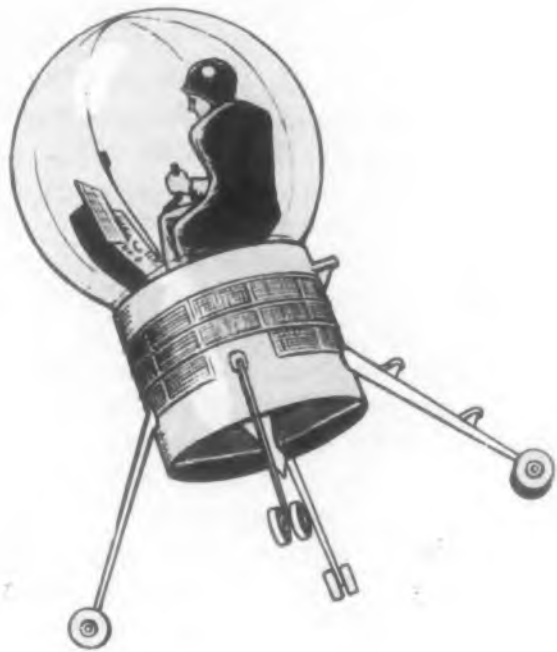
► For a general tour, start on the fourth floor and work down. This will save time, because the elevator from floor 4 to floor 3 does not stop at 3 going up.

► We suggest you make your first stop at ELECTRONIC DESIGN's booths (4101, 4102), right by the elevator as you get out on the fourth floor, to start your tour. Copies of ELECTRONIC DAILY and someone to guide you will be available at our booths to give you all the latest information and directions to save you time. An ELECTRONIC DESIGN editor will be on hand to receive your "design idea" for which we will pay \$10 if accepted for publication. We will also have an "editorial office" where we hope you will drop in and say "hello."

► Make ELECTRONIC DESIGN your headquarters. Your interests are ours.—ETE

Engineering Review

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



Artist's conception of gas turbine powered "Flying Flash Bulb," tomorrow's answer to the overcrowded highway.

Tomorrow's Transportation

"Flying Flash Bulb" will be on the market within ten years, according to its designer P. G. Kappus, top product planner of the Flight Propulsion Lab., General Electric Co., Cincinnati, Ohio. Kappus indicated that vertical take-off and landing may do for aviation what Henry Ford's Model T did for the automobile. The designer anticipates that there will be many different types of such aircraft. Some will have wings and others will not, depending on the distance they will be expected to fly or the load they will carry.

Solid-State Oscillator for Microwaves

Successful operation of a revolutionary solid-state device, which will oscillate at microwave frequencies, has been achieved at Bell Telephone Laboratories by Dr. Derrick Scovil, Dr. George Feher and Dr. Harold Seidel. The experiment as carried out at Bell Laboratories produced oscillations at 9,000 Mc with a power output of about 20 μ w. Operation at both much lower and higher frequencies is possible with proper choice of solid-state materials and operating conditions.

A completely new source of microwave power operating under new physical principles was demonstrated. Scientists believe it is only a question of time until microwave amplification can be obtained employing crystalline materials and operating under

the same physical principles as the oscillator. Potential applications of this device as an amplifier are boundless.

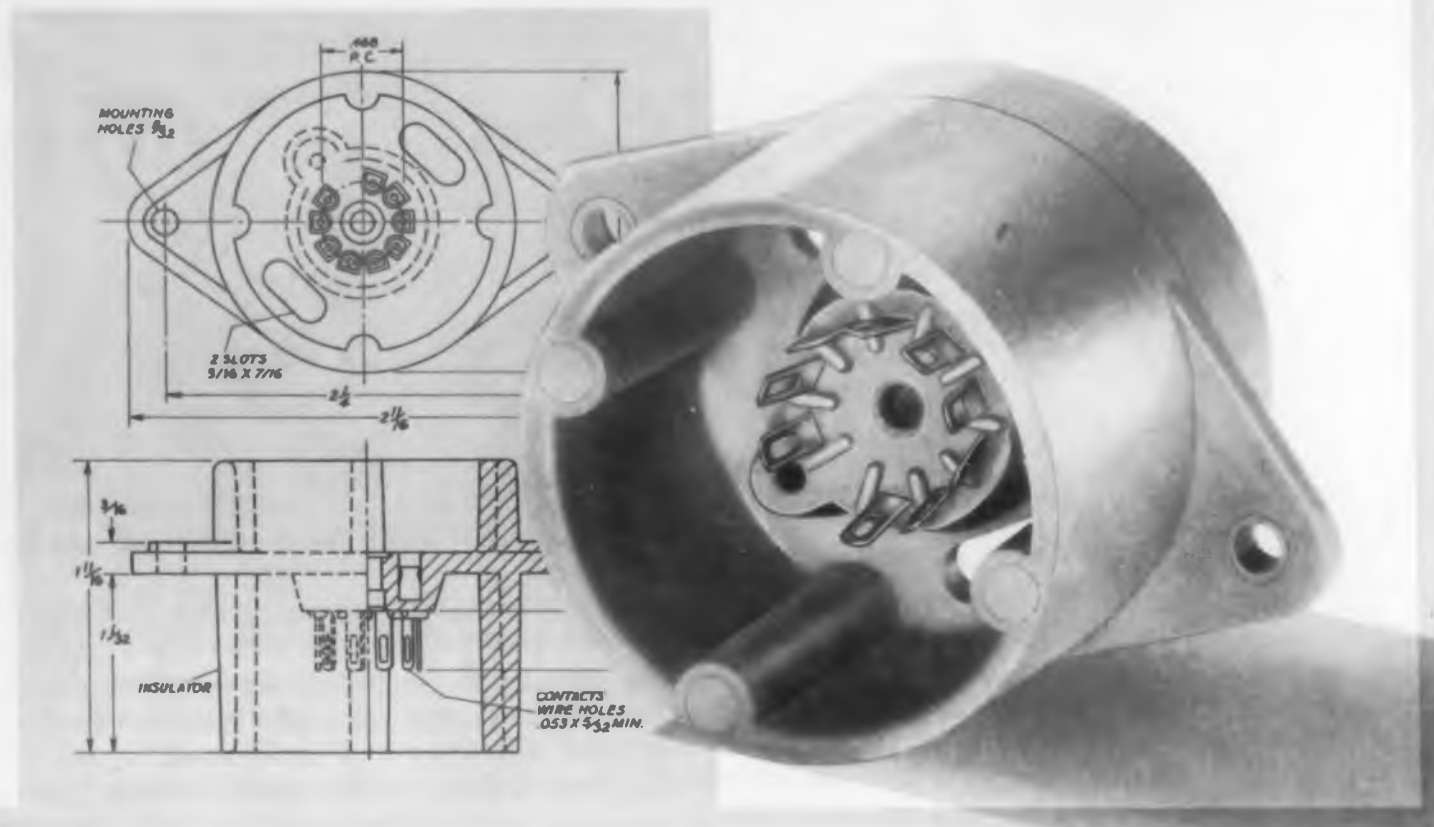
One of the outstanding characteristics of the new device is that it is expected to have very low noise compared with conventional microwave devices. Thus, in theory, it could markedly extend the range of radio astronomy and could result in radically new long distance communication systems to carry television programs and telephone calls across the continent.

While this experimental result is completely new, the possibility of such an occurrence has been the subject of studies and speculative discussion by a number of physicists for some time. The development represents the first successful application to a solid-state device of a relatively new principle,



Drs. Harold Seidel, Derrick Scovil and George Feher inserting waveguide assembly containing the solid-state oscillator into a Dewar Flash. Flash will contain liquid helium at 1.2°K.

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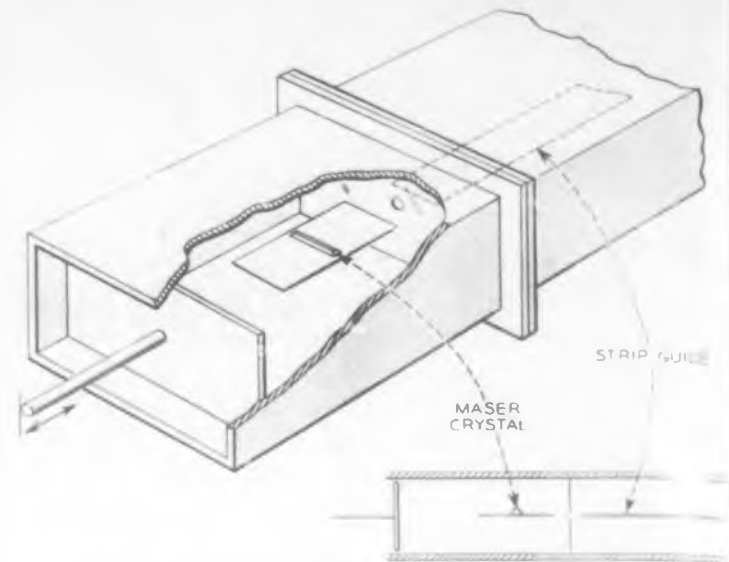
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Sketch of resonant cavity and crystal used in obtaining the oscillations at microwave frequencies.

which has been called the "maser" principle. "Maser" was first demonstrated for molecular beams in gases in 1954 by Professor C. H. Townes and his collaborators at Columbia University. They coined the word "maser" which stands for "microwave amplification by stimulated emission of radiation." Because it operates with electron spins in a paramagnetic crystal, theory predicts that it should have very low inherent noise compared to ordinary electronic oscillators or amplifiers which depend on the motion of charged particles at high temperatures. Therefore, it may be possible to amplify extremely weak radio signals—signals which may be several hundred times weaker than those usable at present. As an amplifier, it should be moderately broadband with a bandwidth of the order of 100 Mc, and easily tuned since its frequency is proportional to the applied magnetic field. Preliminary theoretical estimates indicate that a noise figure corresponding to thermal noise at perhaps 5 or 10 degrees Kelvin should be attainable. This is hundreds of times better than is now available with conventional microwave circuitry and if realized in practice will open wide new vistas in the microwave field.

The basic operation of this particular type of solid state device can be explained roughly by assuming three different energy levels for the unpaired spinning electrons in a paramagnetic crystal lattice in a magnetic field. Normal electron spin states are such that the number in state 1 (lowest energy state) exceeds the number in state 2, which in turn exceeds the number in state 3. By irradiating with sufficient microwave power of the proper frequency, transitions from state 1 to state 3 take place until the populations of these two states are essentially equal (power saturation).

Under these conditions the population of state 2 can be made greater than that of state 1. If a small signal is applied at a frequency corresponding to the energy difference between these two, then

stimulated radiative transitions will occur, and power gain will be realized. In the experiment conducted at Bell Laboratories, the energizing frequency was 17,500 mc and the signal frequency (in this case a self-sustained oscillation) was 9,000 mc.

A number of conditions have to be established before operation such as that described above can take place. In the first place, a single crystal of a solid-state material having certain specific characteristics is necessary. A whole group of materials, known as "ionically bound paramagnetic salts," appear to be suitable. After a careful survey, gadolinium ethyl sulphate was selected, although it is recognized that other compounds might perform as well or better for specific applications. Secondly, this material has to be diluted with an isomorphous diamagnetic substance to separate the gadolinium atoms sufficiently to reduce electron spin interaction. Lanthanum ethyl sulphate was selected, and it makes up about 99 per cent of the finished crystal.

The crystal was mounted in a waveguide cavity having two resonant frequencies, one equal to the frequency of oscillation, and one the frequency of the energizing source. The sample occupied about 8 per cent of the cavity volume, and was located at the point of maximum magnetic field intensity.

Low temperature operation is used so that power saturation of the crystal takes place with a reasonable amount of energizing oscillator power and also to increase the population difference between the energy levels. The sample and cavity were immersed in liquid helium at reduced pressure which provides a temperature of 1.2 K.

To produce the necessary separation of the electron spin energy levels, a magnetic field is required. A value of 2800 oersteds was employed in the device built at Bell Laboratories. This magnetic field may be altered to change the electron spin energies and thus tune the frequency of the stimulated radiation. The field must be properly aligned with respect to the crystal, and can be provided either by a permanent magnet or an electro-magnet.

Equipment employed at the Bell Laboratories in demonstrating the operation of this new solid state device included a waveguide cavity, with the crystal in place, immersed in liquid helium. This assembly was located in the field of a strong electromagnet. The 17,500 Mc energizing oscillator signal was brought to the cavity through a rectangular waveguide, and the stimulated radiation of 9,000 Mc was taken away by means of a strip guide mounted inside the rectangular waveguide. Measured power output was about 20 μ w. Energizing oscillator power, which might be compared to "B+" power in a conventional amplifier or oscillator, was about 10 mw to insure saturation of the crystal. Satisfactory operation can be attained with much less power.

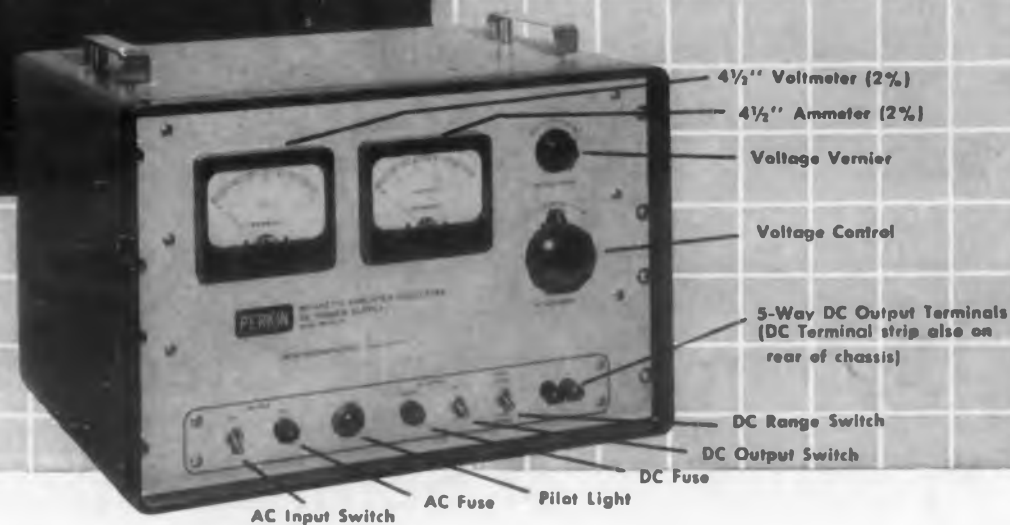
**2 TO 36
VOLTS
@ 15 AMPS
DC POWER SUPPLY**

The **NEW PERKIN**

MODEL MR532-15A

with $\pm 1/2\%$ **REGULATION**

**IMMEDIATE
DELIVERY!**



**Now...for Your Laboratory...the most versatile TUBELESS,
Regulated and Filtered Power Supply**

**OTHER STANDARD MODELS
AVAILABLE:**

VOLTS	AMPS	REG.	MODEL
0-32	25	$\pm 1\%$	M60V
24-32	10	$\pm 1/2\%$	28-10WX
24-32	30	$\pm 1/2\%$	28-30WX
5-40	30	$\pm 1\%$	MR 1040A
24-32	100	$\pm 1/2\%$	100 XA

Ripple on all above models: 1% rms
6, 12 and 115 V models also available.
Write for complete specifications on all models listed above.

- REMOTE SENSING • VERNIER VOLTAGE CONTROL
- NO TUBES, MOVING PARTS OR VIBRATING CONTACTS

Specifications . . .

REGULATION: 5-32V Range: $\pm 1/2\%$ for combined line changes of 105-125VAC and load of 0-15A. DC.

2-5V Range: $\pm 2\%$ for combined line changes of 105-125VAC and load changes of 0-15A. DC.

32-36V Range: $\pm 2\%$ for combined line changes of 110-125VAC and load changes of 0-15A. DC.

RIPPLE: 1% rms max. @ 36 volts and full load. Increases to 2% @ 2 volts and full load.

AC INPUT: 105 to 125 volts, 1 phase, 60 cps. (8 amps, Input)

RESPONSE TIME: 0.1 to 0.2 seconds maximum.

DIMENSIONS: 19 1/2" wide x 15 1/2" deep x 13 1/4" high with cabinet. (19" wide x 14 3/4" deep x 12 1/4" high rack panel construction)

FINISH: Gray Hammertone **WEIGHT:** Approx. 135 lbs.

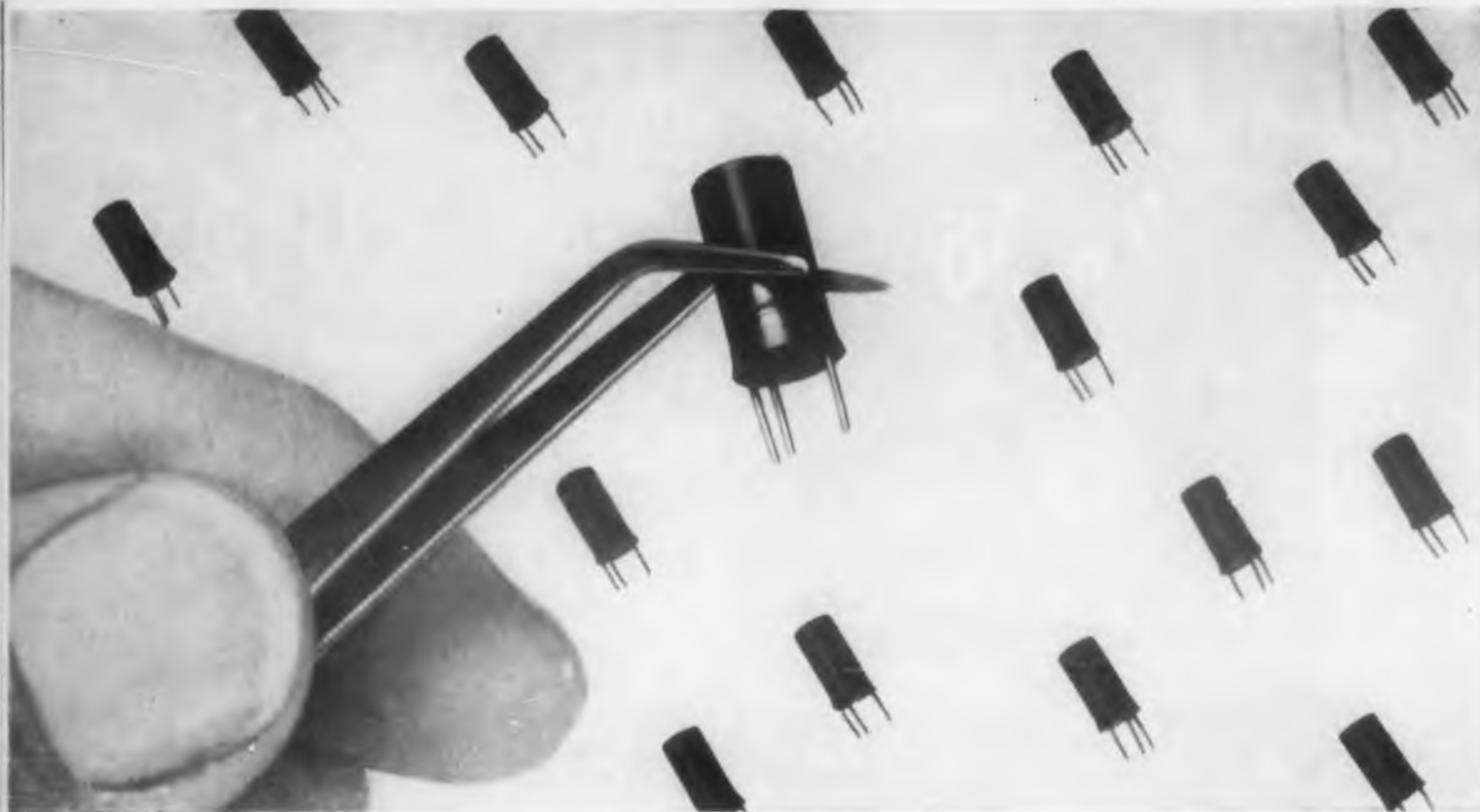
Representatives in principal cities throughout the country.
Wire collect for complete price information.



PERKIN ENGINEERING CORP.

345 KANSAS ST. • EL SEGUNDO, CALIF. • Oregon B-7215 or EAsgate 2-1375

CIRCLE 5 ON READER-SERVICE CARD FOR MORE INFORMATION



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A New High in Electronic Chemical Purity for Production of Semiconductors!

...Drastic reduction of metallic and other undesirable impurities

Previous standards of chemical purity have been outmoded by the stringent quality requirements of the electronics industry—especially for chemicals used in the production of semiconductor devices.

Baker & Adamson, the country's leading producer of extremely high purity laboratory and scientific chemicals, now meets these demands with "electronic grade" chemicals that establish a new high in chemical

purity. Metallic and other undesirable impurities are held to lower limits than ever before.

Listed here is a group of these extremely high purity chemicals made especially for the production of electronic devices—part of B&A's extensive line of electronic grade chemicals. Call or write your nearest B&A sales office today for information on any of the following . . . or other electronic chemicals you may need.

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ALLIED CHEMICAL AND DYE CORPORATION

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CIRCLE 6 ON READER-SERVICE CARD FOR MORE INFORMATION



Acetone

Acids

Glacial Acetic
Hydrochloric (Muriatic)
Hydrofluoric, 48%
Nitric
Sulfuric

Alcohol, Methyl and Propyl

Bromine

Carbon Tetrachloride

Ether

Glycerine

Hydrogen Peroxide, 3% & 30%

Indium Fluoborate

Toluene

Trichloroethylene

Xylene



Pocket-Size Television Camera

A pocket-size live television camera has been developed by RCA, Camden, N.J., for military airborne, mobile and field-closed-circuit TV application. The miniature TV camera utilizes a new design approach which combines transistor circuitry and a new RCA half-inch vidicon camera tube.

Used with an F-1.9 lens, it requires only 10 foot candles of scene illumination for clear, good contrast pictures. A photoelectric iris control automatically activates specific camera circuits to compensate for changing light levels. This iris control enables the camera to accommodate changes in the order of 100 to 1 in scene lighting.

Patent System Study

Dr. Vannevar Bush, retired director at the Carnegie Institution, has made a study of the U.S. Patent System at the request of a congressional subcommittee. In his report to Sen. J. C. Mahoney, he outlines the problems that have arisen out of an "archaic system that has failed to keep abreast of the times." He also makes some suggestions as to how the patent system may be improved to benefit a larger number of people.

Dr. Bush feels that the system has led to a number of objectionable effects. Among these are:

- Strong industrial groups dominating fields of manufacture. This includes not only a patent's statutory term, but often for perpetuity by adding improvements.
- Trivial applications wasting the time of patent examiners.
- Invalidations occurring too often became prior inventions have not been considered.
- No obligations for the holder to bring his invention to use.
- An inability—both in the courts and the Patent Office—to keep up with the great mass of scientific material. This discourages inventors and businessmen who might risk capital to manufacture the invention.

Among the recommendations for improvement, Dr. Bush suggests:

- Legislation that would determine the extent of monopoly in combination, cross licensing, infringement, and domination.

- Freshly defined criteria to raise the standard of invention from trivia to devices worthy of the public's use.

- A special tribunal, under the Department of Commerce, for judging patent cases now going to law courts. Technical matters would then be evaluated by properly qualified persons.

- Increased funds for facilities and employees.

Atomic Battery—Size of Button

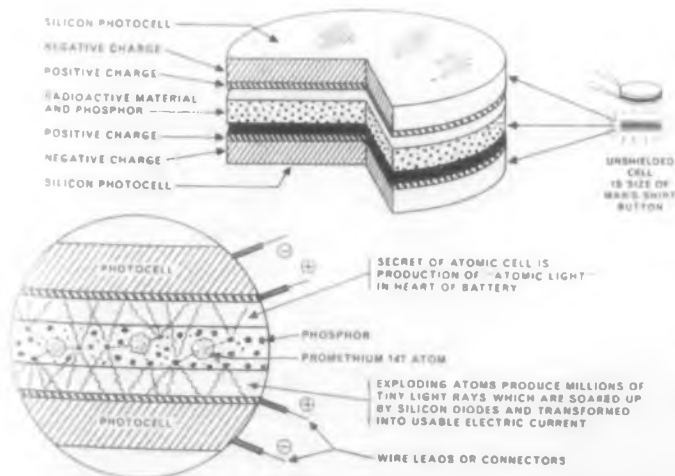
An atomic-powered battery no bigger than a cough drop, yet capable of delivering usable power for at least five years has been announced by the Walter Kidde Nuclear Laboratories, Inc., Garden City, N.Y. The atom-cell uses a radioactive substance known as Promethium 147, once considered an atomic "waste-product," as its power source. This material was chosen because it produces energy over a long period and requires little shielding against radiation. The energy output, limited only by radioactive decay, decreases at a far slower rate than conventional batteries.

A unique characteristic of the cell is its superior performance in widely varying temperatures ranging from boiling hot to bitter cold. Laboratory tests have shown it will actually increase power output in extreme cold, even in temperatures as low as -200 F.

Promethium 147, emits beta particles which are soaked up by a phosphor. The phosphor converts the beta particles into "atomic light." This in turn is captured by a photocell which converts the light energy into electrical current. Actually the principle is the same as using a phosphor to produce light in television picture tubes.

Termed as safe to carry as a house key, the miniature power unit will actually give off less radiation than radium dials on modern-day wrist watches.

Higher power output can be obtained by enlarging the battery.



Atomic Battery with life measured in years.



SUBMINIATURE FILTERS

- for I.F. amplifiers, printed circuit use
- temperature compensated to .15% from -55°C to +85°C
- for operations above 1 mc
- dimensions: 13/16" x 2-1/2" x 2" high



ENCAPSULATED TOROIDS

- hermetically sealed
- high Q
- center-mounting permits stacking
- complete range of sizes and types
- dimensions: 21/32" x 3/8"



TOM THUMB TELEMETERING FILTERS

- miniaturized for guided missiles
- high temperature stability
- designed to withstand shock and vibration
- hermetically sealed—wt. 1.5 oz.
- dimensions: 45/64" x 45/64" x 2" high



SUBMINIATURE ADJUSTOROIDS

- precise continuous adjustment of inductance over a 10% range
- no external control current needed
- hermetically sealed
- low cost—wt. .83 oz.
- dimensions: 45/64" x 45/64" x 3/4" high



you're all set to roll...

...with a toroid, filter or related network by Burnell.

For Burnell *specializes* in these components; in manufacturing them *and* in delivering them on schedule — at competitive prices.

Today Burnell makes toroids, and the filters of which they are the basic components, small enough to meet a multitude of new purposes . . . in aircraft and guided missiles . . . in receivers, carrier and telemetering systems.

Very likely we already have the answer to your network needs among our extensive files. If not, we can swiftly find that answer for you. Try us and see.

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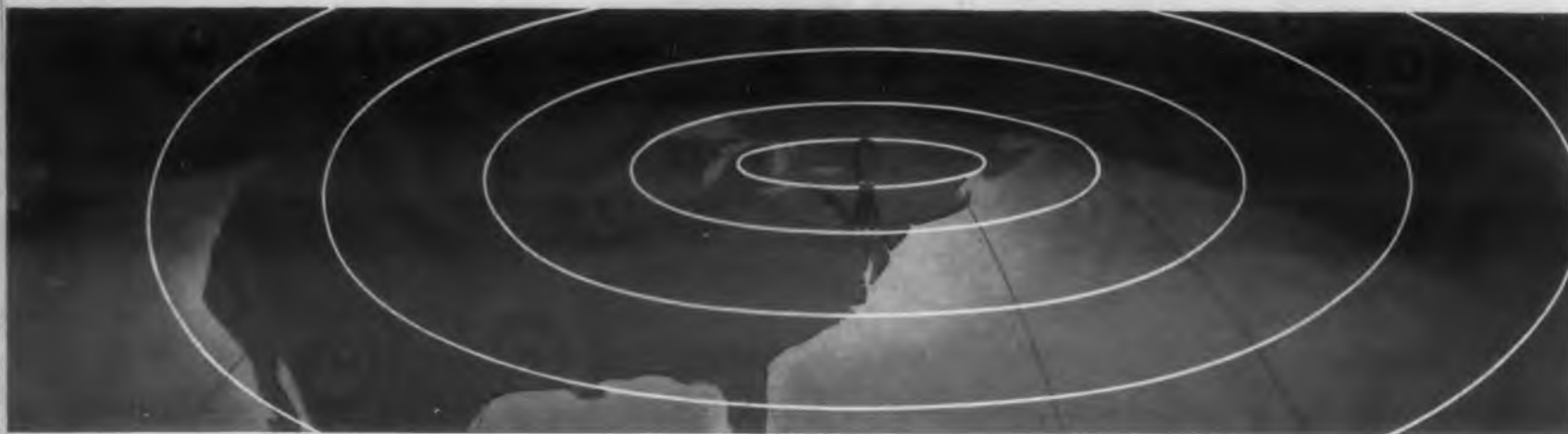
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PACIFIC DIVISION: 720 MISSION STREET, SOUTH PASADENA, CALIFORNIA TELETYPE: PASADENA 7578.

You are warmly invited to visit our booth, #2131, on the second floor of the IRE show.

CIRCLE 7 ON READER-SERVICE CARD FOR MORE INFORMATION

F-I-a-s-h!...from Transistor Center, U.S.A.



Announcing a new transistor class . . . The PHILCO Micro-Alloy Transistor (MAT)*



CHECK THESE UNEQUALLED FEATURES

- Excellent High Speed Switching characteristics.
- Low Saturation Voltage (low impedance)
- Excellent high frequency amplification.
- Excellent low-level amplifier over entire frequency range from D.C. to Megacycles.
- Exceptionally Long Life (hermetically sealed)
- Permits high speed computer design with Fewer Stages.

...world's first production transistor with exceptionally high frequency and high gain . . . plus low saturation resistance!

This newest development from Philco Transistor Center features the characteristic high frequency response obtainable with extremely precise base width control. Designed for low voltage operation, the new MAT transistor is especially well suited for high speed applications where low saturation resistance (reduced power consumption) is necessary.

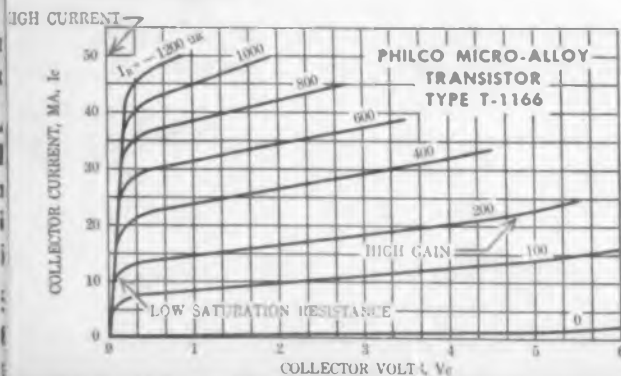
To combine high gain at high currents with high frequency response, the new MAT transistor employs a gallium doped alloy junction for the emitter electrode.

A special short-alloying cycle, combined with precise electro-chemical production techniques (pioneered and developed at Philco Transistor Center for production of SBT), results in the micro-alloy contact for exceptionally high injection efficiency. This new process assures higher gain, and permits operation at higher current. Beta linearity is excellent over the entire range of operating currents . . . up to 50 milliamperes.

● Write for complete information and specifications. Make Philco your prime source of information for high frequency transistor applications.

*Patent Applied For

Visit The Unique Philco Transistor Display at IRE Show, New York Coliseum, March 18-21, Booth # 1410, 1412, 1414.



Computer Flies Copilot

Electronic computing techniques soon may come to the aid of "too busy" aircraft pilots according to Admiral Luis de Florez, president of the Flight Safety Foundation. He emphasized before an audience at the Institute of the Aeronautical Sciences 25th Annual Meeting that "safety in flight from now on is going to be increasingly dependent on bringing the mental problems within range of the average pilot and crew.

"With modern electronics and computing techniques it is not only possible to combine readings but integrate pertinent factors and come instantly with answers which now tax the pilot's mind and consume vital time which should be allotted to planning and consideration of factors beyond his control.

"It is furthermore possible to present the data sensed by instrumentation in a form which can be more readily understood and visualized by a pilot, again to save time, reduce the chances of error, and fatigue."

No Solar Furnace Boom

Dr. Peter E. Glaser of Arthur D. Little Co., Cambridge, Mass., doesn't see a boom in the industrial uses of solar furnaces in the near future. "Under today's economic conditions," he says, "it's cheaper to use conventional arc, gas or electrical resistance furnaces for production work." The occasion for this statement was the unveiling of Arthur D. Little's new solar research furnace, available for immediate delivery at about \$14,500. Its importance to the electronics industry lies in its ability to refine materials like silicon without contaminating the sample. Other furnaces, says Dr. Glaser, can contaminate the product being processed. Crystal growing is another operation that can be carried out with much less complex equipment than required at present. Little's solar furnace utilizes a photocell control system and a sample moving system that allows the furnace to be programmed. Constant temperatures can be maintained to a higher degree of accuracy than with any other type of furnace, according to Dr. Glaser.

◀ CIRCLE 8 ON READER-SERVICE CARD
CIRCLE 9 FOR G.E. SPREAD AD ▶

PHILCO CORPORATION

LANSDALE TUBE COMPANY DIVISION

LANSDALE, PENNSYLVANIA



If it's a 4X250B by **Amperex**...you know it's
interchangeable
 electrically and physically with the 4X150A!

**Amperex TYPE 4X250B AS R-F
 POWER AMPLIFIER OR OSCILLATOR**

Class C Telephony or FM Telephony
 (key-down conditions, per tube)

MAXIMUM RATINGS

DC Plate Voltage	2000 volts
DC Screen Voltage	300 volts
DC Grid Voltage	-250 volts
DC Plate Current	250 ma
Plate Dissipation	250 watts
Screen Dissipation	12 watts
Grid Dissipation	2 watts

TYPICAL OPERATION

DC Plate Voltage	500	1000	1500	2000 volts
DC Screen Voltage	250	250	250	250 volts
DC Grid Voltage	-90	-90	-90	-90 volts
DC Plate Current	250	250	250	250 ma
DC Screen Current	45	35	30	25 ma
DC Grid Current	32	28	28	27 ma
Peak RF Grid Voltage (approx.)	118	116	116	115 volts
Driving Power	3.6	3.2	3.2	2.8 watts
Plate Power Input	125	250	375	500 watts
Plate Power Output	85	195	300	410 watts

The 4X250B has numerous applications as a replacement, in existing circuits, for the 4X150A, where longer life and additional plate dissipation up to 500 Mc are required. It is therefore imperative that the brand of 4X250B you choose be an *exact* plug-in replacement for the 4X150A — meaning the identical base, identical dimensions, identical electrode inductances and identical inter-electrode capacitances. With the AMPEREX 4X250B you can be certain of getting just that — *total* electrical and physical interchangeability!



Write for Detailed Data Sheets

Amperex ELECTRONIC CORP.

230 Duffy Avenue, Hicksville, Long Island, N. Y.

In Canada: Rogers Electronic Tubes and Components
 11-19 Brentcliffe Road, Leaside, Toronto 17, Ont.

CIRCLE 547 ON READER-SERVICE CARD FOR MORE INFORMATION

General Electric announces



GENERAL ELECTRIC VITREOUS-ENAMELED RESISTORS are available in both fixed and adjustable types. Most requirements can be met with immediate shipment from stock. Additional units with a wide variety of mounting arrangements are available for special applications.

GENERAL  ELECTRIC

a new line of...

vitreous enameled resistors

General Electric presents a new line of enameled resistors designed for dependable, long-lasting service. These new resistors—rated from 5 to 218 watts—are ideal for both industrial and electronic applications.

RELIABLE PERFORMANCE THROUGH PRECISION MANUFACTURING

Maximum equipment-performance and long resistor life are assured with G.E.'s new line of resistors because:

- Low-temperature-coefficient wire means stable operation.
- Elimination of "hot-spots" reduces resistor burnouts.
- Special enamel coating is moisture and acid resistant.
- Wire junctions are silver brazed for positive connection.

NEW CATALOG SIMPLIFIES SELECTION AND ORDERING

To aid you in selecting the right resistors for your specific applications, General Electric's new easy-to-use resistor catalog puts complete information on performance, ratings, dimensions, mounting arrangements, and ordering instructions right at your fingertips.

For complete information on General Electric's new enameled resistors, contact your nearest General Electric Apparatus Sales Office. For your copy of the new G-E resistor catalog, GEA-6592, write Section 784-5, General Electric Company, Schenectady, N.Y.

Industry Control Department, Roanoke, Virginia

Progress Is Our Most Important Product

GENERAL  ELECTRIC

For VARIABLE CAPACITORS...



"BFC" butterfly-type capacitor with isolated rotor, very low minimum capacity and low inductance. For VHF applications as series capacitor with no rotor connection.



"MAC" Low minimum capacity and very low inductance. Ideal for VHF-UHF applications. Designed for use in miniaturization. Also available as butterfly type "MACBF".



"APC" A compact, high quality air dielectric trimmer. Extremely high resistance to temperature changes, moisture and vibration.



"MAPC" A scaled down version of the "APC". Designed to fill the needs of miniaturization. Suitable for VHF use.



"HF" A high frequency design featuring extra long sleeve bearing and positive contact nickel-plated phosphor bronze wiper. Also available as a dual unit.

naturally,



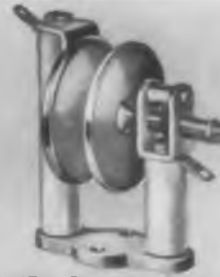
"MFA" Similar to "HF" model, but with larger air gaps for higher breakdown ratings. Used for high-frequency, low-power transmitting. Also available as dual unit.



"MC" Designed for maximum versatility in mountings, connections and capacity characteristics. Rotor stop permits 180° clockwise rotation with increasing capacity. Also available as dual unit.



"RMC" Similar to "MC-S" but featuring extra rigid design. Heavy frame of aluminum tie rods and end plates.



"NZ" Compact transmitting neutralizing capacitor designed for easy and accurate adjustment. Long leakage paths to ground from both rotor and stator.



"VU" Permits use of "lumped constant" circuits up to 500 MC. Two sections in series eliminate rotor wiper. Pyrex glass ball bearings eliminate noise from usual metal-to-metal bearings.

it's
HAMMARLUND



For commercial, military and industrial applications, you just can't beat Hammarlund Variable Capacitors for uniformly high quality design, materials and workmanship. The capacitors illustrated here are just a small representative portion of the complete Hammarlund line. In addition to stock designs, Hammarlund offers you unparalleled variable capacitor know-how in development, design and production. Whatever your needs, when it comes to special or standard variable capacitors, naturally, come to Hammarlund.

HAMMARLUND MANUFACTURING COMPANY, INC.
460 West 34th Street, New York 1, N. Y.

● Send for your copy of Bulletin E 756

CIRCLE 548 ON READER-SERVICE CARD FOR MORE INFORMATION

Radiation, Research and Development

First privately owned Cobalt-60 source of radiation in the New York area is now available to the industry on a regular service basis, for commercial research and development.

The center operated by Radiation Applications Inc. will use the source for experimentation and processing products by irradiation. The service will be offered to both private companies and government agencies on a contract basis. Experimental research development projects will also be performed directly by the R.A.I. Technical Staff.

Woman Wins "Ham" Award

Mrs. Mary D. Burke, a 45-year old housewife from Morton, Pa., has been announced the winner of General Electric's Fifth Annual Edison Radio Amateur award. Mrs. Burke has sent over 312,000 messages to servicemen overseas since 1949.

At times she has sent as many as 10,000 messages per month. Her longest stretch of operating without missing a schedule was 1,825 days—5 years without taking a vacation or a single day off. Her daily operating starts at 6:30 a.m. and closes down at 8:00 p.m. Congratulations to Mrs. Mary D. Burke, W3CUL.

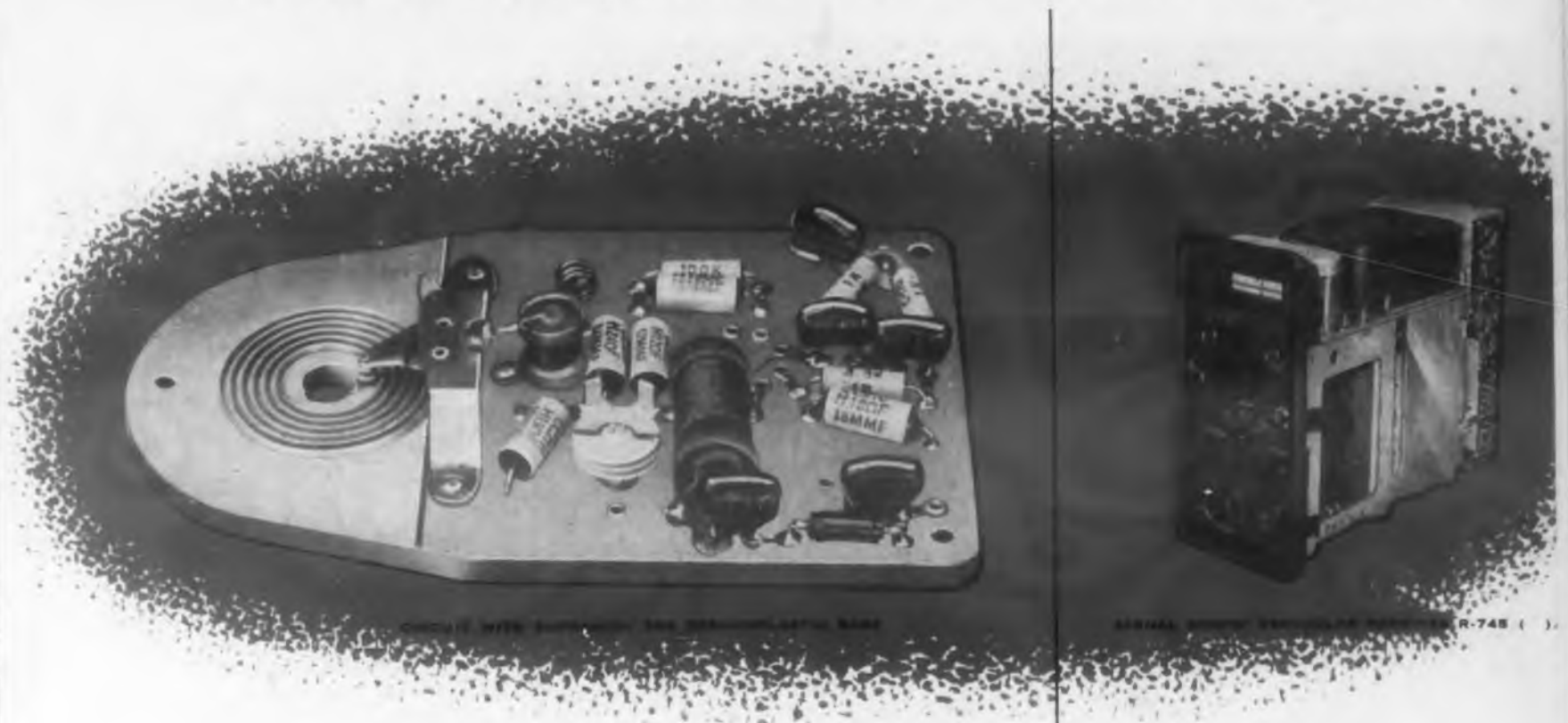
Semiconductor Research

An advanced semiconductor laboratory, to bridge the gap between basic research and semiconductor product engineering, has been established by General Electric Co., Syracuse, N.Y.

Dr. Sullivan, manager of the new laboratory, said that investigations will be conducted to find methods of producing more nearly perfect crystals of germanium and silicon as well as intermetallic compounds. In addition, research will be conducted on developing new techniques for placing selected impurities into the pure materials to obtain alloys with desired semiconductor characteristics.

New methods for measuring the physical characteristics of pure semiconductors and alloys will also be investigated and developed.

◀ CIRCLE 9 FOR G.E. SPREAD AD



SUPRAMICA* 555

ceramoplastic insulation

increases stability

of new

AVCO

STABLE OSCILLATOR

Ceramoplastic's dimensional stability maintains frequency under extreme conditions to ± 6 kc at 41 without crystals . . . doubles channel capacity.

In one version of the Signal Corps' New Vehicular Receiver R-745 ()/VRC is an advanced tuning that eliminates the requirement for many conventional crystals and their accompanying spur heterodyning problems. Designed for "automatic" assembly by the AVCO Manufacturing Corporation Crosley Division, this extremely stable tuner utilizes a unique continuously tunable oscillator circuit, consisting of silver ribbon, precision-molded in a block of SUPRAMICA 555 ceramoplastic. The total dimensional stability of the insulation reduces the receiver's frequency drift to only .015% (32.5 - 57.5 over a temperature range from -55° C to $+7^{\circ}$ C). This, in effect, doubles the number of usable channels on the equipment's allotted frequency by permitting 50 kc adjacent channel operation.

Crosley engineers conducted extensive tests by specifying SUPRAMICA 555 ceramoplastic and found that **no other insulating material** provided all the properties required: mass reproducibility, negligible variations, extremely low electrical dependability, high temperature operation, insignificant moisture absorption, high dielectric strength, total dimensional stability.

This is just one of thousands of SUPRAMICA ceramoplastic products, produced by MYCALEX CORPORATION OF AMERICA for leading manufacturers. A special formulation of SUPRAMICA . . . high quality electrical glass . . . bonded with SYNTHAMICA, synthetic mica . . . can help solve many of your design problems. Send for full technical information.

*SUPRAMICA is a registered trade-mark of the MYCALEX CORPORATION OF AMERICA. 555 and SYNTHAMICA are trade-marks of the SYNTHETIC MICA CORPORATION.

Be sure to see us at booth 2221-23, 4307 March IRE Show.

MYCALEX
CORPORATION OF AMERICA



GENERAL OFFICES AND PLANT:
CLIFTON BOULEVARD,
CLIFTON, NEW JERSEY

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NEW YORK 20, N. Y.

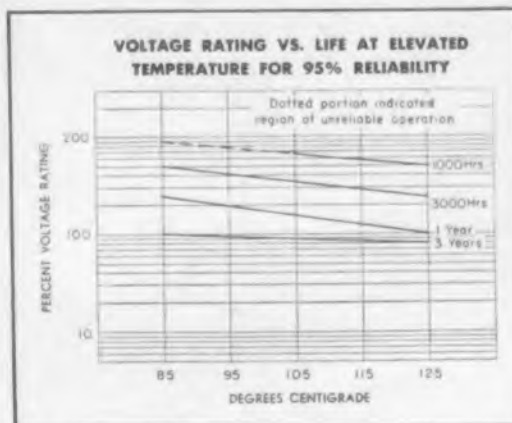
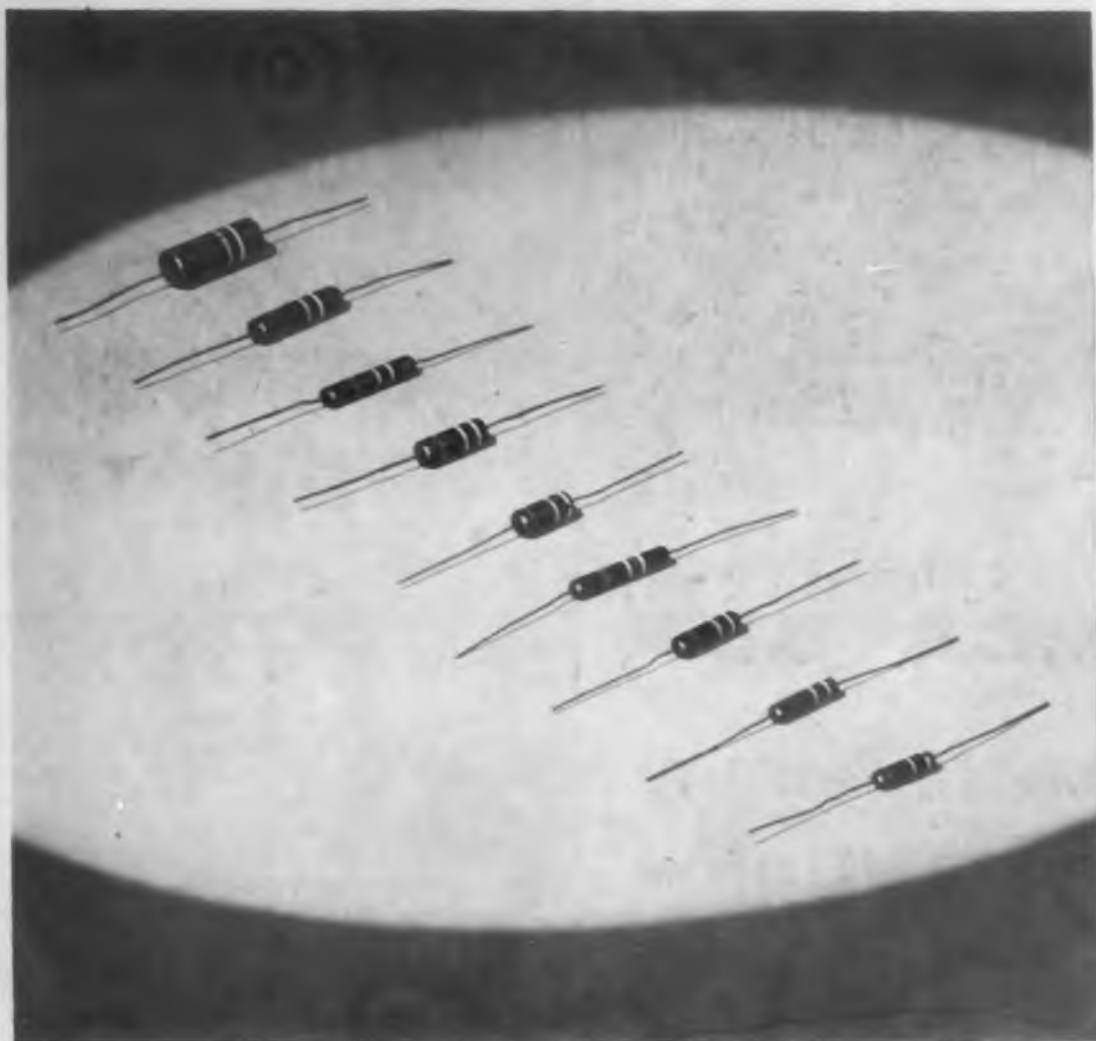
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World's largest manufacturer of glass-bonded mica and ceramoplastic products

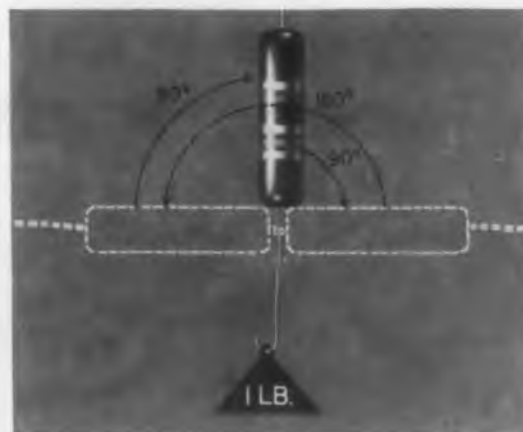
CIRCLE 10 ON READER-SERVICE CARD FOR MORE INFORMATION



DESIGNER'S



TYPICAL PERFORMANCE CURVES for PVZ capacitors, designed for a minimum of one year's life at 125C operation, rated voltage.



HIGH LEAD BEND STRENGTH. Capacitors withstand 1-lb vertical pull test, moving unit 90°, then 180° opposite way, then back 90° to original vertical position.



TESTING TRANSISTORS in electronic equipment is one of many uses for the versatile M2 leak detector, shown in background.

New leak detector can spot leak rate of one cubic inch of air over 5000-year span

The ultimate in leak sensitivity is now offered by the new General Electric Mass Spectrometer Leak Detector. It can detect a leak rate of 1×10^{-10} standard cc of air per second. At this rate it would take 5000 years for a thimbleful of gas to escape.

Among the many applications for this versatile aid in locating leaks in vacuum and pressure systems—to prove equipment reliability—are the testing of transistors, Klystron tubes, hermetic sealing of components, capacitors, and TV tubes.

Designed for greater reliability and ease of maintenance, the new leak detector makes extensive use of plug-in components—minimizing downtime. For example, the complete spectrometer tube is a single unit that is easily and quickly removed for repair or replacement. All electronics are mounted on three easily removed, plug-in type chassis, according to basic functions.

Unit's simplicity of operation is such that nontechnical personnel can operate it successfully. See Bulletin GEC-336B.

New General Electric molded PVZ* paper tubular capacitors are moderately priced, operate from -55 C to +125 C

Now available for electronic designers is a new line of General Electric molded PVZ paper tubular capacitors—at moderate prices—for exacting applications in computers, missiles, telephone equipment, and other high-grade military and commercial electronic equipment.

Priced at less than half the cost of comparable metal-clad tubular capacitors, they offer characteristics similar to "K" of MIL-C-25A, and operate from -55 C to +125 C without voltage derating. They are designed

for a minimum of one year's life at rated voltage and 125 C operation.

Completely solid after molding, the unit has excellent shock, vibration and moisture-resistance properties because of the high grade case material and controlled molding technique used. The paper tubular capacitor is impregnated with a high temperature organic material which is polymerized into a solid resin. The solid capacitor rolls are in a mineral-filled phenolic plastic case.

In this new line, General Electric PVZ

capacitors are available in 100, 200, 300, and 400 volt ratings. Microfarad ratings are, respectively: .00047 to .15 uf at 100 V; .00047 to .1 uf at 200 V; .00047 to .068 uf at 300 V; and .00047 to .022 uf at 400 V. Capacitance ratings are available with $\pm 20\%$, $\pm 10\%$, and $\pm 5\%$ tolerances. To cover the various ratings, nine different sizes are offered, ranging from .175 inch diameter by $\frac{5}{8}$ inch long to .375 inch diameter by $1\frac{1}{8}$ inch long.

For more details, check Bulletin GET-2671.

*Trade-mark of General Electric Co.

GENERAL  ELECTRIC

DIGEST

GENERAL ELECTRIC COMPONENTS FOR ELECTRONIC MANUFACTURERS

Hermetically sealed germanium and silicon rectifiers now in cooling "packages."

General Electric hermetically sealed germanium and silicon rectifiers are now available in carefully engineered, "cooling packages," either air-cooled or water-cooled designs. This eliminates the need for costly, time-consuming engineering on your part, and provides more efficient rectifier operation. General Electric's 30,000 kilowatts of field experience with germanium rectifier installations brings you these two important features:

1. These assemblies are furnished with matched electrical characteristics so that paralleling reactors or multiple transformer secondaries is not required when it is necessary to operate cells in parallel.

2. Better protection against atmospheric conditions is provided by a true

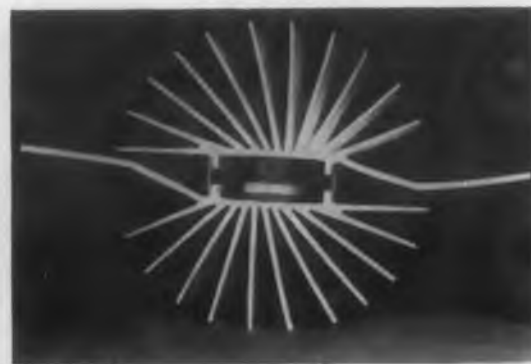
hermetic seal which increases cell uniformity, permits a longer life expectancy, and maintains high rectifier efficiency throughout its life.

Where size and weight requirements are particularly important, General Electric packaged germanium and silicon rectifiers have broad application in efficient, low-cost power conversion equipment. Included among their advantages over other types of metallic rectifiers are increased efficiencies—up to 95%—less heat to be dissipated; exceptionally small size and light weight per watt output, meaning smaller units; excellent voltage regulation; and no aging indicated after five years of operation.

For data on G-E germanium rectifiers, check Bulletins GEA-5773C and GEA-6375.



ACTUAL SIZE OF G-E germanium and silicon rectifier cell, hermetically sealed in ceramic housing, is shown in side view (left) and cutaway (right).



AIR-COOLED type in new "sunburst" fin design provides efficient cooling by conducting heat away from both sides of cell.

WATER-COOLED assembly is mounted on hollow bus bar which serves as conductor for both water and current, providing compact, efficient design.



TYPE ARR-2



TYPE ARR-3

Dependable starting relays eliminate need for voltage adjustments, special mounting brackets

For such applications as starting single-phase motors, particularly where adverse atmospheric conditions exist, General Electric offers two starting relays that are inexpensive, quiet in operation, and easily wired. Both are especially useful where adverse atmospheric conditions exist, or where there is a need for remote control which can be built into an explosion-proof case.

Type ARR-2 current-type accelerating relay, silver-dollar sized, is designed for more than 1,000,000 operations because there are no pivots to wear out, and sturdy plastic case encloses all moving parts. Contact pressure and action are always dependably the same—regardless of line-voltage or motor-performance variations—because contact tips are independent of solenoid plunger.

Easily mounted from any direction, relay eliminates need for special mounting

brackets. Readily accessible terminals, available in push-on, screw or lead-type, speed wiring. At 115 volts, relay will make and break 15 amperes; at 230 volts, 7½ amperes. See Handbook Sheet 3286, Page 23.

Type ARR-3 voltage-type relay, requiring no customer adjustments, is accurately calibrated at the factory to pick up at a voltage predetermined by the specific application. Repetitive accuracy is high—change in calibration is less than 5% after 500,000 operations. Molded cover helps protect against dust and water. Relay mounts in any position and adapts to many mounting brackets. Terminals, including two available spares, are easily accessible. For ratings up through 5 hp, relay at 115 volts will break 50 amperes; at 230 volts, 35 amperes. See Handbook Sheet 3286, Page 29.

GENERAL ELECTRIC COMPANY, APPARATUS SALES DIVISION, SECTION A667-36, SCHEENCTADY 5, NEW YORK

Please send me the following:

for reference only

X for planning an immediate project

GEA-6375 Liquid cooled germanium rectifiers

GEC-336B Leak detector

GEA-5773C Air cooled germanium rectifiers

HB-3286, P. 23 ARR-2 relay

GET-2671 Molded tubular capacitors

HB-3286, P. 29 ARR-3 relay.

For information on other products, contact your nearest G-E Apparatus Sales Office.

NAME.....

COMPANY.....

CITY..... STATE.....

CIRCLE 11 ON READER-SERVICE CARD FOR MORE INFORMATION

Giant Solar Furnace

A giant solar furnace, capable of concentrating the sun's rays to produce temperatures as hot as those of an atomic explosion, will be erected at the Quartermaster Research and Development Center, Natick, Mass., according to an announcement by the U.S. Army from Washington.

The Army explained that the furnace will collect the sun's rays with a huge flat mirror about 40 ft long and 36 ft wide. The mirror will reflect the rays 96 ft to a concentrating apparatus consisting of 180 curved mirrors, each 23-1/2 in. in diameter.

The furnace, the Army added, will be used to test materials designed to protect soldiers against the heat of nuclear and other weapons. Conventional heat sources do not produce sufficient temperatures to simulate atomic explosions. Rays of the sun ultimately will be concentrated in a small test chamber 4 in. wide in the proposed furnace.

Evaluating New Weapons Systems

Dr. Courtland D. Perkins, USAF Chief Scientist, emphasized the qualifications necessary for an evaluation team studying new weapon systems at a recent meeting of the Institute of Aeronautical Sciences. He said they "must not only be competent to compare the technical qualifications of the new weapon systems but also must evaluate their impact on the nation's economy as well as the political implications developing from their use."

In his comments directed to the scientist, Dr. Perkins said, "An increased effort must be made to find simpler and more ingenious solutions to missile problems. We seem to solve many of our military problems with too heavy a reliance on dollars and manpower. I feel that our scientific community has many times led the way towards these complexities. I feel that if we paid more attention to reducing problems to their simplest form, we could go a long way toward solving not only our money problems but our technical manpower shortages at the same time."

CIRCLE 12 ON READER-SERVICE CARD ➤

the Series



TYPE

403

Highest sensitivity
oscilloscope commercially
available. DC amplifier
1 mv full scale sensitivity.



TYPE

401

High gain, DC-150KC.
Identical X- and Y-amplifiers.
Calibrated sweeps.



TYPE

407

Transistorized low noise
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Size 4" x 3 1/2" x 4 7/8". Frequency
response: 0.15 cps to 10 kc.

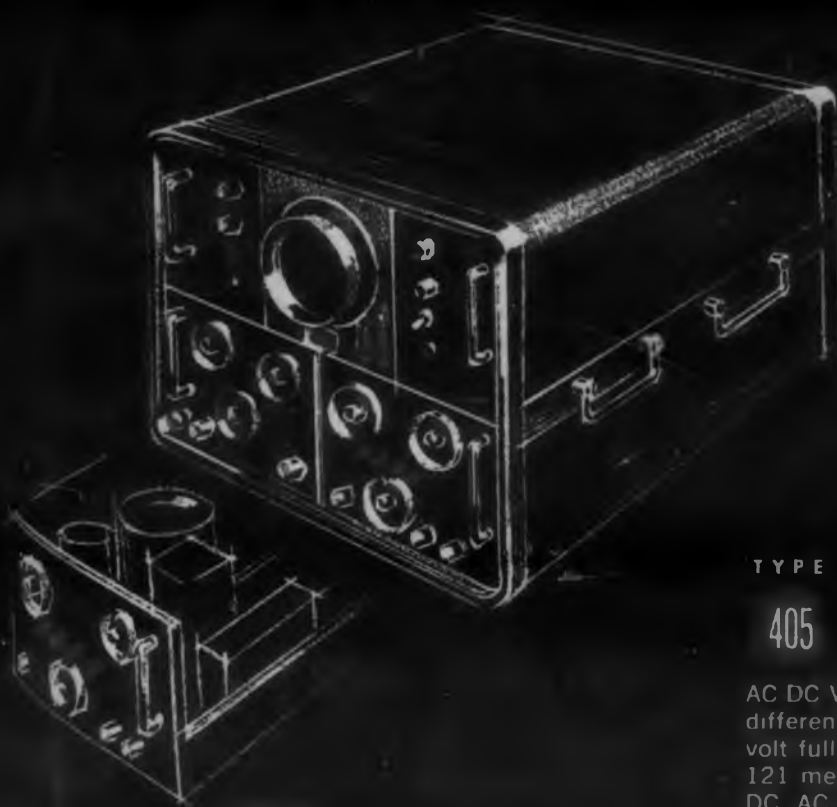
Sparkling new ideas materialize in the DuMont 400 Series. These 6 new instruments are current models, ready right now. See and operate these instruments at the New York I.R.E. Show. Or ask for a demonstration at your convenience. Write for complete details.

6 ready now

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404

Jitter-free, hard tube circuitry pulse generator. Pulse repetition rates up to 100,000 pps.



TYPE

410

High gain DC amplifier with 7 millimicrosecond rise time. High duty cycle calibrated sweeps 24 KV accelerating potential. Building Block construction allows choice of performance characteristics.

TYPE

405

AC DC VTVM. Dual and differential input. 0.1 volt full scale AC or DC. 121 megohm resistance on DC. AC performance to UHF. Storage compartment for probes.



WARRANTY

Every instrument in the DuMont 400 Series carries a five-year guarantee.

DU MONT

Technical Products Division, Allen B. DuMont Laboratories, Inc., 760 Bloomfield Ave., Clifton, N. J., U. S. A.

Magnetic Device Prevents Scale and Corrosion

A Belgium scientist has invented a device that prevents scale and corrosion in piping and industrial equipment. This new device passes water and other fluids through concentrated magnetic fields. The magnetic field induces a physical change in the incrustating salts which form scale with the result that their crystalline structure is altered and they become essentially amorphous, losing the ability to adhere as scale to piping and processing equipment.

The fluid conditioner is made in Belgium and distributed in this country by Cepi-American, Inc., Oak Park, Ill. In addition to preventing the formation of scale, the treated water will cause many old deposits to disintegrate. It is a compact, low-cost unit in contrast to expensive systems now used.

Two-Way Radio Promotion

Representatives of the nation's major two-way radio user-organizations met with leading equipment manufacturers recently at the Statler Hotel, Washington, D. C., to discuss ways and means of assisting the Federal Communications Commission to implement a more widespread use of mobile radio. Section Chairman Myron E. Whitney, of Motorola, Inc. offered several reasons which prompted the formation of the RETMA educational program for land mobile radio.

"The FCC has capable leadership," according to Whitney, "but does not have adequate manpower to do the necessary job. The Commission is still driving a 'Model T'. The FCC is keeping pace with the growth in the use of two-way radio just the way a 'Model T' would keep up with today's modern cars on a super highway."

The conferees were called upon to develop, mutually, a plan whereby a proper educational program could be aimed at the regulators of communications, legislators in Congress, manufacturers of two-way radio and the users of such equipment, in order to remove impediments of the growth of two-way radio.

◀ CIRCLE 12 ON READER-SERVICE CARD

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Tiny shock-absorbing springs, shown greatly enlarged at the left, provide a *second line of defense* against shock damage in Weston ruggedized panel meters. While the entire instrument movement is cradled on an effective overall shock mount of specially formulated rubber, these tiny shock absorbers, mounted in back of each jewel bearing, provide double protection at the critical points. The spring-backed jewel in ruggedized instruments is another Weston FIRST . . . one which assures continuous, dependable service wherever panel meters are subject to severe impact, vibration or shock.

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Weston ruggedized instruments are approved in all sizes—1 1/2", 2 1/2", 3 1/2", 4 1/2".

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PANEL INSTRUMENTS



Washington Report

Herbert H. Rosen

Mobile Radio Girds For FCC Battle

Beginning April 1, a parade of witnesses will appear before the Commissioners of the FCC to present their positions on the allocation of frequencies above 890 mc. So far, more than 150 responses to a request for comments have flooded the FCC offices. Some have only stated their position on service allocations, while others have asked to be allowed to present their case in person.

The main issue of the battle is the use of frequencies above 890 mc for common carrier, private point-to-point systems, and research.

The lines are rather well drawn. Western Union, for investment reasons, opposes any change in the frequencies now allocated to the common carrier TV broadcasters, on the other hand, argue for greater freedom in the use of private point-to-point communications systems. TV stations depend heavily on microwave links between towns, and frequencies above 890 are the only ones available for expansion. Besides, the broadcasters claim, common carrier systems cost too much.

While the FCC is sifting the briefs and setting up a schedule for next month, RETMA has offered its information services to the users of mobile radio. The goal, simply, is to make people as aware of and as appreciative of mobile radio as they are of other forms of radio communications. It's an ambitious program designed to supply raw data to the users for their own implementation.

From the manufacturers, Motorola for example, come the recommendations that 890 to 960 mc should be reserved for landmobile use. Provisions should be made for tropospheric scatter communications above 890. Sarkes Tarzian asks permission to conduct equipment experiments (for TV links) in the 1115 to 1200-mc region. Raytheon asks that marine navigation and anticollision instrumentation be allowed to go above 30 km. And A T & T reports that they have point-to-point systems operating in the 3700 to 4200-mc band. In addition to field trials at higher frequencies, A T & T, along with some other manufacturers, feels that it would be impractical to set standards for all types of microwave services. Naturally, there are others who feel that standards should be established soon by the FCC.

CIRCLE 13 ON READER-SERVICE CARD FOR MORE INFORMATION

Single Sideband Still a Controversy

As a result of an all-day meeting in Washington recently, there is a better understanding of the single sideband issue, but the manufacturers and users of mobile and aircraft communications are not closer to a solution. The issue was thought to center around single sideband transmission versus General Electric's synchronous detection technique. However, the meeting, sponsored by the Airlines Electronic Engineering Committee of Aeronautical Radio, aired single sideband with suppressed carrier, single sideband with no carrier, and a compatible system fostered by Leonard R. Kahn.

A panel composed of proponents of four or five systems presented cases for their particular choice. The discussion was then thrown open to the floor and the dyke sprung a leak. Major concern of the users of mobile radio—and as a consequence, the manufacturers of the equipment—is the scarcity of frequencies in the available spectrum. This fact alone is the overriding influence in all discussions and in all decisions that will have to be reached before long. However, there appears to be a growing sentiment that perhaps what is really needed is greater stability in the receiver. If that could be achieved . . . along with more reliable detection, a good portion of immediate problem would be licked. At least an interim condition would exist that would allow a more thorough study of the competitive systems now proposed. However, both the FCC and an association of airlines have tentatively agreed that conventional amplitude transmission is passé. Rules and plans are pending that provide for the replacement of am by single sideband. Most people want the change to be gradual—on an interim basis that won't cost a lot of money at one time. With four or five opposing systems, the situation is becoming very cloudy.

The final proof and resolution of the controversy will not be found in a meeting of engineers. Rather the best proof will be found in experiments that are designed to compare the systems with each other in an unbiased manner. Within the next few months, it is expected that the Air Force and the manufacturers will be conducting some of these experiments. GE, in fact, has expressed a willingness to offer synchronous detection adapters to any user of mobile airlines radio who wishes to experiment. Motorola expects to have SSB modulator units ready for the military some time this year.

Missile Reinterpretation

The directive delimiting areas of missile responsibility does not appear to curtail present and proposed R & D programs forecast for the future. From all indications there will be renewed interest in the development of new missiles, anti-missile missiles, and greater automaticity in flight operations and control.

Now...an accomplishment so far reaching it will change the sights of all rectifier users

RADIO RECEPTOR'S improved new vacuum process

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* High Current Density
Industrial type
SELENIUM RECTIFIERS

Developed by the famous Siemens Organization of West Germany and now manufactured by Radio Receptor Co. in the U. S. A.



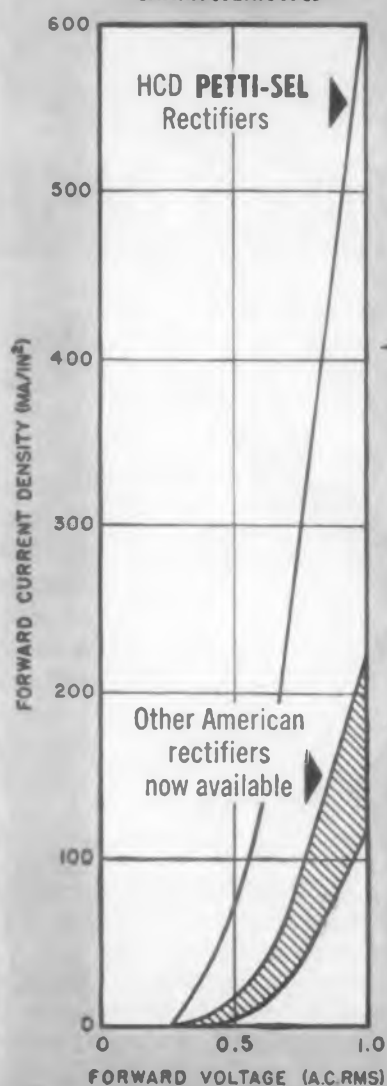
Estimated life 100,000 hours

Much smaller cell sizes than conventional units of the same ratings

Lower forward voltage drop

Suitable for high temperature applications

TYPICAL FORWARD CHARACTERISTICS

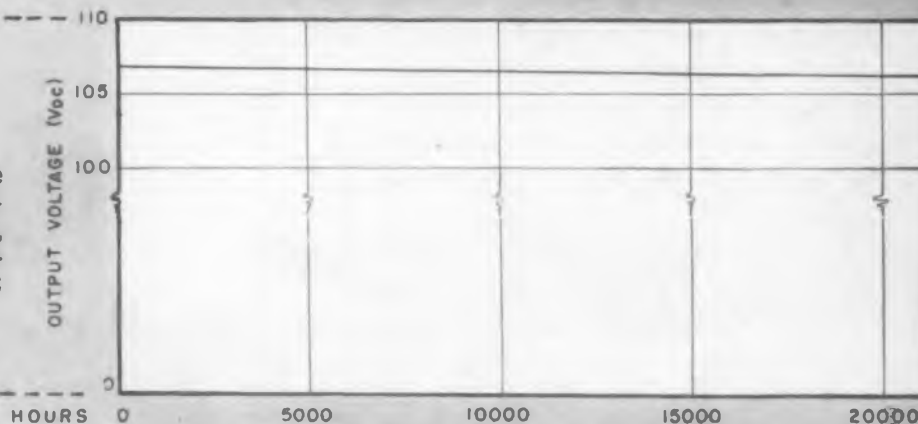


Far smaller in size than other rectifiers of the same current ratings, the new Radio Receptor HCD Petti-Sel units are manufactured under laboratory controlled conditions with fully automatic machinery, assuring new standards of product uniformity.

Field experience extending over several years with these rectifiers indicates an estimated life of 100,000 hours. This is largely attributable to the special process requiring no artificial barrier layer. Low forward voltage drop and low aging rate make the new Petti-Sel Rectifiers applicable to magnetic amplifiers and other control applications.

TYPICAL AGING CHARACTERISTIC

Cell size 4" x 4", single phase bridge (4-5-1-B) operated at 130 volts AC input, 8 amperes DC output current, resistive load, 35° C ambient temperature.



Watch for further announcements of unique developments on these history-making rectifiers. If you would like our new bulletin as soon as it is available, write today to Section D-3R.

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CIRCLE 14 ON READER-SERVICE CARD >



Letters to the Editor

Missile Control Suggestion

Dear Sir:

A number of radio control systems are in use for controlling types of guided missiles over limited ranges for flight test purposes. These systems vary in complexity in accordance with the degree and type of control required. All suffer from one or more defects such as lack of ranges, poor antenna radiation patterns, poor reliability and excessive complexity. I would like to point out a simpler approach to the problem.

I propose that a telemetering system be used in reverse! The operating frequency should be in the 40 to 400 mc range which will permit simple antennas, excellent antenna radiation patterns and long range control. Two telemetering systems would be employed, one from the missile to ground for flight test measurements, and the second, on a different frequency from the ground to the missile for control purposes.

A compact fm/fm receiver, such as the Land-Air Subminiature Airborne Receiver Model 127, would be installed in the airborne vehicle. This receiver weighs less than 6 pounds and can be mounted in various ways of close coupling. It is constructed in units which can be packaged together or placed in voids left by other instruments or airframe. The three units—r-f section, i-f section, and power supply, can be mounted in any one plane.

CIRCLE 96 ON READER-SERVICE CARD ►



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Three more top airforce weapons depend upon Rheem amplifiers and power supplies to provide dependability in a minute package. Here is electronics engineering at its best... a complete line of packaged components produced for individual or combined use in the rugged environmental conditions common to modern weapons system applications. Rheem's new electronic plant, with seasoned, experienced engineering and production personnel, is equipped to handle your individual requirements for off-the-shelf or special purpose electronic components.



SUPERSONIC LOCKHEED X-7, shown with Marquardt power-plant installed, was recently revealed as a stratospheric test-bed for powerful new engines under test for U.S.A.F. missiles. The needle-nose X-7, which is launched from a B-29, is parachute recovered after each flight so that it may be flown again. Rheem power amplifiers form a part of the electronic control system of the X-7.

A NORTHROP SNARK, inter-continental guided missile, roars from its launching cradle at a U.S.A.F. base to begin a long range test flight over the Atlantic ocean. The Snark, which couples inter-continental range with the ability to carry a first priority warhead, utilizes Rheem amplifiers for a share of the telemetering chores.



LOCKHEED'S F-104, prototype Starfighter, climbs on razor blade wings to the upper stratosphere at ground speed equaling its speed in straight and level flight. The ship is described by Hall L. Hibbard, Engineering Vice President of Lockheed, as "a masterpiece of simplification." Rheem light weight, small space, amplifier components play an important role in this simplification.

RHEEM MANUFACTURING COMPANY



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You Can Rely on

Rheem

If a power source is available in the missile, the receiver power supply can be omitted.

All receiver units are approximately 1 in. wide x 3 in. high x 9 in. long. Up to 16 subcarrier oscillator discriminator would be installed in the vehicle. The discriminator outputs can either actuate a relay for on-off functions, or the output can be used with a simple d-c null balancing servo system for proportional control. The complexity of the servo system will depend on the accuracy and drive power required, but it can be simple. More sophisticated circuits can use a commutator on one channel so that many more on-off functions can be achieved.

Frequency drift of subcarrier oscillators (at the ground station) can easily be controlled; and airborne discriminator drift should be of little consequence. Telemeter signals from the vehicle could be used to double check the proportional control positions.

The major problem today would be to subminiaturize the present ground station equipment, such as discriminator, for airborne use. This program should not be excessively expensive, as much work has already gone into subminiaturization methods.

Edwin N. Kaufman
6201 Jumilla Avenue
Woodland Hills, Calif.

► Mr. Kaufman has an interesting idea here. Although this is a very "sensitive" subject for discussion, we would welcome reader's comments on his suggestion.

Apologies

On page 6 (line 25) of the December 1st issue the company name Avion was incorrectly called Avien. Our apologies to the Avion Division, ACF Industries, Inc.

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of ELECTRONIC DESIGN;
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renewal card today.*

◀ CIRCLE 96 ON READER-SERVICE CARD

IBM GROWTH promoted these men



PRODUCT DEVELOPMENT ENGINEER: Before his recent promotion, this man was a member of a small engineering "team" (two M.E.'s, an E.E. and a model maker) in IBM's Poughkeepsie plant. His specific project entailed the creation of the "ultimate package in printed circuitry." His group "brainstormed" the project in continual sessions, putting the results in model form. Then the group would try to "tear the idea to shreds" in order to create something even better.



PRODUCT CONTROL ENGINEER: Promoted recently, this man formerly worked at IBM's Poughkeepsie manufacturing facilities. His job was to design information systems to insure a smooth flow of work through the plant. "It takes *creative* engineering ability to design these systems," he'll tell you, "and *administrative* ability to 'sell' a system to higher management and make it stick. If you possess this rare combination of abilities, this is the job for you!"

Could you handle their responsibilities?

Jobs like these continually open up at IBM—due to rapid expansion. If you are an engineer or scientist—or have equivalent experience—you may be qualified for such a position. Innumerable opportunities exist in:

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- Numerical analysis and programming
- Electronic circuit design and packaging
- Electrostatic phenomena
- Real time systems engineering
- Photo and magnetic device memory
- Semi-conductor research, development, and manufacturing
- Manufacturing process control
- Computer systems testing
- Test equipment design

Economic experts rank the electronic computer with automation and nucelcnics in growth potential. More than 10,000 electronic computers will be in operation by 1966. IBM sales have doubled, on the average, every five years since 1930. IBM engineering laboratory personnel quintupled in the past five years. IBM spent \$19,000,000 on research and new product development in 1956. Salaries are excellent; company-paid benefits set standards for industry today. Personnel turnover at IBM is less than one-sixth the national average.

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Mgr. of Engineering Recruitment, Dept. 903
International Business Machines Corporation
590 Madison Avenue, New York 22, N. Y.

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Engineering Shortage?

Dear Sir:

There has been much writing on the seemingly crucial issue of a shortage of engineering personnel.

In order that the whole of the issue be made clear, an examination of the engineering shortage is necessary. . . . A surface view divulges a shortage of engineers that varies in popular estimates from 40,000 to 60,000 in number. This apparently means that there are a like number of positions available into which graduate engineers can be absorbed. Today, a graduate engineer is one who has been exposed to at least 4 years of college education, most of which is of a technical nature, while others attend schools where the 4-1/2 to 5 years course is now required. After graduating, these engineers are routed into the humorously innumerable phases of industry's engineering world—where they are often employed in positions for which a technician or draftsman of six months training would be well qualified. Frequently, the remainder of their careers is spent in such positions.

Another heavily contributing factor to the engineer shortage is the oft-referred-to act of engineer stockpiling, a newly developed science (following World War II) which is simply the hiring of ten engineers into a situation that merits the hiring of only two—as there is work for only two.

The aforementioned vices have become so much the practice that such phrases (and they can be found in most engineering help wanted advertisements) as "stimulating," "challenging," "no stagnation of creative minds," have become a cause of laughter for most engineers.

It should be obvious that, though this shortage may exist in some degree, the problem, in the main, is not one of too few engineers, but one of mis-handling of those engineers that are available. This quandary is one that is directly responsible to, and can only be solved by, this country's top level management; for it is at this level that these precedents have been set and the above mismanagements of personnel sanctioned.

William H. Goudy
Design Engineer
248 Broad Street
Tonawanda, N.Y.

► We are firmly convinced that better use can be made of our technical manpower—and we have often said so in our editorials. However, this is only a stop-gap measure, and some intelligent long range actions have to be taken. This is especially true as we see our technology constantly getting more and more complex.

The company that misuses its engineers in the manner referred to by Mr. Goudy is cutting its own throat. If it is "stockpiling" engineers, it is cutting the Industry's throat as well as its own.

Meetings

1957

IRE National Convention Waldorf-Astoria Hotel and New York Coliseum March 18-21

Only a few of the 275 papers being read at the IRE National Convention are reported here. Those of most interest to electronic equipment designers are presented here. Papers are listed under subject areas.

Microwaves

THE SELECTION AND APPLICATIONS OF TRAVELING-WAVE TUBES, *Tues. PM, Mar. 19.*

X-BAND TRAVELING-WAVE TUBE FEEDBACK, *Tues. PM, Mar. 19.*

A LIGHT-WEIGHT, LOW-LEVEL TRAVELING-WAVE TUBE AMPLIFIER FOR S BAND, *Tues. PM, Mar. 19.*

A NEW METHOD FOR MODULATING ELECTRON BEAMS FOR PULSE APPLICATIONS AND LINEAR AMPLITUDE MODULATION SYSTEMS, *Tues. PM, Mar. 19.*

BEHAVIOR OF A BACKWARD-WAVE OSCILLATOR WITH EXTERNAL FEEDBACK, *Tues. PM, Mar. 19.*

A BROADBAND FIXED COAXIAL POWER DIVIDER, *Wed. PM, Mar. 20.*

BROADBAND WAVEGUIDE-TO-COAX TRANSITIONS, *Wed. PM, Mar. 20.*

TRANSMISSION PROPERTIES OF HYBRID RINGS AND RELATED ANNULI, *Wed. PM, Mar. 20.*

DEVELOPMENT OF CIRCULARLY POLARIZED MICROWAVE CAVITY FILTERS, *Wed. PM, Mar. 20.*

DESIGN OF IMPROVED MICROWAVE LOW-PASS FILTERS USING STRIP-LINE TECHNIQUES, *Wed. PM, Mar. 20.*

BROADBAND FREQUENCY STABILIZATION OF A REFLEX KLYSTRON BY MEANS OF AN EXTERNAL HIGH "Q" CAVITY, *Wed. PM, Mar. 20.*

HIGH-SPEED MICROWAVE SWITCHES (3 papers), *Thurs. AM, Mar. 21.*

AN X-BAND FERRITE COAXIAL LINE MODULATOR, *Thurs. AM, Mar. 21.*

FERRITE MICROWAVE DETECTOR, *Thurs. AM, Mar. 21.*

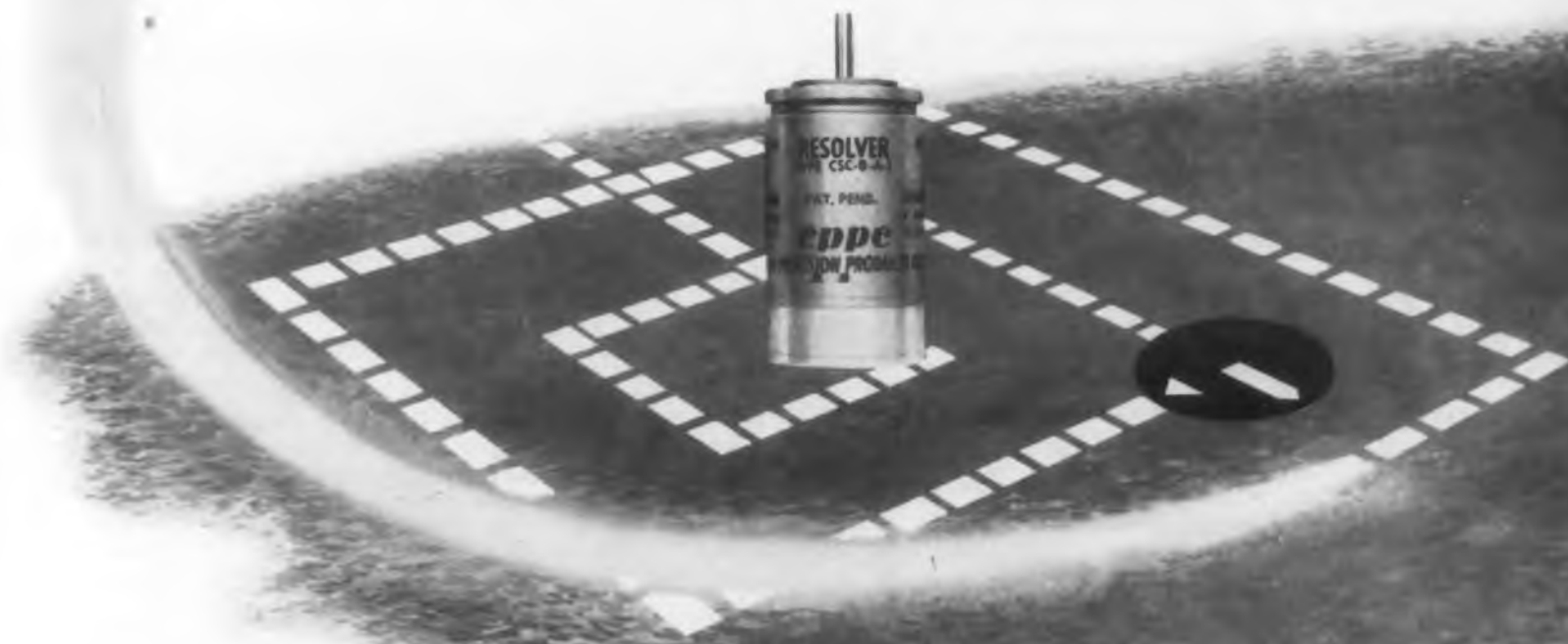
General articles on: spacing bead supports; multiple line directional coupler, dielectrics to 3000 F. *Thurs. PM, Mar. 21.*

CIRCLE 17 ON READER-SERVICE CARD >



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Control Techniques

- NONLINEAR COMPENSATING NETWORKS FOR FEEDBACK SYSTEMS, *Mon. PM, Mar. 18.*
 DIRECT SYNTHESIS THROUGH BLOCK DIAGRAM SUBSTITUTIONS, *Mon. PM, Mar. 18.*
 DIGITAL CONTROLLERS FOR FEEDBACK SYSTEMS, *Tues. AM, Mar. 19.*
 SAMPLING IN LINEAR AND NONLINEAR FEEDBACK CONTROL SYSTEMS, *Tues. AM, Mar. 19.*

Transistors

- A NEW HIGH FREQUENCY N-P-N SILICON TRANSISTOR, *Mon. PM, Mar. 18.*
 NOISE FIGURES IN SEMICONDUCTOR DIELECTRIC AMPLIFIERS, *Mon. PM, Mar. 18.*
 DETERMINATION OF THERMAL RESISTANCE OF SILICON JUNCTION DEVICES, *Mon. PM, Mar. 18.*
 AN ALLOY TYPE MEDIUM POWER SILICON TRANSISTOR, *Mon. PM, Mar. 18.*
 A NEW SEMICONDUCTOR DEVICE, *Mon. PM, Mar. 18.*
 CADMIUM SULFIDE PHOTOCAPACITORS, *Mon. PM, Mar. 18.*
 CIRCUIT CONSIDERATIONS FOR HIGH-FREQUENCY AMPLIFIERS USING DRIFT TRANSISTORS, *Wed. AM, Mar. 20.*
 DESIGN CONSIDERATIONS IN THE FIRST STAGE OF TRANSISTOR RECEIVERS, *Wed. AM, Mar. 20.*
 TRANSISTOR RECEIVER CIRCUITS, *Wed. AM, Mar. 20.*
 TRANSISTOR CIRCUIT PROBLEMS IN TV RECEIVER DESIGN, *Wed. AM, Mar. 20.*
 SOME USEFUL TECHNIQUES FOR OVERCOMING FREQUENCY LIMITATIONS OF DISTRIBUTED AMPLIFIERS, *Thurs. AM, Mar. 21.*
 REGENERATION EFFECTS IN DOUBLE-TUNED BAND-PASS AMPLIFIERS, *Thurs. AM, Mar. 21.*
 A NEW JUNCTION-TRANSISTOR HIGH-FREQUENCY EQUIVALENT CIRCUIT, *Thurs. AM, Mar. 21.*
 CIRCUIT APPLICATIONS OF SEMICONDUCTOR JUNCTION CAPACITANCE, *Thurs. AM, Mar. 21.*
 PULSE CIRCUIT APPLICATIONS OF A NEW SEMICONDUCTOR DEVICE, *Thurs. AM, Mar. 21.*
 DESIGN OF JUNCTION TRANSISTOR MULTIVIBRATORS BY DRIVING-POINT IMPEDANCE METHODS, *Thurs. AM, Mar. 21.*

Component Parts

- CERAMIC FILTER CAPACITORS FOR VHF AND UHF, *Thurs. AM, Mar. 21.*
 NEW SUBMINIATURE METALLIZED PAPER CAPACITORS, *Thurs. AM, Mar. 21.*
 THERMISTORS FOR THE GRADUAL APPLICATION OF HEATER VOLTAGE IN THERMIONIC TUBES, *Thurs. PM, Mar. 21.*
 NEW LEVELS OF PERFORMANCE FOR GENERAL PURPOSE RESISTORS IN ARMY APPLICATIONS, *Thurs. PM, Mar. 21.*
 THEORY, MEASUREMENT, AND REDUCTION OF PRECISION POTENTIOMETER LINEARITY ERRORS, *Thurs. PM, Mar. 21.*
 VIBRATION AND SHOCK RESISTANT RELAY DESIGNS, *Thurs. PM, Mar. 21.*



MICRO SWITCH Precision

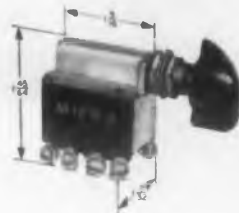
... FIRST IN PRECISION SWITCHING

If reliability, long life, ruggedness, compactness, sensitivity and accurate repeat point of operation are vital to you, then

Look to MICRO SWITCH for a solution of your Precision Switch problems

Here is a partial picture of some of the thousands of switch combinations available—news of a new MICRO SWITCH development—how and for what and why one manufacturer is using MICRO SWITCH Precision Switches—and a report on what MICRO SWITCH field application engineering can mean to alert design engineers

This MICRO SWITCH 3-Position Rotary Actuated Switch is compact and rugged



Ideal for airborne and industrial use, this switch is a four-pole double-throw switch with 12 terminals (catalog listing 4TR1). An eight-pole with 24 terminals is also available (catalog listing 8TR1) . . . Eliminates use of relays. Tested for impact, shock, acceleration and vibration.

Careful inspection assures long life operation. Positively detented positions eliminate accidental operation. The solid silver contacts and silver-plated copper moving contact carrier provide maximum conductivity, minimum temperature rise.

(For more details ask for Data Sheet No. 112)

CHARACTERISTICS

Operating Torque (4TR1) . . . 9 in. lbs. max.
 Pretravel 10° each direction
 Operating Torque (8TR1) . . . 4 in. lbs. min. to 6 in. lbs. max.

ELECTRICAL RATING 4TR1 & 8TR1

Continuous	Resistive Load		Lamp Load		Inductive Load	
	30 v dc	115 v ac	30 v dc	115 v ac	30 v dc	115 v ac
20	20	20	5	4	12	15



This Compact Limit Switch Is Widely Used by Industry

This is a double-pole two-circuit switch, completely sealed. Cover screws are held captive in cover when it is removed. The 1/2 n.p.t. internally tapped opening is in the bottom of the enclosure . . . Actuator can be positively locked in any position through 360° and can be operated in either direction. Actuator head is removable in field, can be rotated to any of four positions. This switch can be mounted either front or back side, .192-inch diameter holes extend through the enclosure, tapped from the back to a depth of 9/16-inch with 1/4-20 nc thread. Mounting holes accept No. 10 screws. No. 8 terminal screws accommodate No. 14 stranded wire. Can be used single-pole double-throw.

(Ask for Catalog 101)

CHARACTERISTICS

Operating force—3 lbs. max. Pretravel—20° max.
 Full overtravel force—6 lbs. max. Diff. travel—12° max.
 Release force—1/2 lb. min. Overtravel—30° min.
 Rated: 10 amps, 120, 240, 480 v ac; 1/2 H.P., 120 v ac;
 1 H.P., 240 v ac; .8 amp, 115 v dc; 4 amp, 230 v dc; 1 amp,
 550 v dc. Pilot duty rating 600 v ac. max.

15 MICRO SWITCH Precision Limit Switches Assure ABSOLUTE DEPENDABILITY in Particle Board Loader and Unloader Unit*

Operates 20,000 cycles per day on a 24-hour basis

Prevents shut-down time at estimated cost of \$50.00 to \$100.00 per minute



Three of the many MICRO SWITCH Type "ML" 2-circuit switches index the cage stops of the upward and downward travel of the racks of the particle board loader and unloader unit.

Operating 20,000 cycles a day, these rugged MICRO SWITCH "ML" Limit Switches with their long life, accurate repeatability of point of operation, excellent seal, convenient mounting and one-way actuation features, provide dependability for the continuous high speed production of particle board.

Serving as indicators and timers in various automatic operations, these two-circuit switches control the up and down motion of the unit which loads and unloads the particle board to and from the hot plate press.

The manufacturer* of these custom-built units has standardized on MICRO SWITCH Precision Switches because of their longer life, accurate and dependable operation and excellent environmental seal. As many as 100 switches are used on some of these custom-built units.

(Ask for Catalog No. 83 "Industrial Enclosed Switches")

*Washington Iron Works, Seattle, Washington

CIRCLE 18 ON READER-SERVICE CARD FOR MORE INFORMATION

Switches have uses unlimited



NEW!

A Subminiature
Screwdriver
Operated
Switch—
Saves Wiring
and
Panel Space

Designed to be used where there is limited access and where accidental operation must be prevented, Switch is operated by a 90° turn of a screwdriver and the slotted head gives visual indication of its position. The switch can be ordered with a number of variations of the subminiature basic switch. Contact arrangement is single-pole double-throw (maintained position).

(To learn full details of this new switch, send for Data Sheet No. 115)

ELECTRICAL RATING

Listed by Underwriters' Laboratories at 5 amps. 125 or 250 v ac. The 30 v dc is: Inductive—3 amps. at sea level, 2.5 amps. at 50,000 ft., resistive—4 amps. at both sea level and 50,000 ft. Maximum inrush capacity—20 amps. ac and 24 amps. at 30 v dc.

For Tough Service in Industrial Applications— The "BAF1" High Capacity Series

Especially designed for rough, general service in industrial applications, these MICRO SWITCH Precision Switches are protected from the effects of dirt, dust and occasional liquid splash by an elastomer boot on the plunger and an O-ring gasket under the cover plate . . . This series is really rugged, the three mounting holes in the heavy mounting flange accommodate ¼ in. bolts. These switches have a capacity to make and break steady state currents of 20 amperes and will handle inrush currents as high as 75 amperes. If your service requirements are rugged, this rugged switch will handle them.



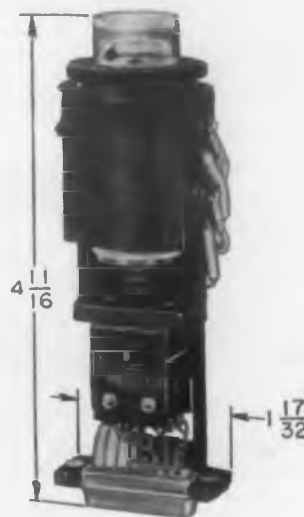
(You can learn all about this series, if you send for Catalog No. 83)

CHARACTERISTICS

Operating force 2 lbs.
Release force 1/2 lb. min.
Pretravel 7/32 in. max.
Overtravel 1/4 in. min.
Differential Travel015 in. max.

MICRO SWITCH 3-Light Pushbutton Switch Reduces Panel Space 50%

This compact, double-throw double-pole switch with its pre-wired plug will light in three different colors. It was developed expressly for use in complex console panels. Because push button and switch are combined in one unit, it reduces panel space by 50%. The compact stem carries three separate lamps. The switch incorporates a special connector plug which permits quick and easy installation and replacement—no complicated wiring required. Designed for use where high reliability is a requirement; two SPDT precision subminiature basic switches with fine silver or gold contacts and special treated snap-acting springs are the switching elements. All materials are corrosion resistant.



(Data Sheet No. 110 will give you more details. Send for it!)

ELECTRICAL RATINGS

Rated for .1 amp. inductive at 28 or 48 v dc and 1 amp. inductive at 115 v ac.

Service Pays Off Again; for Orin McIntyre

"We don't sell switches, we give service. Give them the right switch for the job and the switches sell themselves."



That's the sales approach of Orin Mac McIntyre, MICRO SWITCH salesman. And Mac's approach recently paid off.

Mac offered his talents to a prospective customer's engineers, hoping to assist them with their switching problems.

Mac kept at it and finally found the "in." The prospect needed heavy-duty limit switches with extremely light operating force and soft-roller actuators to prevent breakage of his product. Mac checked the home office, found the perfect solution, and had two samples in the hands of the prospect—pronto.

This prospect's engineers found these switches ideal for their needs, and issued an order.

This fast and efficient service made an impression. Soon Mac was called in on another switching problem which resulted in a second order.

Through Mac's efforts, MICRO SWITCH has gained the added respect of this company.

MICRO SWITCH

A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY

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



Instrumentation

A UNIQUE STANDARD-FREQUENCY MULTIPLIER, *Thurs. PM, Mar. 21.*

MEASUREMENT OF THE COMPLEX PERMEABILITY OF MAGNETIC MATERIALS OVER THE FREQUENCY RANGE OF 50 TO 500 MEGACYCLES, *Thurs. PM, Mar. 21.*

AN AUTOMATIC IMPEDANCE PLOTTER BASED ON A HYBRID-LIKE NETWORK WITH A VERY WIDE FREQUENCY RANGE, *Thurs. PM, Mar. 21.*

HIGH PRECISION SAWTOOTH GENERATOR, *Thurs. PM, Mar. 21.*

A special session on millimicrosecond instrumentation will be held on *Thurs. AM, March 21.*

Circuit Theory

SYMPOSIUM ON MODERN METHODS IN NETWORK THEORY, *Wed. AM, Mar. 20.*

PULSE-FORMING NETWORKS APPROXIMATING EQUAL-RIPPLE FLAT-TOP STEP RESPONSE, *Thurs. PM, Mar. 21.*

INTERSTAGE NETWORK DESIGN WITH PRACTICAL CONSTRAINTS, *Thurs. PM, Mar. 21.*

DELAY LINES, *Thurs. PM, Mar. 21.*

RECENT ADVANCES IN THE SYNTHESIS OF COMB FILTERS, *Thurs. PM, Mar. 21.*

Antennas

ON FERRITE LOOP ANTENNA MEASUREMENTS, *Tues. AM, Mar. 19.*

LIMITS ON THE INFORMATION OBTAINABLE FROM ANTENNA SYSTEMS, *Tues. AM, Mar. 19.*

HIGH ALTITUDE BREAKDOWN PHENOMENA, *Tues. AM, Mar. 19.*

BROADBAND TRAVELING-WAVE ANTENNAS, *Tues. PM, Mar. 19.*

FREQUENCY INDEPENDENT ANTENNAS, *Tues. PM, Mar. 19.*

A VERSATILE MULTIPOINT BICONICAL ANTENNA, *Wed. AM, Mar. 20.*

RECENT ANNULAR SLOT ARRAY EXPERIMENTS, *Wed. AM, Mar. 20.*

RADIATION FROM MODULATED SURFACE-WAVE STRUCTURES, *Wed. AM, Mar. 20.*

THE "SANDWICH WIRE" ANTENNA: A NEW MICROWAVE LINE SOURCE RADIATOR, *Wed. AM, Mar. 20.*

RECENT DEVELOPMENTS IN THE STUDY OF PRINTED ANTENNAS, *Wed. AM, Mar. 20.*

Information Theory

WHAT GOOD IS INFORMATION THEORY TO ENGINEERS? *Tues. AM, Mar. 19.*

COST OF TRANSMISSION RELIABILITY *Tues. AM, Mar. 19.*

CHANNEL CAPACITY WITHOUT CODING, *Tues. AM, Mar. 19.*

OPTIMUM DECISION FEEDBACK SYSTEMS, *Mon. PM, Mar. 18.*

MESSAGE REDUNDANCY VS FEEDBACK FOR REDUCING MESSAGE UNCERTAINTY, *Mon. PM, Mar. 18.*

Have you sent us your subscription renewal form?

CIRCLE 18 ON READER-SERVICE CARD FOR MORE INFORMATION

Three unusual direct-display storage tubes by Hughes

MEMOTRON

FEATURES: bright display . . . constant and uniform intensity of presentation . . . no perceptible transient decay . . . simplifies photography.
APPLICATIONS: transient analysis . . . spectrum analysis . . . direct comparison of wave forms.
SPECIFICATIONS: 100,000 inches/sec. writing speed . . . stores traces until intentionally erased . . . erasure triggered by push-button, or programmed voltage . . . electrostatic focusing and deflection.



MEMO-SCOPE

Model 104, incorporating MEMOTRON, is a new memory oscilloscope with 5 optional preamplifiers to satisfy the most critical production, test and laboratory requirements.



TONOTRON

FEATURES: half-tone presentation . . . excellent grey scale . . . controllable decay rate . . . compact design. **APPLICATIONS:** closed circuit TV . . . instrumentation . . . P.P.I. . . . narrow band, slow scan TV.
SPECIFICATIONS: 1,000 foot-lamberts brightness at 10 kv . . . electrostatic focusing . . . magnetic deflection . . . 60 lines per inch resolution . . . writing speed of 150,000 inches/sec.



TYPOTRON

FEATURES: high brightness . . . permanent display until intentionally erased . . . rapid display of printed data . . . 63 character matrix. **APPLICATIONS:** digital computers . . . teletype reception . . . wherever printed data must be displayed rapidly for use by human operator. **SPECIFICATIONS:** writes up to 25,000 characters/sec. . . permanent storage until erased . . . almost instantaneous erasure . . . electrostatic focusing and deflection.

See demonstrations of these tubes and MEMO-SCOPE at the I.R.E. Show, booths 2801, 2803, 2805, Second Floor. For additional information write to:

HUGHES PRODUCTS • ELECTRON TUBES
International Airport Station, Los Angeles 45, California

HUGHES PRODUCTS

© 1957. HUGHES AIRCRAFT COMPANY

CIRCLE 19 ON READER-SERVICE CARD FOR MORE INFORMATION

Computers

AN RCA HIGH-PERFORMANCE TAPE TRANSPORT SYSTEM, *Wed. AM, Mar. 20.*

DIODELESS MAGNETIC CORE LOGICAL CIRCUITS, *Wed. AM, Mar. 20.*

DIGITAL COMPUTER DESIGNS CIRCUIT FOR LONGEST MEAN TIME TO FAILURE, *Wed. AM, Mar. 20.*

COMPUTATION WITH PULSE ANALOGS, *Thurs. PM, Mar. 21.*

A CYCLIC DIGITAL-TO-ANALOG DECODER, *Thurs. PM, Mar. 21.*

AN AUTOMATIC ANALOG COMPUTER METHOD FOR SOLVING POLYNOMIALS AND FINDING ROOT LOCUS, *Thurs. PM, Mar. 21.*

MAGNETICALLY CONTROLLED COUNTERS, *Thurs. PM, Mar. 21.*

SYSTEMATIC TRACING OF DISCREPANCIES IN ANALOG COMPUTERS, *Thurs. PM, Mar. 21.*

Symposiums on computers in simulation, data reduction and control and telemetering, *Thurs. AM, Mar. 21.*

Reliability

Four reliability programs will be discussed *Thurs. AM, March 21.* Analysis and techniques for improved reliability will be discussed in 5 papers *Thurs. PM, March 21.*

Aeronautical Electronics

THERMAL DESIGN OF COMMERCIAL AIRBORNE ELECTRONIC EQUIPMENT, *Mon. PM, Mar. 18.*

THE NEW LOOK IN ELECTRONIC CONTROLS, *Mon. PM, Mar. 18.*

Special Programs

Microminiaturization Techniques, *Tues. PM, Mar. 19.* Application of the electronic art to air traffic control, *Tues. PM, Mar. 19.*

Other interesting sessions cover ultrasonics engineering, propagation, communications, navigation, high fidelity measurements, telemetry, production, and medical electronics.

March 11-15: 1957 Nuclear Congress

Convention Hall, Philadelphia, Pa. Theme of the Congress is "For Mankind's Progress" and peacetime uses of atomic energy will be discussed. Included in the Congress are four major elements, including the Second Nuclear Engineering and Science Congress, coordinated by Engineers Joint Council on behalf of twenty engineering and scientific societies. This will include 130 technical papers during a four-day program. The National Industrial Conference Board will hold its Fifth Conference on Atomic Energy in Industry, featuring twelve round-table discussions. The International Atomic Exposition, sponsored by the American In-

stitute of Chemical Engineers in cooperation with four other engineering societies, will display industry's latest items in the atomic field. The Fifth Hot Laboratories and Equipment Conference will take place March 14 and 15. For information, write to Engineer Joint Council, 33 W. 39th St., New York, N. Y.

March 18-21: The 1957 SPI Annual National Conference and Pacific Coast Plastics Exposition

Hotel Biltmore, Los Angeles, Calif., sponsored by the Society of the Plastics Industry, Inc. Sessions will cover plastics in the fields of electronics, aircraft and defense, building, and processing. Exposition will be held at the Shrine Exposition Hall. Further information may be obtained from the Society of the Plastics Industry, Inc., 250 Park Ave., New York, N. Y.

March 25-27: Special Conference on Research and Development

Palmer House, Chicago, Ill. Sponsored by the American Management Association. Subject will be "Product Development in Medium and Small Companies." For information, write American Management Association, 1515 Broadway, New York, N.Y.

April 4-5: Special Conference on Research and Development

Hotel Statler, New York, N.Y. Sponsored by the American Management Association. The conference will be an Engineering Forum. For information write to American Management Association, 1515 Broadway, New York N.Y.

April 8-11: Fourth National Electrical Industries Show

71st Regiment Armory, New York, N.Y. Sponsored by the Eastern Electrical Wholesalers Association. For more information, contact William S. Orkin, Co-Producer, The American Electrical Industries Expositions, Inc., 19 W. 44th St., New York, N.Y.

April 11-13: Southwestern IRE Conference and Electronics Show

Houston, Texas. Sponsored by the Houston Section of the IRE. This conference will be augmented by the National Simulation Conference which will be sponsored by the IRE Professional Group on Electronic Computers. For information, write to Ninth Southwestern IRE Conference and Electronics Show, P. O. Box 1234, Houston 1, Texas.

Don't forget to mail your renewal form to continue receiving ELECTRONIC DESIGN.

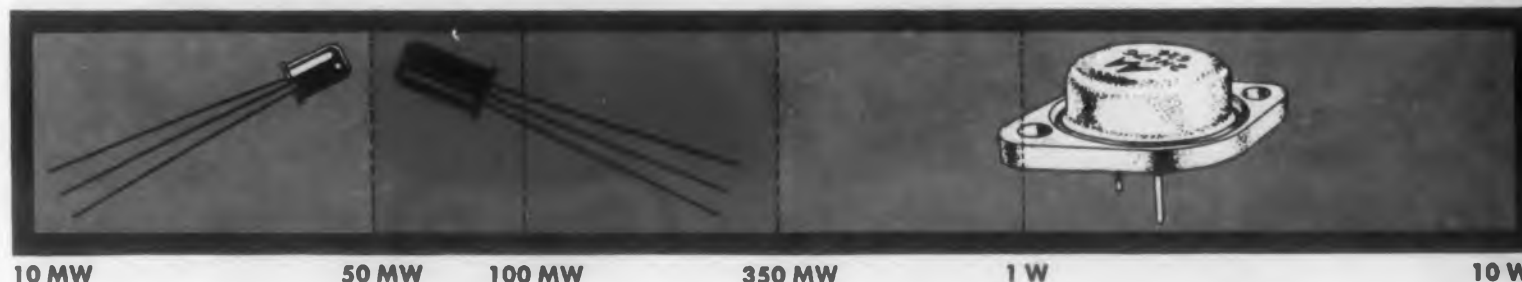
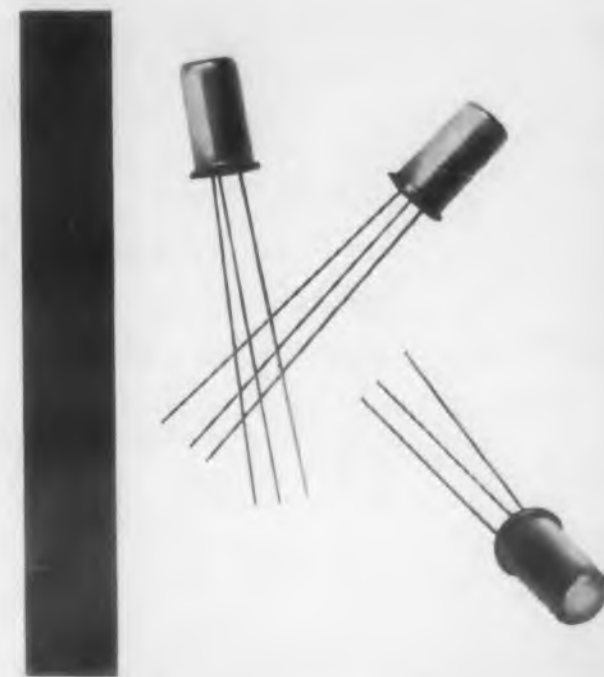
ELECTRONIC DESIGN • March 1, 1957

MOTOROLA TRANSISTORS

FILL THE GAP

IN THE

POWER SPECTRUM



Motorola opens a new range with the medium power transistor family. Here is a proved 50-350 MW device, another accomplishment of the Motorola Semiconductor team.

The MN13A, MN13B and MN13C are in use, driving power transistors, providing substantial audio power output for portable radios, working in DC converters, and serving in a wide range of other applications.

Here is another step in Motorola's march of leadership. Produced by the fusion alloy process, these small size medium-power transistors are filled with a liquid of the highest purity, specially processed for sure stability of characteristics. And they carry the distinguishing mark of Motorola quality-in-quantity—"productionered" for peak performance at a more-than-competitive price.

Write for the story of the transistors that fill the gap. Or ask for specifications, applications information and prices on the entire Motorola family of high- and medium-power transistors.

TYPICAL OPERATION
(Single-Ended, Class A, Common Emitter)

	Vc (volts)	Ic (ma)	Zi (ohms)	Zo (ohms)	P.G. (db)	P.O. (mw)
MN13A	20	15	100	1000	33	100
MN13B	12	25	100	500	36	100
MN13C	12	25	150	500	39	100



More Motorola Power Transistors have been produced and are now in use than all other comparable types combined. Hundreds of thousands have passed the only true test of reliability — months of successful customer use.



MOTOROLA, INC.
SEMICONDUCTOR PRODUCTS DIVISION
5005 E. McDOWELL ROAD
PHOENIX, ARIZONA

CIRCLE 20 ON READER-SERVICE CARD FOR MORE INFORMATION



JAN Types
High Temperature Types
High Conductance Types
High Resistance Types

All CLEVITE gold-bonded subminiature glass diodes feature high forward conductance . . . high inverse resistance . . . fast pulse recovery . . . and fast forward switching time.

CLEVITE gold-bonded diodes are now used by the nation's leading computer manufacturers. If you have similar requirements, our engineers will be glad to discuss them. Contact us for complete information and data sheets.

See us at the I.R.E. Show, Booths 2616-2626



Clevite diodes are used for the Remington Rand UNIVAC computer.

GOLD-BONDED
COMPUTER
DIODES



CHARACTERISTICS

TYPE	Forward Current at +1V (ma. Min.)	Inverse Current at Specified V (μa. Max.)	Continuous Inverse Operating Voltage	DESCRIPTION
CTP-301	40	25 @-50V	50	Inverse recovery time meas. 1.0 μ sec
CTP-307	300	20 @-30V	40	Inverse recovery time meas. 1.0 μ sec
CTP-309	300	20 @-6V	20	Forward recovery time 0.1 μ sec
CTP-318	50	500K between -10V & -50V	60	Inverse recovery time 0.3 μ sec Forward 0.1 μ sec
CTP-319	150	500K between -20V & -90V	90	Inverse recovery time 0.3 μ sec
CTP-320	5	50 @-50V	80	Inverse recovery time 0.3 μ sec
CTP-328	7.5	500K between -10V & -60V	60	Inverse recovery time 0.3 μ sec
IN34A	8.5	30 @-10V 500 @-50V	60	General Purpose
IN279	100	200 @-20V	30	General Purpose
IN116	5	100 @-50V	60	General Purpose

Available JAN Types — 1N127, 1N128, 1N198, 1N277, 1N281

Other Clevite Divisions



Brush Electronics Co.



Cleveland Graphite Bronze Co.



Clevite Harris Products Inc.



Clevite Ltd.



Clevite Research Center

CLEVITE

TRANSISTOR PRODUCTS
 241 Crescent St., Waltham 54, Mass. TWinbrook 4-9330



A Division of Clevite Corporation

CIRCLE 21 ON READER-SERVICE CARD FOR MORE INFORMATION

April 15-17: Symposium on Systems for Information Retrieval

Western Reserve University, Cleveland, Ohio. Sponsored by the School of Library Science of Western Reserve University in conjunction with its center for Documentation and Communication Research. This will be a comprehensive demonstration of systems presently in use for the organization, storage and retrieval of recorded information, together with a symposium on information-handling problems and techniques. Further information may be obtained from Jesse H. Shera, Dean, School of Library Science, Western Reserve University, Cleveland 6, Ohio.

April 16-18: Symposium on Nondestructive Tests Developed in the Field of Nuclear Energy

Morrison Hotel, Chicago, Ill. Sponsored by American Institute of Chemical Engineers, American Nuclear Society, American Society for Testing Materials, and Society for Nondestructive Testing. Information resulting from 15 years research and development in testing applications in the nuclear field will be presented. Papers will be in three categories: reactor materials, completed fuel assemblies, and miscellaneous. For information, write to American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

April 23-25: International Symposium on the Role of Solid State Phenomena in Electrical Circuits

Auditorium of the Engineering Societies Building, New York, N. Y. Symposium will cover recent developments in application to electrical circuits on systems of unusual physical effects in solids. For information write to the Polytechnic Institute of Brooklyn, Microwave Research Institute, 55 Johnson St., Brooklyn 1, N.Y.

April 24-26: Seventh Region IRE Conference

San Diego, Calif. Theme of the meeting is "Electronics in Space." Sessions will be held on electronic aids to air navigation, audio, management, uses of computers, antennas and propagation, nuclear activation and damage of electronic equipment, electronic devices, electron tubes, microwave instrumentation, telemetering, data handling and automation, magnetic components, and radio astronomy. For information, write to IRE Seventh Region Conference, U. S. Grant Hotel, San Diego, Calif.

April 25-26: Annual Technical Meeting of the Institute of Environmental Engineers

LaSalle Hotel, Chicago, Ill. For information contact the President of EEI, Henry F. Sander, Vapor Hearing Corp., 6420 W. Howard St., Chicago, Ill.

Location of technical sessions at the IRE National Convention, March 18-21.

Those shown are at the Coliseum; all others are at the Waldorf-Astoria Hotel.

Multiple Communications Systems, Information Theory-Coding and Detection, Solid State Devices, Antennas I and II and Microwave Antennas, Information Theory-Review and Recent Advances, Microwave Tubes, Televisual Systems Devices, Microminiaturization—The Ultimate Technique, Transistor Applications, Electron Tubes-General, Color Television Receivers, Microwaves I, II and III, Production Techniques, Symposium: Digital Techniques For Problems In Telemetry and Remote Control, Millimicrosecond Instrumentation-Special Topics, Symposium: Low Level Multiplexing For Telemetry and Remote Control, and Instrumentation II.

May 1-3: Electronic Components Conference

Hotel Morrison, Chicago, Ill. Sponsored by the AIEE, IRE, RETMA and WCEMA. Papers to be given on high temperature components, radiation effects, component reliability, passive components, active components, instrumentation and measurements, materials development and general component needs. For information write to J. S. Powers, Electronic Components Symposium, 84 E. Randolph St., Chicago 1, Ill.

May 3: Fourth Annual Conference for Engineers and Architects

Ohio State University campus. Sponsored by the College of Engineering.

May 13-15: National Conference on Aeronautical Electronics

Dayton, Ohio. Sponsored by Dayton Chapter, IRE.

Paper deadlines

May 1: Deadline for papers submitted for the Wescon convention August 20-23 in San Francisco. Send 100-200 word abstracts, together with complete texts or additional detailed summaries, to D. A. Watkins, Technical Program Chairman, Stanford Electronics Laboratories, Stanford University, Stanford, Calif. Authors will be notified of acceptance by June 1.

May 1: Deadline for papers submitted for the April, 1957 convention of the American Society of Tool Engineers. ASTE membership is not required. Each proposal should include an outline of the paper, the author's name, his title and affiliation. Send outlines to L. S. Fletcher, Program Director, American Society of Tool Engineers, 10700 Puritan Ave., Detroit 38, Mich.



available
now...

POWER TRANSISTORS

- High power ratings
- High power gain
- Rugged, compact mechanical design
- Welded, hermetically sealed package for stability and long life
- Excellent heat dissipation characteristics

Now Clevite can supply you with power transistors that fit your needs for audio applications, portable power supplies, etc., from a full line of six types. All are available in production quantities. All are rated at 25 watts continuous operation with infinite heat sink — 15 watts with 36 sq. in. heat sink.

Clevite Power Transistor packaging is compact. Hermetic sealing under carefully controlled conditions insures stability and long life. Low thermal resistance between collector junction and large copper flange insures excellent heat conduction from the package to the heat sink.



CLEVITE TRANSISTOR PRODUCTS

241 Crescent St., Waltham 54, Mass. TWinbrook 4-9330



Clevite Power Transistors are used in leading auto radios.

OUTLINE SPECIFICATIONS

TYPE	2N268	CTP 1111	2N257	CTP 1104	CTP 1109	CTP 1108	Units
Instantaneous Collector-to-Base Voltage (absolute maximum)	-80	-80	-40	-40	-20	-20	Volts
Junction Temperature (absolute maximum)	85	85	85	85	85	85	°C
Average Total Power Dissipation (with inf. heat sink @ 25°C)	25	25	25	25	25	25	Watts
Average Total Power Dissipation (with 36 sq. in. heat sink @ 25°C)	15	15	15	15	15	15	Watts
Power Gain	28 ^a	23 ^a	30 ^a	23 ^a	27 ^b	20 ^b	db
Frequency Cutoff	6	4	7	4	6	4	kc/s

^a V_{cc} = -14V; I_c = 500 ma; R_L = 30 Ω (choke coupled); R_E = 10 Ω

^b V_{cc} = -7V; I_c = 500 ma; R_L = 15 Ω (choke coupled); R_E = 10 Ω

Write for Data Sheet B-211

Clevite Divisions: Brush Electronics Co. • Cleveland Graphite Bronze Co. • Clevite Harris Products Inc. • Clevite Research Center • Clevite Ltd.

CIRCLE 22 ON READER-SERVICE CARD FOR MORE INFORMATION



AMP'S PATCHCORD PROGRAMMING SYSTEM

Speeds confirmation of airline reservations

A wide variety of AMP Taper Technique product provides long-life assurance of perfect electrical terminations and is a contributing factor in keeping electronic equipment compact. The AMP Patchcord Programming System offers a multiformity of internal wiring arrangements and connections and permits circuit versatility by use of prepatched, removable front boards.

A number of major airlines, including the Long Island City facilities of Pan American Airlines (shown above), have installed electronic equipment manufactured by Teleregister Corporation, Stamford, Connecticut to eliminate delay and uncertainty in air travel reservations procedure. AMP Taper Technique and AMP Patchcord Programming Systems are prominent in the design of this equipment.

AMP Taper Technique and AMP Patchcord Programming Systems have been utilized for years to solve problems inherent in the design of computers, business machines, and automatic control equipment.

Complete information is available on request.



This unit is actually located in our display at the IBM show in New York City March 16th to 24th, 1957
MOOTHS 2472423

AMP INCORPORATED



General Office: Harrisburg, Pa.

Wholly Owned Subsidiaries: Aircraft-Marine Products of Canada Ltd., Toronto, Canada
Aircraft-Marine Products (G.B.) Ltd., London, England
Societe AMP de France, Le Pre St. Gervais, Seine, France
AMP-Holland N.V. 's-Hertogenbosch, Holland
Japanese Distributors: Oriental Terminal Products Co., Ltd., Tokyo, Japan

CIRCLE 23 ON READER-SERVICE CARD FOR MORE INFORMATION

COUNTERS for high speed operation are desirable in many applications such as in computers or in frequency measuring equipment. High speed operation often permits a reduction in equipment size when a high speed circuit performs in time sequence the function of a large number of slower circuits operating together in the same time interval.

The flip-flop circuit is the basic element of most counters. Fig. 1 shows a typical junction transistor flip-flop circuit. The circuit of Fig. 1 is similar to the Eckles-Jordan vacuum tube flip-flop. One of the transistors is always conducting and the other is always turned off. Applying a pulse to the complement input turns the 'on' transistor 'off' and the other one 'on'. A pulse applied to the set-to-zero input turns transistor TR_1 'off' and a pulse applied to the set-to-one input turns Tr_1 'on'. Outputs are taken at the collectors of the transistors.

There are numerous variations of the flip-flop circuit. Generally they become more complicated as higher operating speeds are attained although this is not always the case. For example, surface barrier transistors may be operated at pulse rates of 4 or 5 megacycles in a circuit similar to that of Fig. 1 without the resistor and condenser in the emitter circuit (emitter returned to ground). For high speed operation with most transistors it is necessary to prevent the transistors from going into saturation where minority carrier storage effects considerably delay turning a saturated transistor off. Nonsaturated operation may be achieved by several means such as having the proper relationships between the various resistors in the flip-flop circuit and the transistor parameters, by use of diode clamping circuits, circuits using breakdown diodes or diode and resistor combinations used to make certain that the collector to base voltage of the 'on' transistor never goes to zero.

Transistor Counters

A. William Carlson
Project Engineer
Transistor Applications Co.
Boston, Mass.

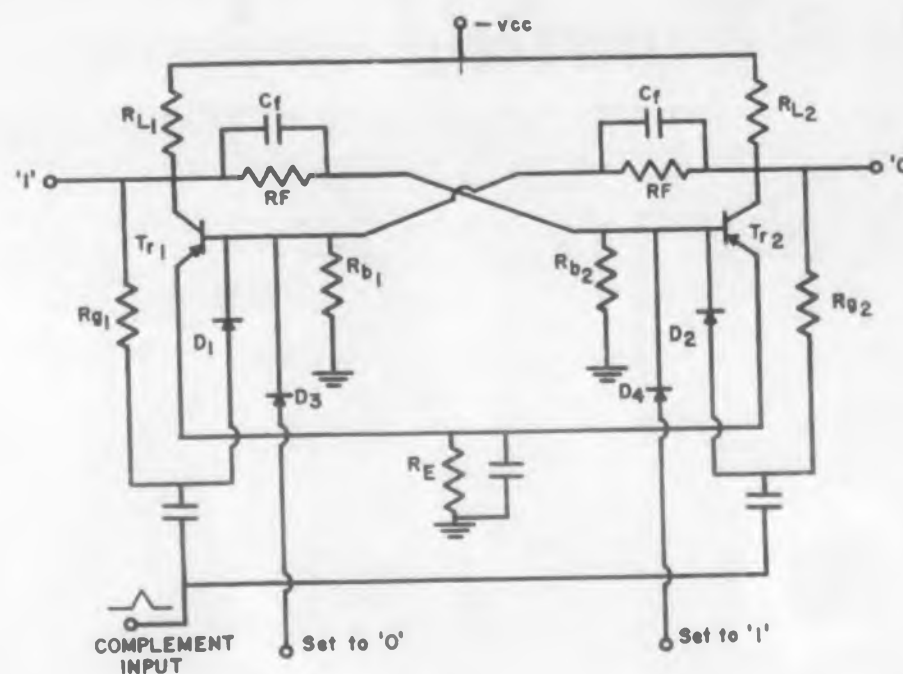


Fig. 1. Typical junction transistor flip-flop.

Circuits to reduce the rise and fall times of the collector wave forms result in further variations of the flip-flop circuit, sometimes leading to 4-transistor flip-flops. An example of a 4-transistor flip-flop is a circuit using transistor emitter followers in the cross-coupling circuits between the collector of one transistor to the base of the other to improve the impedance match between these two points and increase the switching speed. Another 4-transistor flip-flop replaces the collector load resistors with transistors of the opposite polarity* (as shown in Fig. 2) giving a circuit with

*Circuit due R. H. Baker, Lincoln Laboratory, Massachusetts Institute of Technology

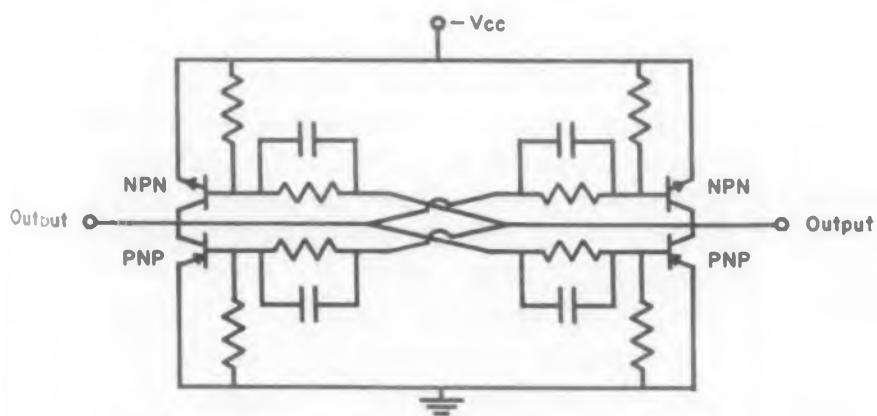


Fig. 2. Basic circuit of flip-flop with load switching.

an active load. In the circuit of Fig. 2, one of the lower transistors is 'on' and the other 'off' with the transistor in series with an 'on' transistor being 'off' and vice versa. This circuit is particularly useful in driving capacitive loads as they are charged and discharged through low impedance by one or the other of the 'on' transistors connected to the load.

Binary counters may be made with a series of flip-flops as shown in the block diagram of a four stage counter in Fig. 3a. Fig. 3b shows the waveforms of the '1' outputs of each of the flip-flops in the counter. (Referring to Fig. 1, when Tr_1 is 'on' it will be said that the flip-flop is in state '1' and when Tr_2 is 'on' the flip-flop is in state '0'.) The waveforms of '0' outputs are

of the opposite polarity (when one transistor of the flip-flop is 'on' the other is 'off'). For convenience, it will be assumed that the flip-flops are similar to that of Fig. 1 in that the flip-flop changes state when a positive pulse is applied to the complement input of the next succeeding flip-flop. Thus each time the voltage at the '0' output lead of the first flip-flop goes positive, the second stage changes state, i.e., the second stage changes state at half the rate of the first stage. In a similar manner the third stage is controlled by the second and the fourth stage is controlled by the third. The four-stage counter of Fig. 3 counts 16 pulses before returning to its original state. An N stage binary counter counts 2^N pulses in completing a cycle. Other

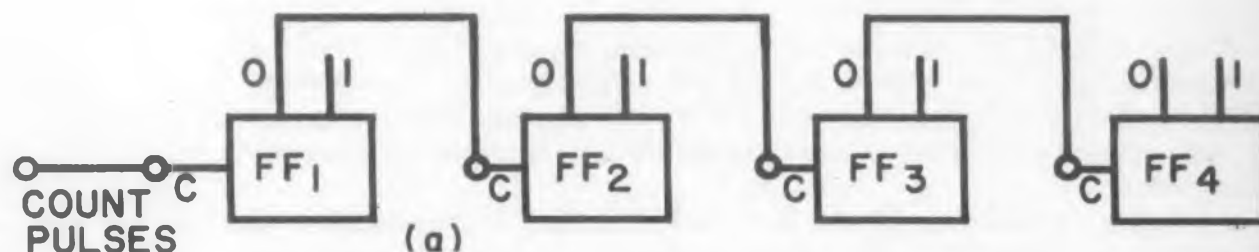
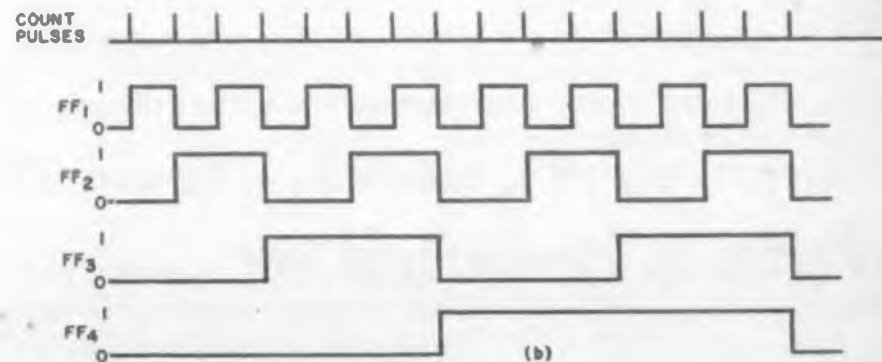


Fig. 3. Four-stage binary counter.



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ENGINEERING DATA

SERIES: TS. Miniature off-set springs telephone type.

CONTACTS: 5/64" dia. palladium (rated 3 amps.) 1/2" dia. pure silver (rated 5 amps.).

CONTACT ARRANGEMENTS: Up to 20 springs, maximum 10 in each stack, using any form combinations within max. limits.

VOLTAGE RANGE: DC: up to 220 V. AC: up to 230 V. (4 poles).

COIL RESISTANCE: 30,000 ohms. Shaded coil available for 60 cycle operation up to 230 V. using 4.7 VA nominal.

POWER REQUIRED: 100 mw. per movable arm.

TEMPERATURE RANGE: Stack insulation of XXX phenolic spacers: -55° C to +85° C. Glass malamine spacers: -55° C to +125° C.

TERMINALS: Pierced solder lug holes for 2 No. 16 hook-up wires. Also available: Push-on taper tab connectors.

ENCLOSURES: Dust cover or hermetically sealed enclosures. Round: With octal plug (Max. of 8 springs) Rectangular: With octal plug; 4 to 14 pierced solder lugs; header to fit 14-pin miniature relay socket. Multiple solder header 18 springs Max.

DIMENSIONS: (4 Form C) 1-19/32" L. x 1-1/16" W. x 1 1/2" H. (open) (4 Form C) 1 1/4" L. x 1-13/32" W. x 2-3/16" H. (Hermetically sealed) (6 Form C) 1-29/32" L. x 1-5/16" W. x 2-9/16" H. (Hermetically sealed). The standard TS structure with a life of 100 million operations will soon be available.

counts may be obtained by "feedback" circuits. For example, the four stage counter could be made to count to 10 with a circuit that would reset all the counter stages to '0' at the tenth count pulse. The counter of Fig. 3 cannot be used in some applications because of the delay in propagating the count down the counter chain. This delay comes about in the following manner. Assume that all the stages in the counter were in the state '1'. The next count pulse will switch all the flip-flops to the state '0' but this will occur in time coincidence with the count pulse which is applied directly to the first stage only. The first stage changing state generates a pulse transferred to the second stage but delayed because of the finite switching time of the first stage. The third stage cannot switch until the second stage has changed state and likewise with the other stages in the counter. The greatest delays occur in the situation just described where all the stages in the counter must change state. These delays are intolerable in some applications such as driving a matrix switch with the counter where the delays cause a narrowing of some of the output pulses and generate spurious pulses.

The delay problems of the counter shown in Fig. 3 may be overcome by applying pulses simultaneously to the proper stages. Methods of simultaneous switching are shown in block diagram in Figs. 4a and 4b. In Fig. 4 the rectangular blocks labelled G are gates controlled by the flip-flops. The arrows show the path of the count pulses through the gate when it is enabled. The gate permits the pulse to pass when all the flip-flops which control the gate are in the state indicated by the output lead to which the gate is connected. For example, G_1 in Fig. 4a permits a pulse to pass only when the first flip-flop is in the state '1'. G_2 in Fig. 4b permits a pulse to pass only when the first three flip-flops stages are in the state '1'. Assume that the first stage of the counter in Fig. 4a has just been turned 'on' by a count pulse and all the rest of the counter pulse stages are 'off'. Gate G_1 is now enabled. The second pulse turns off stage 1 and passes through G_1 to stage 2 (there is sufficient delay in G_1 being disabled for the pulse to pass) and changes it to '1'. G_1 is disabled and G_2 is enabled. The third pulse turns the first stage 'on' and enables G_1 . The fourth pulse turns stage 1 'off'; passes through G_1 to turn 'off' stage 2 and passes through G_2 to turn 'on' stage 3. The process continues with succeeding pulses and reproduces the waveforms shown in Fig. 3b.

The circuit of Fig. 4b operates in a similar manner except that the pulses, instead of passing through a series of gates, pass through a number of gates in parallel. The counter of Fig. 4b requires more components in the gate circuits than the counter of Fig. 4a and also loads the flip-flops more. For example, the first stage flip-flop is connected to all the gates. The counter of Fig. 4b has the advantage over the circuit of Fig. 4a if the pulse is delayed in passing through the gates.

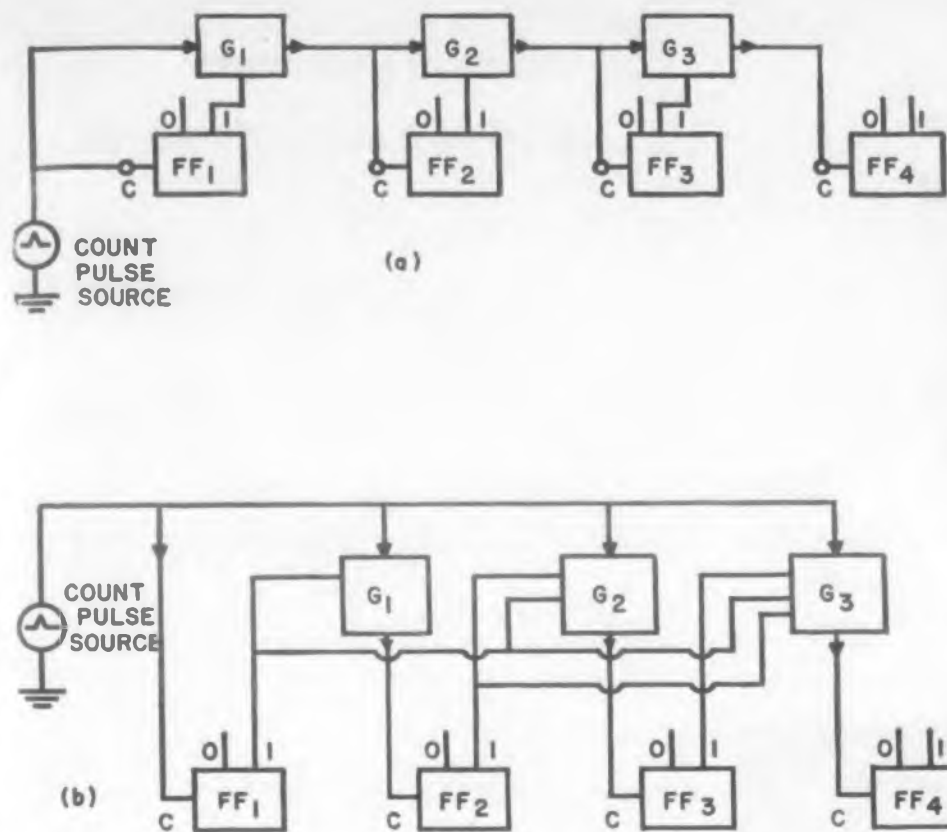


Fig. 4. Counter circuits with simultaneous switching.

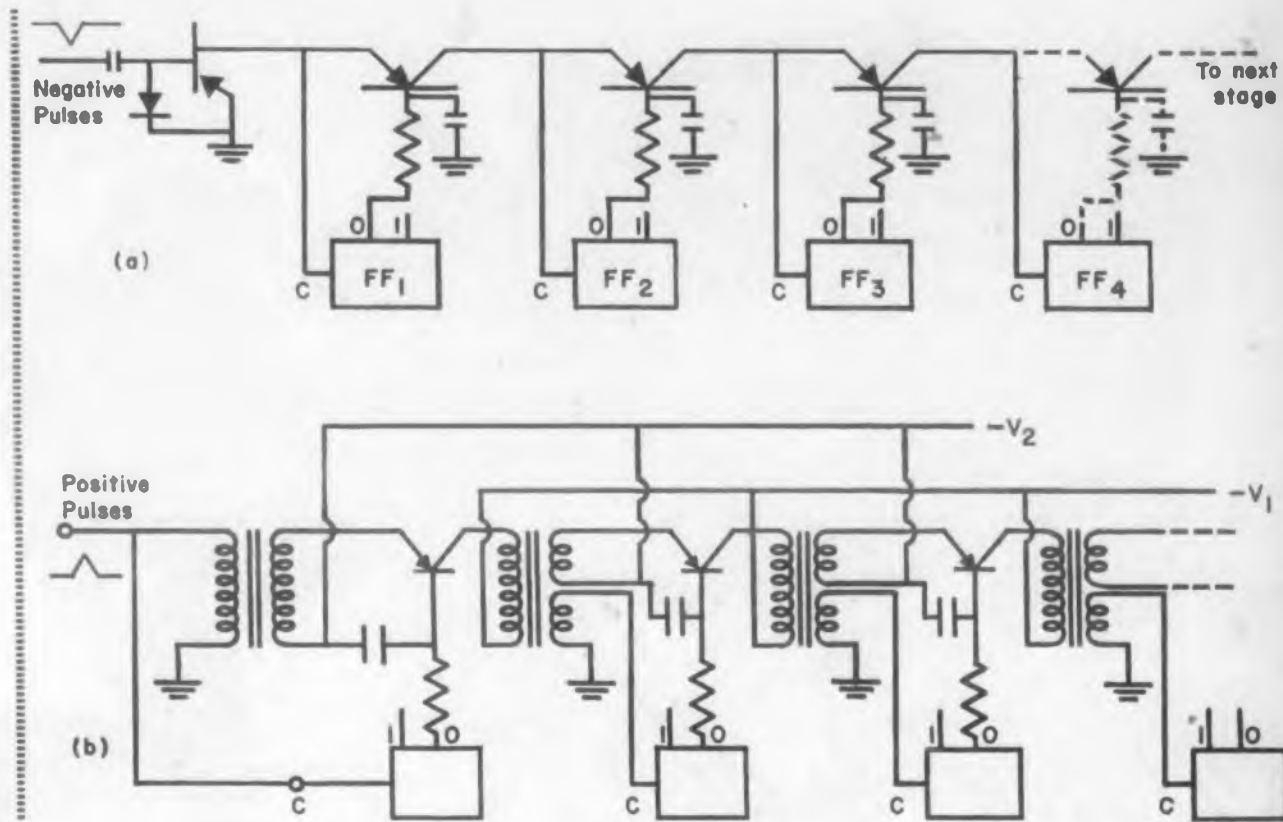


Fig. 5. Transistor gate circuits for four-stage counter.

Two of the many transistor gate circuits suitable for use with counters are shown in Fig. 5. The gate circuits of Fig. 5a require transistors with a very low impedance between emitter and collector when turned on (such as surface barrier transistors) but lead to very simple circuits. (The complement input circuit for flip-flops used with this gating circuit consists of two diodes with the anodes tied together at the complement input terminal and with a cathode connection to each of the flip-flop collectors when using PNP transistors.) The number of counter stages that may be controlled by the gates in Fig. 5a is limited by the reduction in size of the pulse at succeeding stages. The bases of the transistors in Fig. 5 are shown connected to the '0' output since these gates are enabled by an 'off' collector voltage.

The gate circuit in Fig. 5b^o is more complex than that of Fig. 5a but may be used with larger counters because the pulse is amplified in passing through the gate. The emitters are returned to a voltage V_2 which is slightly more negative than the voltage at the collector of the 'off' transistor in the counter flip-flops. The voltage V_1 is more negative than V_2 by several volts, representing the effective collector supply voltage. When the base voltage of the gate transistor is at the negative voltage of an 'off' transistor in the counter

a small positive pulse at the emitter is amplified and transferred to the next gate and counter stage. When the base voltage of the gate transistor is at a low value as when the '0' transistor in the flip-flop is 'on' a positive pulse at the emitter cannot overcome the reverse emitter to base bias and the gate is disabled.

In both circuits of Fig. 5 the condensers are small ones giving the required delay in enabling and disabling the gates.

The conventional binary counters previously described have a varying number of stages, up to the total number of stages in the counter, changing state at a given count. The large number of transients taking place at certain counts can be troublesome in some applications such as in driving matrix switches where these transients may cause spurious pulses to appear at the outputs.

Two types of counters have been designed by the author to minimize the number of switching transients. In the first type a maximum of two stages, regardless of the length of the counter chain, change state at a given count. In the second type only one stage in the counter chain changes state at a given count (Gray code counter). These counters have the further advantage that switching is coincident with the appearance of the count pulse.

Junction transistors may also be used in ring counter circuits. A ring counter may be made up of flip-flop units in circuits which are essentially shift registers or variations of shift registers with the last stage con-

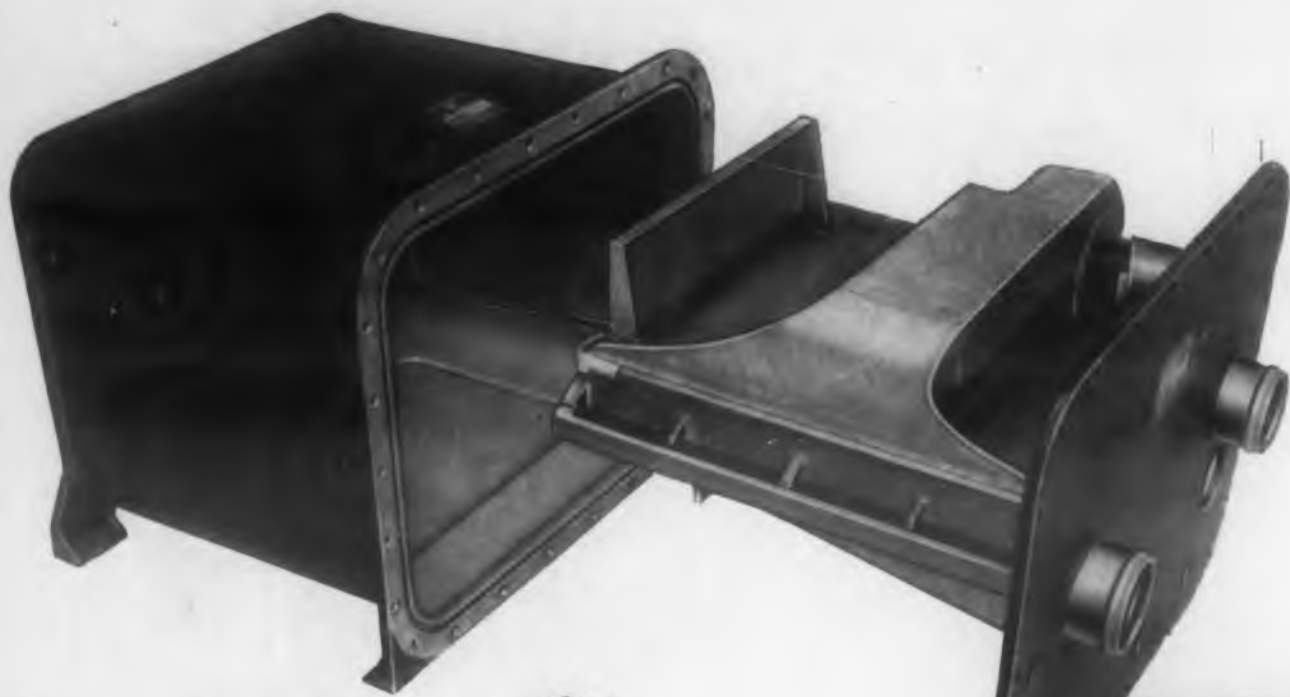
nected to the first. One of the binary stages is set to the '1' state with the rest of the stages in the '0' state. The count pulses then move the '1' state on stage along the ring with each count. The disadvantage of this type of ring counter is the possibility that some perturbation of the circuit may cause an additional stage or stages to go to the '1' state or the reference '1' state to go to '0' thus putting the counter in error until the mistake is noticed and the counter reset.

Another type of ring counter uses one transistor per count (half as many as the ring using binary stages) but is limited to about a count of 10 in a single ring. Since this was written, faster junction transistors have become available. A ring counter using surface barrier transistors has been constructed and operated at megacycle pulser rates.

Bibliography

1. "Steady State Conditions of a Junction Transistor Flip-Flop", Edmund U. Cohler, Memorandum M-2686, March 11, 1954, Div. 6, Lincoln Laboratory, Mass. Inst. of Technology, Cambridge, Mass.
2. "A Design Procedure for Junction Transistor Flip-Flops", R. E. McMachon, I. L. Lebow and R. H. Baker, Internal Memo M24-34, April 28, 1954, Group 24, Lincoln Lab, M.I.T., Cambridge, Mass.
3. "A New Ring Counter for Junction Transistors and Vacuum Tubes," A. W. Carlson, AFCRC-TN-54-100, June 1954, Electronics Research Directorate, Air Force Cambridge Research Center, Bedford, Mass.

^o(2) Circuit described by T. P. Bothwell, G. W. Booth, and E. P. English. "A Junction Transistor Counter with High-Speed Cory". Transistors I, RCA Laboratories, March 1956



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R-f power is measured in the Type 666 Calorimeter, designed by Polytechnic Research and Development Co., 202 Tillary St., Brooklyn 1, N.Y., by completely transforming the electromagnetic energy into heat. By calorimetric substitution, the heating effect produced by an unknown power is measured in terms of a known d-c power producing the same heating effect.

Construction

The calorimeter consists of two identical pieces of waveguide containing an absorbing r-f load. The active calorimetric body absorbs either the r-f power of the d-c power used for calibration purposes. The dummy waveguide acts as a thermal reference body for the temperature-sensitive detector, which in this case is a thermopile. The calorimetric bodies are enclosed in a thermal shield so that effects from external heat sources are minimized. The thermal shield consists of 3 isothermal envelopes separated by high thermal resistances. The identical construction of the two calorimetric bodies also helps in minimizing the undesirable effects from external heat sources.

The active waveguide is made up of several sections designed to offer little transmission loss to the electromagnetic wave but have high thermal resistance. The pictorial diagram of the waveguide shows construction details.



Internal view of dry calorimeter showing active and reference waveguide and thermopile.

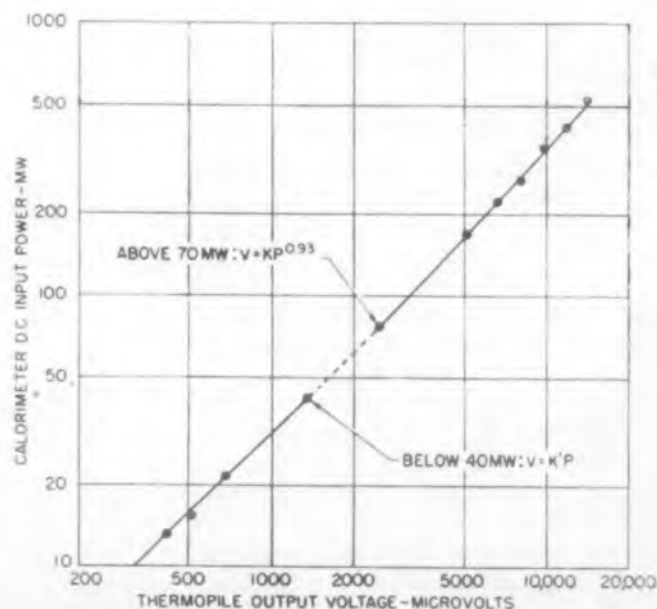
The construction of the r-f load consists of a tapered metallized mica blade. Two silver point contact areas along the tapered part of the load provide electrical contact with the waveguide. A potential applied between the front and back contact areas will produce a current distribution in the film which resembles to some extent that produced by the r-f field. The load is mounted in narrow and accurately centered slits in the top and bottom walls of the waveguide. The wires strung between the two waveguides (see photograph) constitute the thermopile, an iron-constantan combination.

Performance

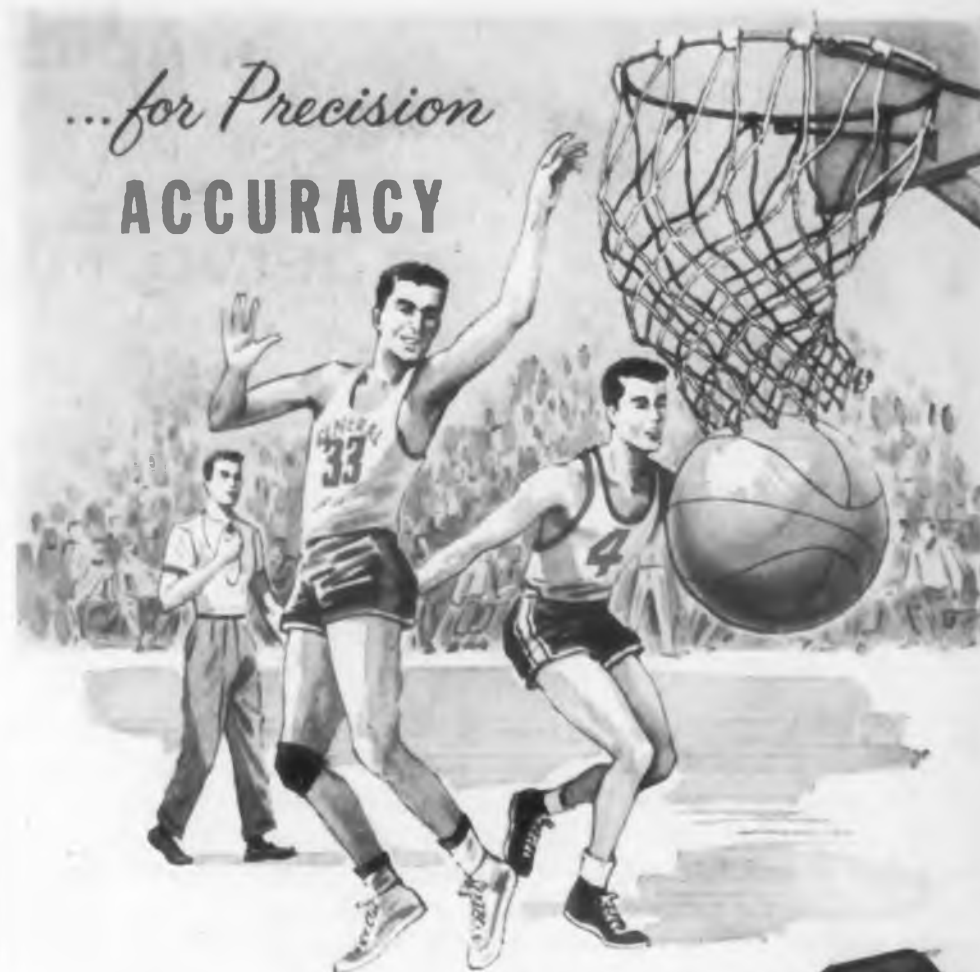
The total combined error is less than 2 per cent after corrections are made for load VSWR and insertion loss of the waveguide. The sensitivity is constant for lower levels; dropping at higher power levels. Higher power measurements are possible, but loads may burn out. Highest frequency is 75 kmc.

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Simplified Calculations for Servo Function Generators

Holton E. Harris and Rawley D. McCoy

Reeves Instrument Corp.

New York, N.Y.

FUNCTION generation by means of resistance loading on tapped servo potentiometers is a simple and convenient method, but the average engineer is apt to shy away from the problem of calculating the values of padding resistances to produce a given function. With the proper approach, the calculations can be simplified so as to involve nothing worse than Ohm's law and Kirchoff's current law.

There are two major methods of padding tapped resistances, tap-to-tap loading and tap-to-end loading. In the following examples a 9-tap (10 segment) potentiometer is used.

Tap-to-Tap Loading

This system is the more straightforward of the two methods. It involves putting a resistance across each pair of taps on the potentiometer to bring the voltage across the segment between them down to the value required by the slope of the function between the corresponding points. The potentiometer is thus converted into a simple nonlinear resistance, and as the slider moves along the desired nonlinear function of θ , and hence of X , is produced.

Consider the simple Monotonic, first quadrant function shown in Fig. 1. The simplest way to organize the calculations is to draw a schematic of the potentiometer and make the calculations right on it. The various stages are shown in Fig. 2.

1. Divide the abscissa of the function into 10 segments and draw in the 10 straight-line segments which best approximate the function. Try to keep deviations of the lines above and below the function equal and at a minimum. Mark the ordinate of each intersection between the straight-line segments on the corresponding tap on the potentiometer diagram (Fig. 2A).

2. Since the resistance of each segment is known (5 k for the pot used here) and the voltage across each segment is determined, the current that must flow in each segment to produce the desired voltage distribution can be calculated (Fig. 2b).

3. Consider now the segment having the greatest current, corresponding to the part of the curve having the greatest slope. This is the "control" segment. Since there is no point in drawing any more power from the source than necessary, it is left unparallelled.*

4. Working each way from this control segment towards the ends of the potentiometer the padding resistors are drawn in parallel with all other segments. Since the sum of the current in each segment and its padder must equal the current in the control segment, the current in each padder is easily determined by subtraction (Fig. 2c).

5. If the voltage across each padder and the current through it are known it is a simple matter to determine the resistance (Fig. 2d).

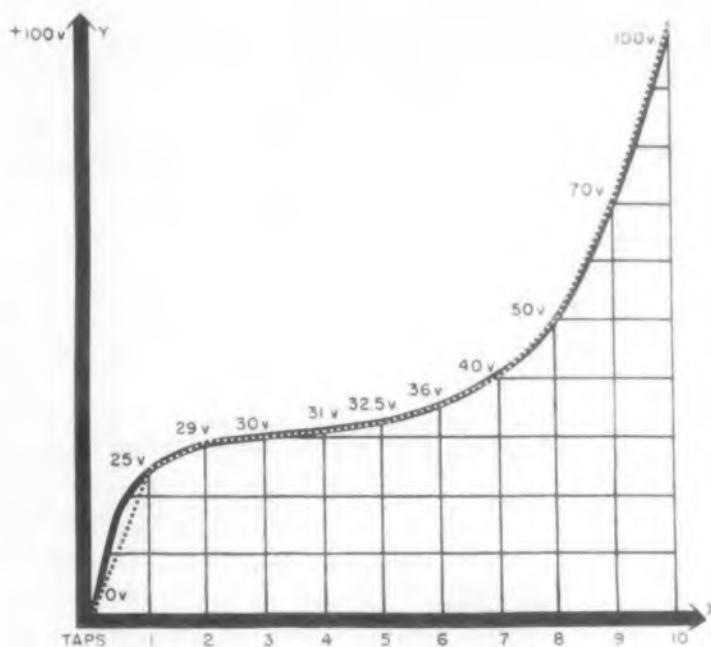


Fig. 1. Simple monotonic function

* At this point make sure that the current required does not exceed the current rating of the potentiometer:

$$I_{max} = \sqrt{\frac{P}{R}}$$

where P = Power rating of the servo potentiometer in watts

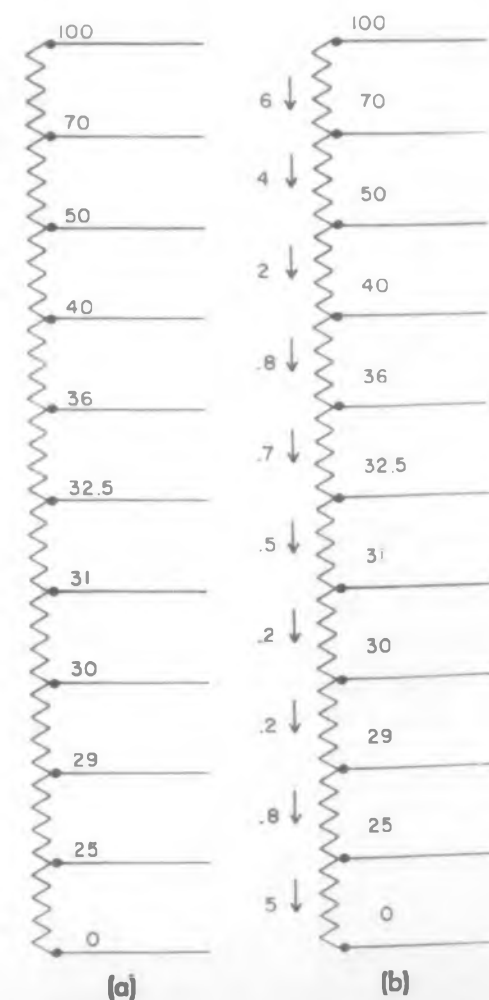
R = Total resistance of the potentiometer in ohms

I_{max} = Potentiometer current rating in amperes.

In the event that the required current is greater than the rated current of the potentiometer, it is usually possible for monotonic functions such as this to reduce all slopes by a constant and add a linear term by summation in an external amplifier.

In the above example, the greatest current is 6 ma in segment 10, well within the rating of the potentiometer.

Fig. 2. Schematic of tap-to-tap loading technique.

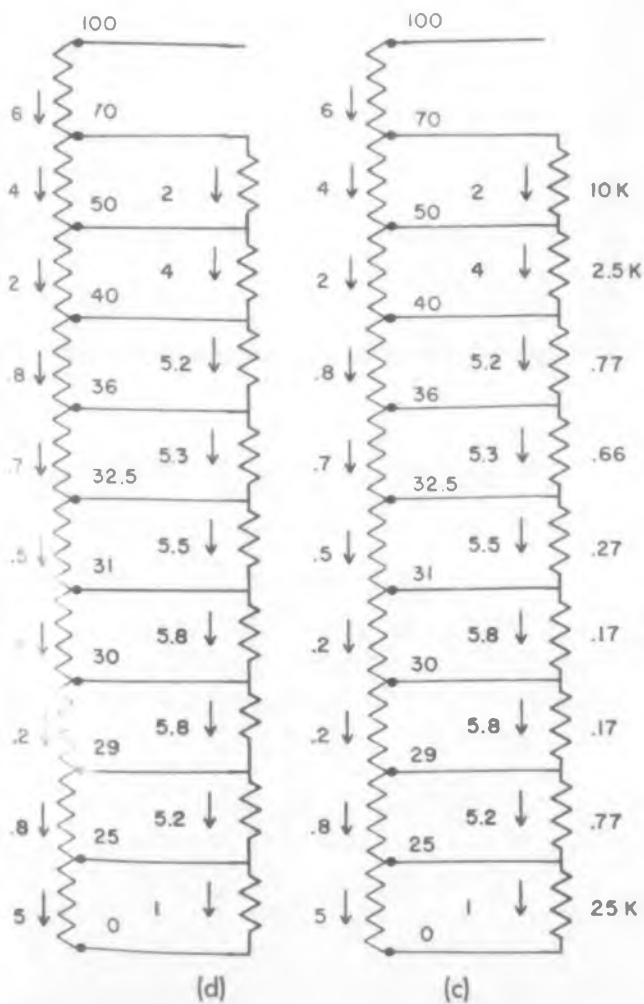




Typical servo showing plug-in padding turrets with adjustable load resistors.

Terminal-to-End Loading

The other common method of loading brings the loading resistor from the tap to either end of the potentiometer in question, or to a point which is connected to the end of the potentiometer through an additional loading resistor. (It is sometimes misleadingly stated that the loading resistor goes from the terminal directly to ± 100 v. To do so would eliminate the possibility of generating $y.f(x)$. The tap should be brought to a point which can then be connected to y ,



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to the ± 100 v supply, or to a resistor leading to the end of the potentiometer).

The calculation for this same function is now as follows:

1. Plot the straight line function approximation.
2. Draw a schematic of the tapped potentiometer. Calculate the currents of each segment as before (Fig. 3a).
3. Consider the segment having the greatest current as the "control" segment and make sure that the maximum current is within the power rating of the potentiometer.
4. Working each way from the control segment to the ends of the potentiometer, consider the tap points and make use of Kirchoff's current law, which states that the net current into or leaving any junction must be zero.

For example, at Junction 9 the voltage is 70 v, and 6 ma flows in from segment 10. Since only 4 ma flows out through segment 9, obviously 2 ma must flow to the ground through a parallel path (Fig. 3b). Since the voltage across this resistor is 70 v and the current through it is 2 ma, the resistance must be 35 k.

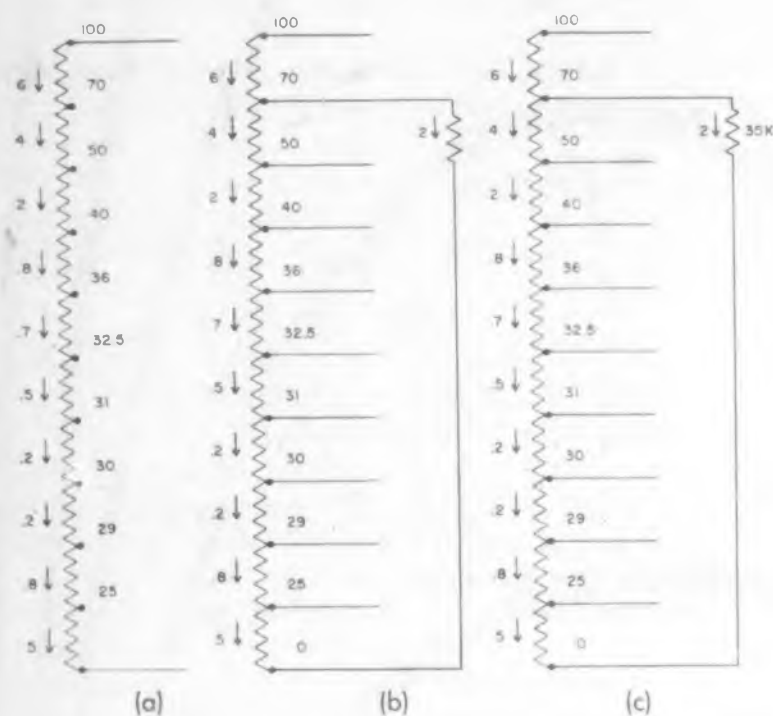


Fig. 3. Schematic of terminal-to-end loading technique.

The calculation proceeds in this manner until Junction 2 (29 v) is reached, at which point additional current must be supplied through a 118 k resistor from the top of the potentiometer (note in this calculation, not the tap potential but $100 - E_{tap}$ must be used). The fully loaded pot is shown in Fig. 3d.

Nonmonotonic Functions

The nonmonotonic function approximated by the straight lines in Fig. 4 is such that no point of the function reaches 100 v, and both ends of the potentiometer are at zero potential.

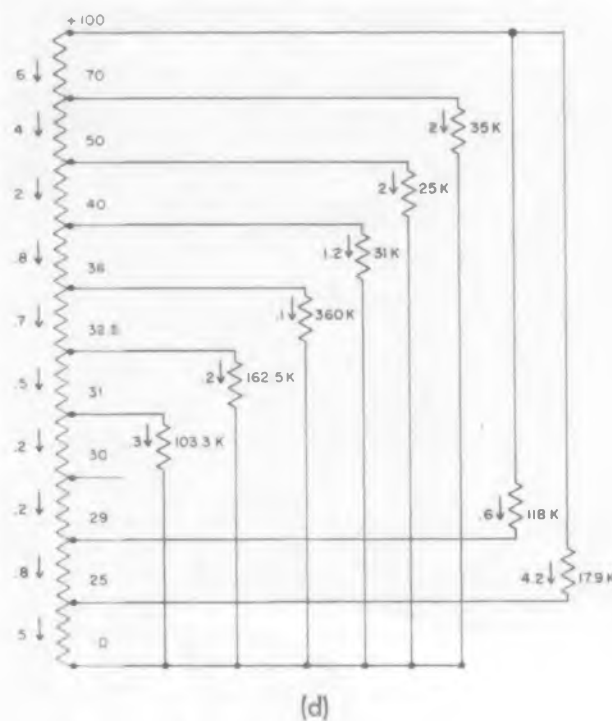
Tap-to-Tap Loading:

Simple tap-to-tap loading is not possible with non-monotonic functions. Currents must be introduced at each maximum or minimum from the ends of the potentiometer to reverse the slope of the curve, although the same general method applies.

1. Calculate the current in each segment, and check to make sure that the safe current rating of the potentiometer is not exceeded.
2. Note the nodal point, where the proper voltage cannot be obtained by simply paralleling a resistor. Obviously current must be introduced into the pot at this nodal point.

Such nodal points divide the potentiometer into groups of segments. If the maximum current required in each group of segments are different, the total currents through segments and padders in each group need only to be as large as the largest current in that group. Each group then has its own "control" segment. This is not applicable to the function shown in Fig. 4, since this particular function is symmetrical.

A straightforward calculation leads easily to the loaded potentiometer of Fig. 5a.



For instance, in the first example tap-to-tap loading requires only 6 ma total from the source while tap-to-end loading requires 10.8 ma. In the second example tap-to-tap loading requires only 12 ma, while tap-to-end loading requires 20 ma. In some instances, particularly with nonmonotonic functions, tap-to-tap loading will require as much current, but will never require more.

This reduced power requirement is not too significant if only $f(x)$ is wanted, since the extra drain on the ± 100 v supply is not great. But if $y.f(x)$ is to be obtained, in conjunction with an amplifier feeding several loads, the extra drain on the y amplifier might be troublesome.

3. The padding resistors for tap-to-tap loading usually have lower values. In the above example tap-to-tap resistances range up to 25 k, while tap-to-end padders have values up to 360 k. Lower values mean better stability for the function, since they permit the use of the more stable wire wound resistors, generally available only in lower resistance values. It also makes possible the use of small wire wound trimmer pots mounted in a turret which may be plugged right into

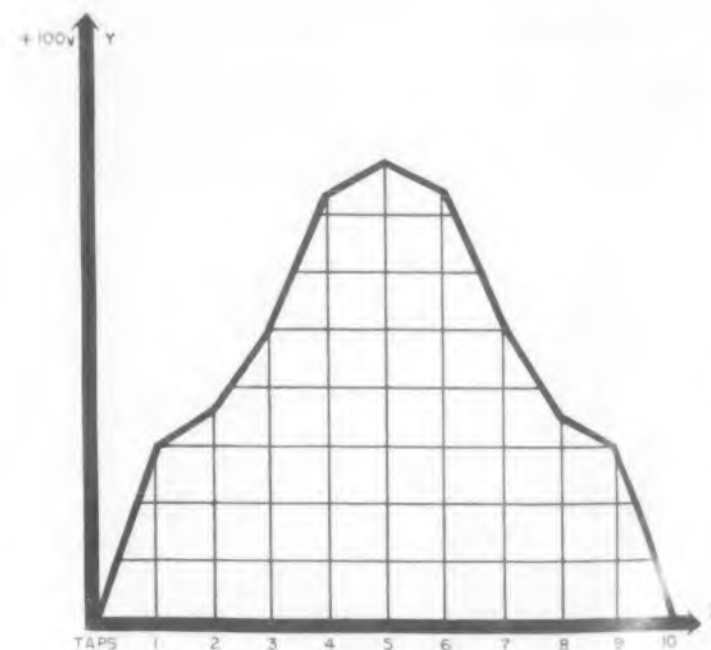


Fig. 4. Symmetrical non-monotonic function.

Tap-to-End Loading:

This calculation proceeds exactly as before and yields the results shown in Fig. 5b.

Comparison of Methods

The tap-to-tap loading method has a number of advantages over tap-to-end loading, and in general is the recommended method:

1. It is more straightforward and the calculations are simpler.
2. It draws less current from the source.

the servo itself for easy changing of functions.

4. There is much less danger of ruining the main servo pot through inadvertent misadjustment. It is common practice to trim the function to exact values or to make minor adjustments while the padders are actually connected to the servo potentiometer. According to the pot loading schematic of Figs. 2 and 3, it is apparent that any one of the padder potentiometers in the tap-to-tap case could inadvertently be moved to any value from zero to infinity without seriously increasing the current through the servo potentiometer.

In the tap-to-end method of Fig. 3 however, where voltages are introduced directly, the situation is different. If one of the padding pots is inadvertently turned down to too low a resistance, the current through any given segment could exceed safe limits.

Padding turrets for those servos which are primarily multiplying servos (or resolver servos) are normally supplied with turrets arranged for padding with fixed resistors. Simple functions can be made up using stock resistors, and functions used repeatedly can be stored to be used as required. If function generation is to be done more frequently, it is convenient to be able to adjust the padding without changing resistors, and

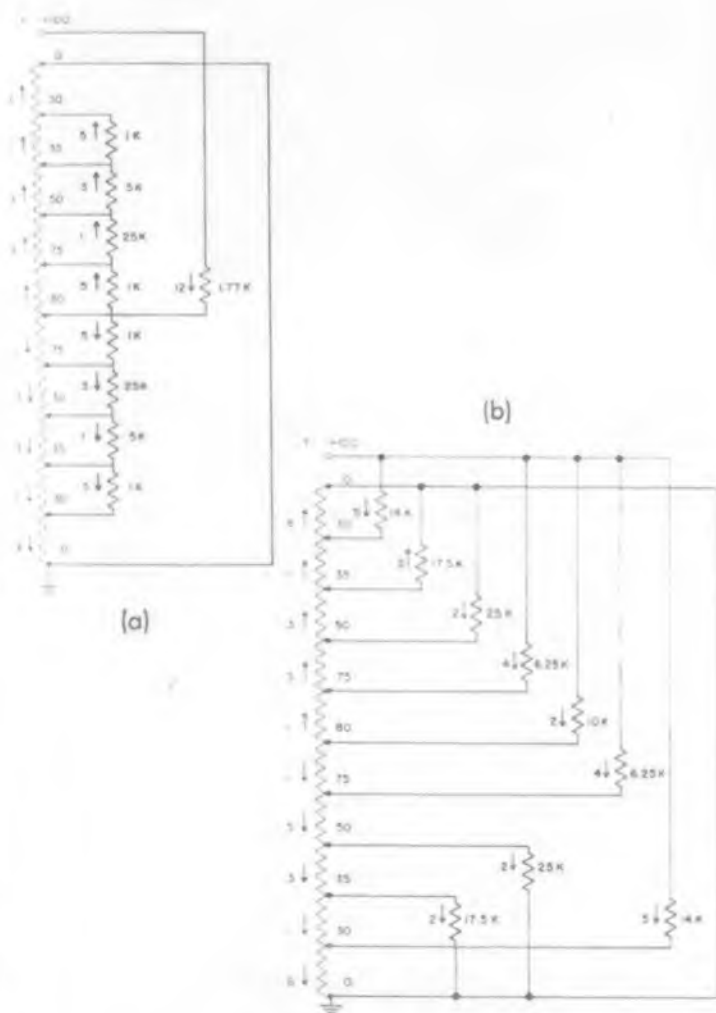


Fig. 5. Tap-to-tap and tap-to-end loading for non-monotonic function.

for this purpose padding turrets with built-in miniature wire-wound potentiometers can be used.

In practice a fixed resistor is supplied in series with each miniature padding pot, equal in value to the padding pot itself. The resistor is then shorted out for covering the lower half of the padding range and left in for the upper half. This arrangement serves the dual purpose of reducing the power dissipation in the padding pot and improving the resolution of adjustment. The padding pots used have approximately the same temperature coefficient as the servo potentiometer itself.

Pot Loading Computer

Although the calculations for the proper value of padding resistors to generate a given function can be made quite simple, in large computer installations, where a great deal of function generation is to be done, a quick mechanical means of arriving at the correct resistance is useful. A pot loading computer is available for this purpose in the "400" series REAC[®] Computer.

The pot loading computer is simply a device for isolating the segment (tap-to-tap loading) or the node (tap-to-end loading) under consideration by making sure that the adjacent ones meet the specified conditions. It is then simple to adjust the padder until the one in question does also.

The pot loading turret is plugged directly into the front of the pot loading computer. The voltage at each of the nodes in the final function is then set up on a series of 21 ordinary scale factor potentiometers on the pot loading computer. The internal switching then isolates the segments (or nodes) one by one, and the padder is adjusted until a null is reached with the desired function, previously set up. Loading is normally done against a precision resistor string in the pot loading computer itself, so as not to waste analog computer time. Padding may also be done against the actual servo cup by means of an extension cable which leads from the pot loading computer and plugs right into the turret receptacle in the front of the servo itself.

Accuracy

It should be noted that all of the preceding calculations have ignored the effect of the load on the potentiometer. For the usual function generation this omission is justifiable. For a 50K pot operating into a 1 meg load, for example, even if no padding resistors are used, the error will only be 0.6 per cent from true value, and any padding resistors used will tend to reduce the total pot resistance, and hence the effect of loading. In general this error will be lower than those inherent in the straight-line approximation to the function. In any event, if this error is a problem, it can be removed by the use of a standard unloading circuit.

The taps on some one-turn potentiometers may also vary by as much as 0.5 per cent from the theoretical value. A first order correction can be made to this error by calculating the padding resistance first from the theoretical tap resistance and then multiplying each padder by the ratio of the actual resistance measured between taps to the theoretical value. This correction will also take care of variations in the total pot resistance.

The accuracy of the calculation will also be affected by the original linearity of the potentiometer being used. This can be corrected to almost any desired value within the limits of the resolution by permanent connection of trimming resistors between taps on the pot itself.



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UTILIZING a balun type feed, this coaxial hybrid ring achieves broadband operation and excellent isolation and balance characteristics. Isolation and balance are obtained in a size more compact than possible with waveguide techniques. The bandwidth of this unit is much broader than is presently achieved in comparable-sized conventional coaxial hybrid rings.

The broadband unit is ideally suited for ECM received mixers. The device, developed by Bogart Manufacturing Corp., 315 Seigel St., Brooklyn, N.Y., might find use in any system where balanced mixer operation is desirable. It can be used as a power divider; for example, feeding two antennas from a single transmitter. Conversely, a single load can be fed from two transmitters. Small size and weight suggest that this unit be considered for guided missile applications, in particular, where space is a problem.

The "series-shunt" fed coaxial hybrid differs from the conventional coaxial hybrid in the positioning and feed of arm 4. In a conventional hybrid all are are shunt fed. By moving arm 4 $\lambda/4$ at the design frequency, and changing it to a series feed the hybrid action is maintained, although arm 4 will no longer be matched to the same Z_0 . The series feed is achieved by lifting the outer conductor of the coaxial line above ground by means of a balun. The unit illustrated has a type N connector, but in special applications other types of connectors could be used.

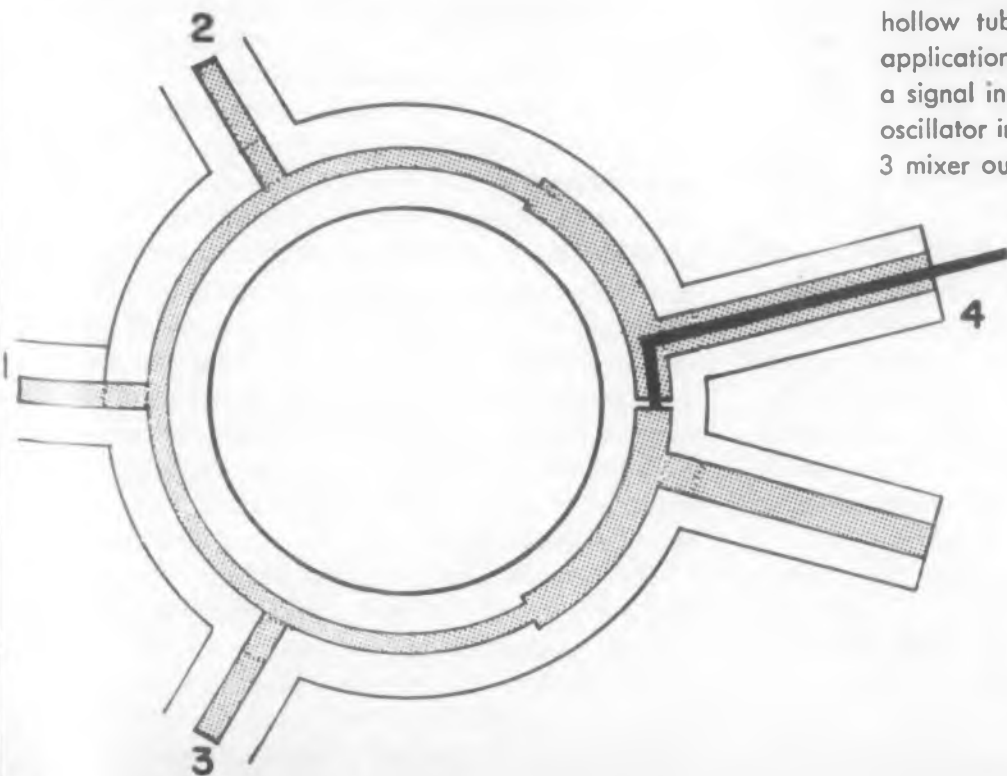
Model NS 5802 for the S band has been designed to operate over a 50 per cent bandwidth centered about 3000 mc. Variations of this design are being

Compact Broadband Coaxial Hybrid Ring

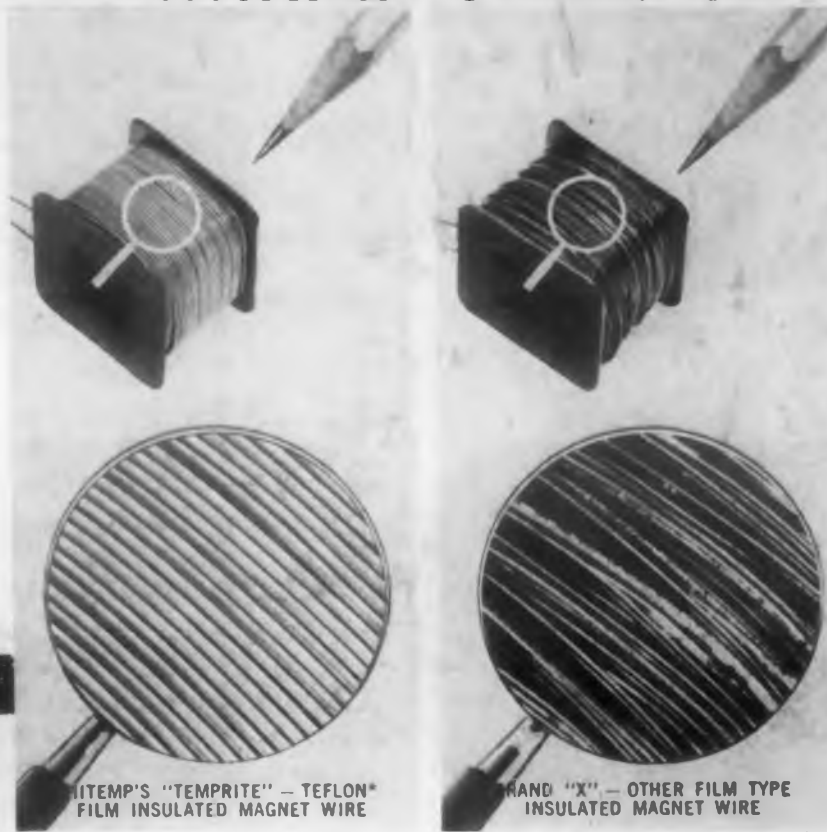
developed for other frequency bands. The frequency range of NS 5802 is 2250-3750 mc.* Average power rating of arm 1 is 200 w; arm 4, 30 w. The VSWR looking into either arm 1 or 4 does not exceed 2.9. Isolation between arms 1 and 4 is greater than 30 db over the entire band. The degree of unbalance between arms 2 and 3, when power is fed into either arm 1 or 4, does not exceed 0.4 db. The unit, made of aluminum, weighs approximately 14 oz.

For more information on these coaxial hybrid rings turn to the Reader's Service Card and circle 31.

Schematic of coaxial hybrid ring with balun feed, arm 4. The conducting ring is a hollow tube. In a typical application, arm 1 could be a signal input; arm 4, local oscillator input; arms 2 and 3 mixer outputs.



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before exposure

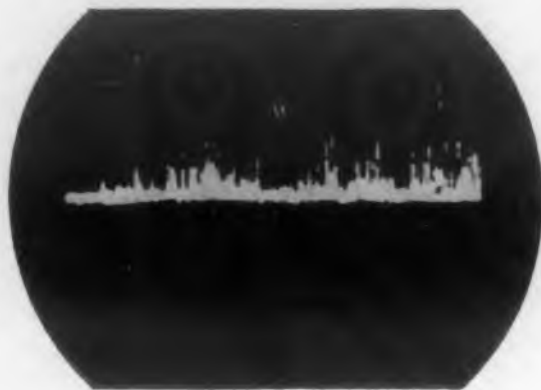


after exposure

Typical noble metal alloy



before exposure



after exposure

Typical nickel base alloy

Comparative noise patterns of potentiometers wound with noble metal alloys, *a*, and with nickel base alloys *b*, before and after a 6-hr exposure to humidified air containing a trace of ozone.

Noble Metal Wire for Precision Potentiometers

Adolph Cohn, President

Sigmund Cohn Corporation
Mount Vernon, N.Y.

RECENT developments in the wire industry make it possible for both the potentiometer designer and the equipment designer, who evaluates and selects potentiometers, to achieve performance not before possible.

The introduction of new noble metal alloys permits construction of potentiometers of very low noise level. This low level is maintained during long periods of inactivity of the potentiometer under severe environmental conditions. Noble metal windings require only light wiper pressure so that potentiometers can be constructed which require very small force to operate them.

Improvements in wire drawing and enameling methods enable the manufacturer to produce potentiometers of better linearity, life and resolution. It is now possible for him to obtain wire held to close and difficult specifications, so that he in turn may improve his own product along the lines suggested below. Characteristics of noble metals and their influence on potentiometer performance are covered in this article.

General Characteristics of Noble Metals

A noble or precious metal or alloy is one which is stable and very inactive chemically even at elevated temperatures. It is therefore not subject to atmos-

pheric corrosion after prolonged exposures to extreme conditions and the contact area retains its initial characteristics over very long periods of time. Platinum and gold are typical noble metals.

Since precious metal windings are and remain free from oxides (and other chemical compounds) on the contact surface, the contact resistance retains its original low value, permitting the use of considerably lighter wiper or contact pressure than with metals which later form surface films of insulating oxides. It is this contact resistance which produces noise of the type discussed below.

With the precious metals it is not necessary to have sufficient contact pressure to break through such a layer. This low wiper pressure which is characteristic of noble metal potentiometers is a particular advantage in the design of instruments where only small forces are available for moving the brush. Instruments such as pressure transducers, gyros and accelerometers as well as others come within this classification.

Lighter contact pressures usually prolong the useful life of a potentiometer. On tests run by ourselves as well as by many manufacturers and users of potentiometers, life of twenty million or more cycles is not uncommon. In addition, since wear is held to a minimum, the initial high linearity can be maintained

within closer limits for longer periods of time.

A further advantage of a noble metal winding is the ability of the potentiometer to withstand very high temperature. There is evidence that the useful life of a potentiometer with such a winding is not adversely affected by elevated temperature as would be the case with base metal windings.

Recent trends in potentiometer design have been towards miniaturization, higher resolution and sometimes higher total resistance values. This necessitates the use of smaller wires, in some cases as small as 0.0004". Wires of these small diameters require high tensile strength to prevent breaking in winding. In the present state of the art, the combination of high tensile strength (200,000 to 300,000 psi) combined with relatively low temperature coefficient of resistance, can be obtained with platinum alloys and with gold alloys of high precious metal content. The great hardness of these high tensile strength alloys assures excellent wear resistance.

Most precious metal alloys suitable for potentiometer windings are of lower resistivity than the usual chromium nickel alloys permitting the use of smaller wire diameters for comparable resistance. Therefore for any given resistance value of the winding, there is a considerable gain in resolution as a greater num-

ber of turns of the smaller wire will be required per unit length of the winding. Resolution is still further improved by the use of ultra thin enamel which is described below. As a general rule, noble metal alloy windings with proper contact materials make more nearly noise-free potentiometers than chrome nickel base alloys.

Noise and Corrosion Resistance

For many applications, it is important that a potentiometer retain its noise-free characteristics during long periods of inactivity. This requirement can be met by noble metal windings.

Accelerated tests were run in this company's laboratory to determine the relative noise level of potentiometers wound with noble metals and chrome nickel alloys before and after periods of inactivity. Two typical noble metal alloys were investigated (Sigmund Cohn No. 479 Platinum alloy and L.T.C. alloy, the newest member of the company's noble metal alloy family) and also typical chrome nickel alloys. Mandrels were wound with enameled wire of the alloy to be tested in the form of enameled wire 0.001 in. diam. The mandrel was Formvar covered copper wire 0.080 in. diam. One inch of winding was swept using a heat treated Paliney 7 contact, manufactured by the J. M. New Company in Hartford, Connecticut, 0.015 in. diameter, at a 5 gram pressure. Noise measurements were made using the conventional circuit in the oscilloscope, (as described in N.A.S.-710 of the National Aircraft Standards Committee) and a constant current source of 1 ma.

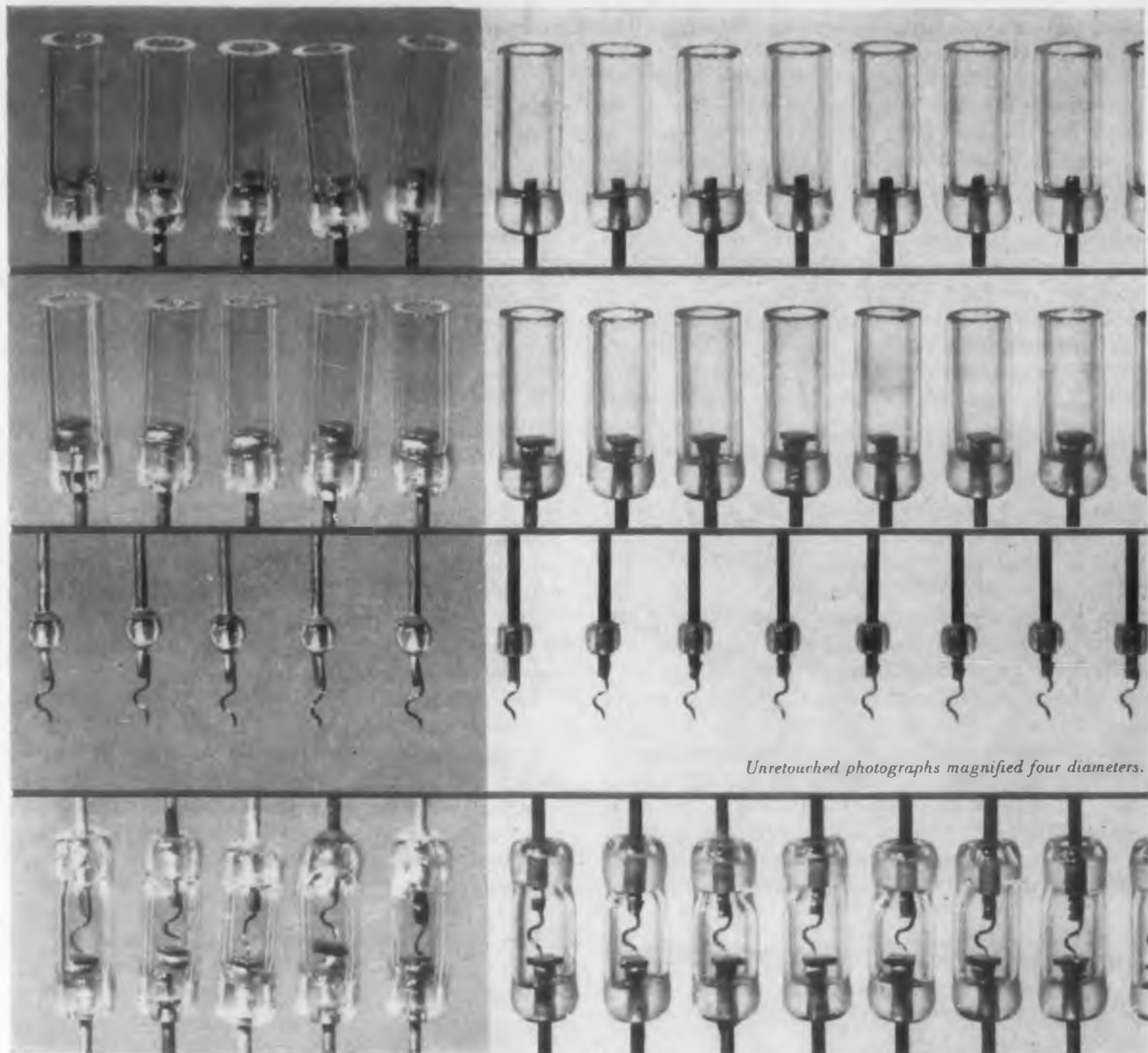
The specimens were carefully polished and mounted in the test fixture. A noise level of substantially zero was noted in this initial condition for each specimen. Observation and photographs were made using an oscilloscope.

The potentiometers were then exposed for six hours to a moist atmosphere containing a trace of ozone, during which time the wipers were motionless. After this exposure, the potentiometers were again put into motion, and their noise level observed and photographed. No change occurred in the potentiometers with the 479 Platinum alloy or the L.T.C. alloy, but a noticeable change (more than 500 ohms equivalent noise resistance) occurred with the base metal chrome nickel alloy. In the photographs reproduced below, the vertical scale is 1 in. = 1,000 ohms equivalent noise resistance.

After 50 or 100 sweeps the noise of the potentiometer with the chrome nickel winding greatly diminished, and ultimately reached a minimum. The number of sweeps required to clear up the noise is dependent upon the exposure, longer periods of inactivity will result in longer periods of noisy operation.

Linearity

The potentiometer manufacturer is to a large extent dependent upon the linearity of the wire he purchases,



Unretouched photographs magnified four diameters.

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for the linearity of the potentiometer he can produce with it. Although non-linearity of the wire can be compensated for during potentiometer manufacture, such compensation is not necessarily perfect. The more nearly linear the wire, the better in this respect.

It is highly desirable that the electrical and physical characteristics of a wire remain as constant as possible throughout its length. However, minor and gradual changes continuing uniformly throughout the length are not as objectionable as abrupt random variations occurring within short lengths. A wire of good linearity is one in which these variations are held to a minimum.

The manufacturer of the wire is aware that its linearity is dependent upon two basic requirements. The first requirement is homogeneity of the ingot as originally cast. It must be quite free from segregation. Ingots which are allowed to solidify over a longer period of time, generally speaking, exhibit more segregation than ingots which have solidified more rapidly. In other words, larger melts mean slower cooling and greater segregation. The use of a pure metal, as opposed to an alloy, would overcome this difficulty but unfortunately, no pure metal is known to make a truly satisfactory potentiometer winding. Hence an alloy must be used and the problem of segregation is always present to a greater or lesser extent.

The second general requirement for high linearity in wire (even though the ingot itself be almost completely free from segregation) is good drawing techniques. The diamond dies must be constantly maintained at maximum efficiency by polishing them to the highest finish, correct entrance angle and bearing and

correct "draft" with respect to the preceding die. As the wire approaches the final size the last several drafts are made "single pass." In this way the wire does not come into contact with revolving drums or capstan and passes directly from one spool to another thereby avoiding a possible source of surface scoring or "galling."

Roundness, Smoothness, and Straightness of Wire

The life, noise level and linearity of a potentiometer are often governed by the physical condition of the wire used in the winding. The wire requirements of the potentiometer manufacturer are considerably more severe than wire requirements for most other purposes.

The term "roundness" is intended to cover not only a circular cross section, but also lack of surface irregularities such as longitudinal scratches which may result in a noisy potentiometer, as well as poor life. It is very desirable in the winding of potentiometers to have a wire with as nearly as possible a perfectly round cross section. This ideal condition can very closely be approximated by the selection and care of the diamond wire drawing dies, and by careful wire drawing techniques.

The diamonds used for drawing dies are never as perfect as might be desired. Nonuniformity of hardness or unsuspected flaws in the stone may result in uneven wear and therefore out-of-roundness or scratches on the wire the die produces. These defects may be of a very minor nature; however, with constant vigilance on the part of the operator during the drawing operation, they may be detected. At the first

sign of out-of-roundness the die must be repolished or discarded.

The detection of out-of-roundness in a wire is much simpler than measuring the magnitude of such out-of-roundness. Visual inspection by an experienced operator is usually the most sensitive and most dependable method. A wire with sufficient out-of-roundness to be detected with ordinary measuring methods would be wholly unsuited for the manufacture of even semi-precision potentiometers. Optical methods have proven too cumbersome to be of practical usefulness.

Although out-of-roundness does not necessarily destroy the linearity of a wire, a potentiometer wound with such out-of-round wire will probably be less linear than one wound with a more nearly round wire. This is because the wire cannot be made to properly "lay" on a mandrel or card and usually results in uneven spacing of the turns. Occasional "high" wires may also result. When used in applications involving rapid wiper travel this may cause the wiper momentarily to break contact with the winding.

Although not related to the matter of roundness of wire, spaced turns are also produced by wire which exhibits a longitudinal twist. A twist of this kind is very difficult to detect, and even though present to a marked degree may not be evident except by the effect it produces on the winding. It may be introduced at various stages of the drawing process and care must be taken to avoid it.

Straightness of wire is very important and desirable. An excessively curly and wavy wire can create winding difficulties resulting in spaced turns, high wires and other defects that may be at once apparent or develop in the form of short life.

Enamel

The function of an enamel when used on a wire for winding potentiometers differs in many respects from that of wires used for fixed resistors. A wire quite suited for winding fixed resistors might be unsuited for winding precision potentiometers, and vice versa. The dielectric requirements of potentiometer wire are usually lower than for most other wire, but uniformity and thinness are of utmost importance in the manufacture of potentiometers.

When ordering wire, potentiometer manufacturers may now specify not only the kind of enamel the wire manufacturer must use, but also its thickness which may be far less than that formerly available. It is customary to specify an enamel thickness which results in an increase of diameter of the wire of 10% on wires of 0.0015 in. and smaller. However diameter increases of as little as 5% can be specified. The recent trend has been in the direction of thinner enamel for reasons mentioned below.

The method of applying the enamel for potentiometer purposes, consists of applying many extremely thin coats by free dip methods. When required, each individual coating may have a thickness of only about 0.000001 in. and many individual coats are usually

Characteristics and Specifications of Three Precious Metal Alloys Customarily Used in Potentiometer Winding

	479*	851	L.T.C.**
Resistivity $\pm 5\%$	400 Ω /cmf	180 Ω /cmf	550 Ω /cmf
Temperature Coefficient of Resistance (Nominal) (0 to 100°C.)	240 p.p.m.	600 p.p.m.	20 p.p.m.
Tensile Strength	300,000 psi	300,000 psi	200,000 psi
Composition (Nominal)	Pt 92% W 8%	Pt 79% Ru 6% Rh 15%	65% noble metal

Type designations refer to Sigmund Cohn Corp.

* Patented for use as a potentiometer winding

** Patent applied for

applied. Each coat is baked before the succeeding one is applied.

The above method results in an extremely smooth and uniform enamel coating, free from beads or other irregularities. Bare wire which is of high quality, as far as linearity and roundness is concerned, when enameled by this method, may be "close" wound or "but" wound producing potentiometers of surprisingly high linearity. The good linearity of such a winding depends to a very large extent on the uniformity of the enamel.

A thermo-setting resin has been found very satisfactory as the enamel. Sigmund Cohn Corp. generally uses a Class A enamel which although officially rated at 105 C. maximum, nevertheless for potentiometer purposes is frequently used successfully for temperatures up to about 150 C. With recent interest in potentiometers for operation at considerably higher temperatures, Class B enamel is now also available. This can also be used successfully for potentiometers at temperatures in excess of the official rating.

In addition to producing a more uniform and linear winding, thin enamel has two other important advantages. First, since more turns may be wound per unit length better resolution is possible. This may necessitate the use of a smaller mandrel or card if the same total resistance value is required, but this usually is no disadvantage and may be an advantage. Secondly, a thinner enamel coating may more easily be removed from the contact area of the winding than the conventional thicker enamel. It has been found for example that this thin type of enamel may quickly and conveniently be removed by buffing with a slurry of bicarbonate of soda and water. Details of this process will be supplied upon request.

If desired after all enamel on the contact area has been removed with bicarbonate of soda the winding itself may be lightly buffed by conventional methods. This final burnishing or polishing of the metal surface is considered by some to result in less noise and longer life.

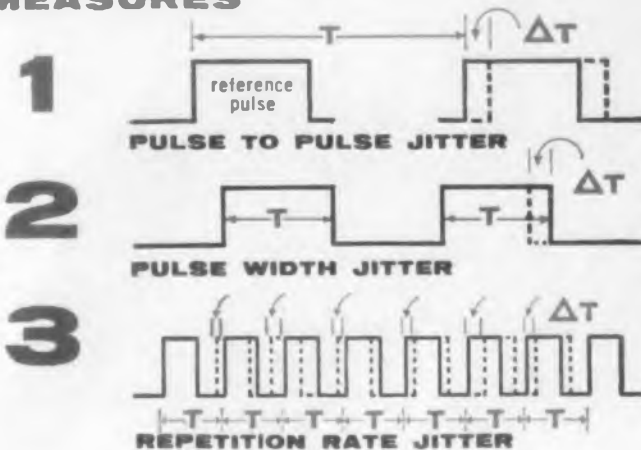
The manufacturer of potentiometers is not limited to "stock sizes" as far as precious metal wire is concerned. Since this wire is drawn to order, he has unlimited choice in the selection of resistance values. These values are normally held to a tolerance of plus or minus 3%; where requested to a tolerance of plus or minus 1%. In addition, if enameled wire is required, he should indicate what kind and thickness of enamel best suits his design.

Conclusion

In potentiometers of low noise levels, where long shelf life and light wiper pressures are involved, the use of a noble metal winding is indicated. These modern precision potentiometers require wire of the utmost roundness and linearity. When enameled wire is used for the winding, the enamel must be thin, smooth and uniform to a degree not normally required in most resistance wires.

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MEASURES



DISPLAYS

- JITTER MAGNITUDE
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A new Polarad instrument to show the magnitude and waveform of jitter modulation in rate generators, pulse width modulators encoding devices, precision time generators.

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- 2. pulse width jitter.** The leading and trailing edges of a pulse gate the 5 mc oscillators and are compared.
- 3. repetition rate jitter.** The leading edge of the pulse gates a 5 mc oscillator which is compared with a stable 5 mc crystal controlled oscillator in a phase detector. The output of the phase detector is divided by a calibrated attenuator in factors of ten and two and displayed on a CRT.
- 4. waveform of jitter.** Obtained by rectifying the output of the phase detector.



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- Power frequency range from 50 to 420 cps.
- Provision for measurement of jitter frequency by Lissajous figures.



MODEL PJ-1

SPECIFICATIONS

Input Requirements:

Pulse Width	0.2 to 10.0 microseconds.
Repetition Rate	50 to 6,000 pps.
Amplitude	5 to 50 volts, peak-to-peak.
Polarity	Positive or negative.
Input Impedance	82,000 ohms shunted by 25 micromicrofarads.
Measuring Level	50% point of input pulse, nominal.

Jitter Measurements:

Repetition Rate Jitter	5, 10, 100 millimicroseconds and 1, 10, 100 microseconds full scale.
Width or Relative Jitter	5, 10, 100 millimicroseconds full scale.
Residual Jitter	Less than 0.5 millimicroseconds on 5, 10, and 100 millimicrosecond ranges.
Useable Horizontal Frequency Range	15 cycles to 25 kc.
Power Input	115 v \pm 10%, 50 to 420 cps, 400 watts.
Dimensions	19 wide by 17½ high by 12 inches deep.
Weight	60 lbs.
Outputs Provided For	(1) External oscilloscope; (2) Recorder (\pm 5 ma. into 1,000 ohms) for disturbance frequency.

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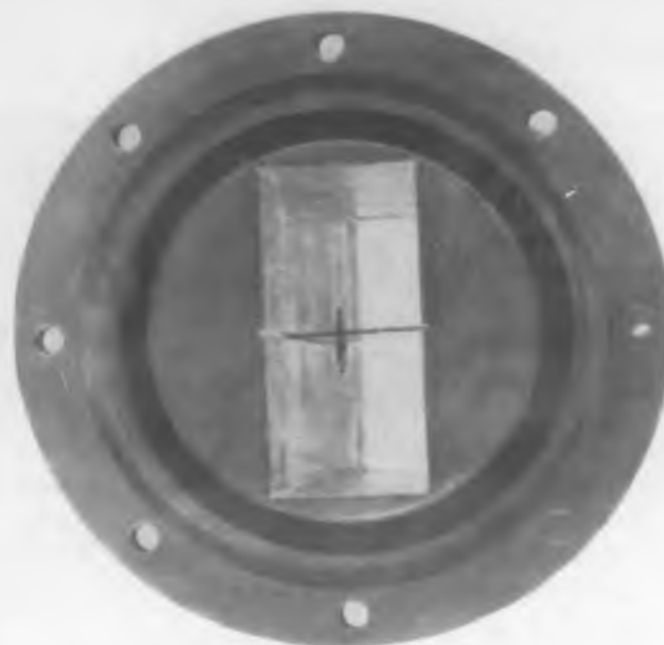
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- P-3 Platings & Plated-Thru Holes
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CIRCLE 35 ON READER-SERVICE CARD FOR MORE INFORMATION

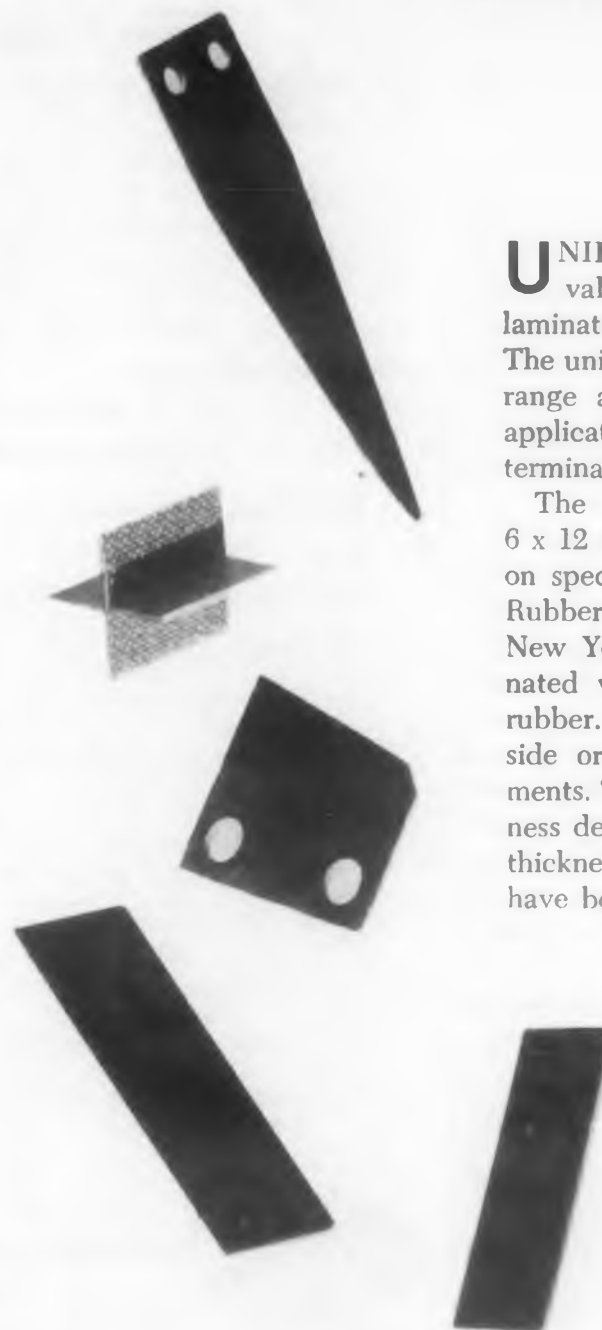


Waveguide fitted with attenuator made from conductive rubber laminate.

Conductive Rubber

UNIFORM area resistance in a wide range of values results from a unique process of plastic laminating involving the use of conductive rubber. The uniformity of resistance over a wide frequency range at microwave frequencies has resulted in applications for the "Cards" as attenuation and termination devices.

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Typical configurations of resistance cards consisting of fiberglass laminates impregnated with phenolic resin containing conductive rubber.

Resistance Cards

700 ohms per square ± 15 per cent have been supplied. Other resistances can be provided upon order. Dimensional stability of the cards is excellent, and warp in width and length does not exceed 0.250 in. per foot. Aluminum foil terminal strips can be furnished, bonded to the cards for test purposes or for making connections.

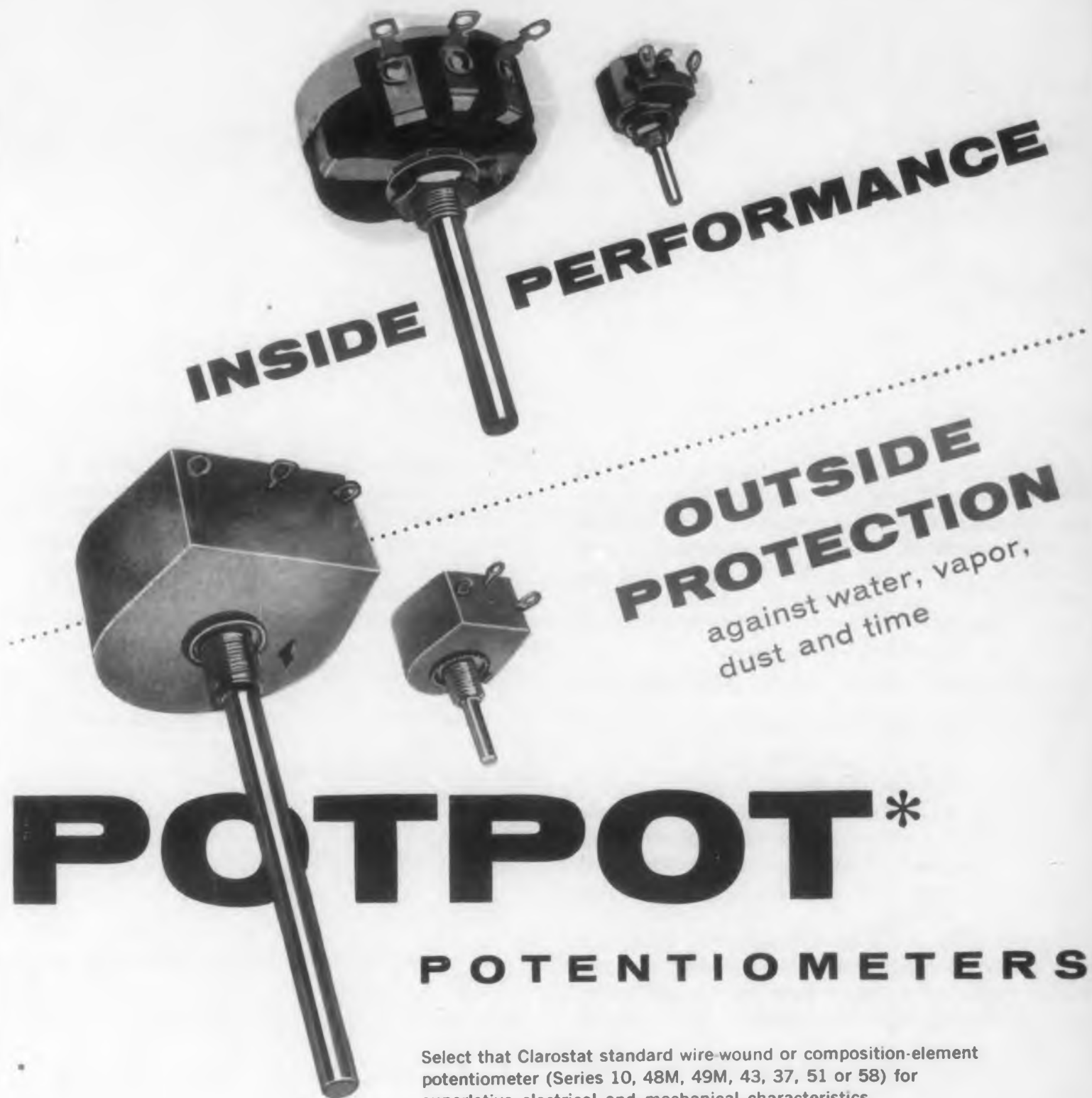
Applications

Known as *US-KON HGP-4*, this material has been successfully used throughout the microwave frequency spectrum for applications requiring power dissipation, predetermined loss or attenuation, protection of crystals or other sensitive devices, isolation, or impedance matching. The chief uses have been as microwave terminations and attenuators. It has also been used as a radiation absorber to suppress unwanted vertically polarized electromagnetic waves.

How Used

For use in attenuating power in waveguides, the Resistance Card is placed in the center of the waveguide, aligned in the direction of the electric field. Generally, a symmetrical V or a taper is cut into one end or both ends of the rectangular strip of material to reduce the voltage-standing-wave-ratio. Under such conditions loads and attenuators can be built with VSWR under 1.01. The value of attenuation can be fixed by varying the resistivity of the conducting material.

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CLAROSTAT MFG. CO., INC., DOVER, NEW HAMPSHIRE
A Division of General Motors Corp., 1957, Patent 17, 000

CIRCLE 37 ON READER-SERVICE CARD FOR MORE INFORMATION

Silicon Diode Application Notes

Arnold Bergson

Raytheon Manufacturing Co.

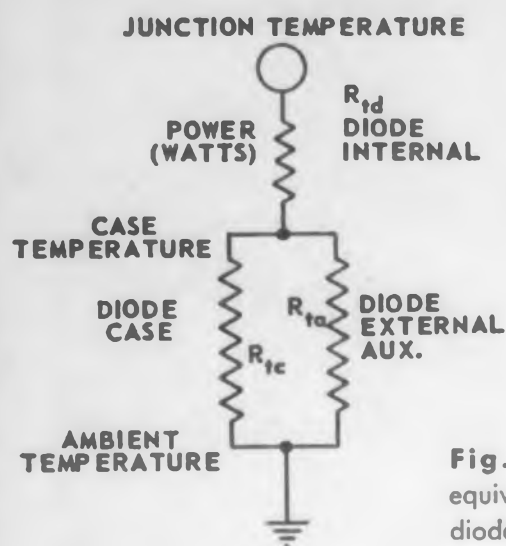


Fig. 1. Electrical equivalent (approx.) of diode thermal circuit.

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

Forward Power Dissipation

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

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

where, P_{fd} = forward power dissipation

E_o = approximate diode threshold voltage

K_f = theoretical forward current form factor

R_d = diode dynamic forward resistance

$I_a = 0.45 E_s / R_L$ avg amperes (E_s = sinusoidal rms supply voltage; R_L = load resistance)

Eq. 1 is quite useful for approximating diode forward power dissipation for various standard star and bridge configurations. The form factors and other characteristics of these combinations are shown in the table.

As an example, a single-phase, half-wave circuit has resistance load, R_L , and an ac supply voltage, E_s (such that $E_s \gg E_o$, and $R_L \gg R_d$). Using the specification limiting CK775 diode, $E_o = 1.0$ v, and the resistance $R_d = 0.1$ ohm. From equation (1), calculate the forward power dissipation (P_{fd}) for an average forward current of 5 amp:

The form factor (K_f) for the 111H circuit is 1.57, and K_f^2 is 2.46. $P_{fd} = 5 \times 1 + 2.46 \times 5^2 \times 0.1 = 11.2$ w

Using the same diode as part of a three-phase, half-wave circuit (311Y), carrying 15 amp total output current, the average current per diode would be 5 amp. K_f for this circuit is 1.76 and K_f^2 is 3.1 $P_{fd} = 12.3$ w per diode.

The polyphase calculation above is based on equal load distribution through the diodes. In similar applications where diodes are not properly matched, single

diode dissipation can be appreciably higher with noticeable increase in load ripple and commutation effects. Forward characteristics can be matched to within ± 10 per cent forward current at a given forward voltage to insure good load division for poly-phase and paralleling circuits. Magnetic amplifier units may require some matching in both forward and reverse characteristics, since circulating components of current in either direction cause loss of gain.

In some cases, maximum allowable P_{fd} watts are known, and it is required to compute average current (I_a) per diode, or load current for a given configuration, from diode characteristics E_o and R_d . For this case, equation (1) can be solved as a quadratic:

$$I_a = \frac{-E_o + \sqrt{E_o^2 + 4K_f^2 R_d P_{fd}}}{2 K_f^2 R_d} \text{ average amperes} \quad (2)$$

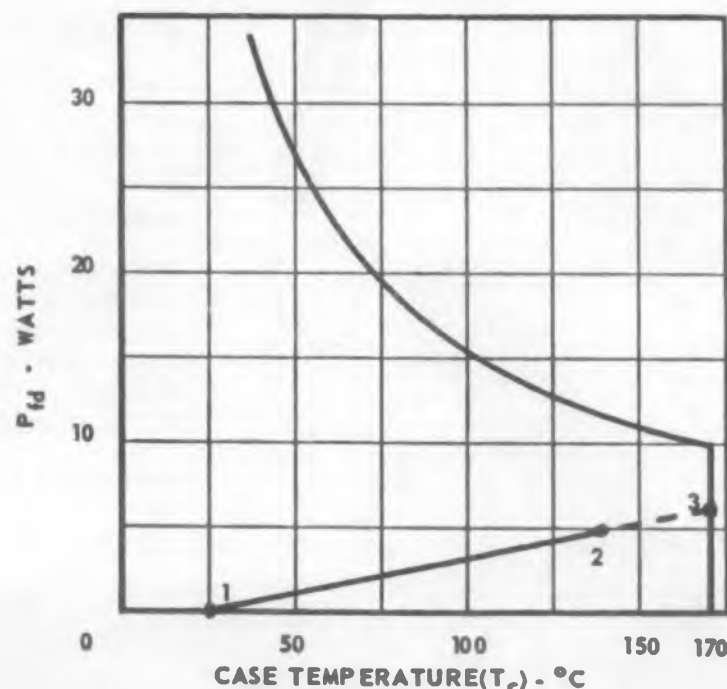


Fig. 2. Limiting relationship between junction power and case temperature. See text for design example.

Thermal Characteristics

Test results on a large number of diodes indicate a reliability requirement for limiting diode power dissipation, P_{fd} , as a function of junction temperature. Junction testing, however, has proven complex, requiring special calibration and interpretation of data, so as to make this method impractical for field use. An approximate electrical circuit to the "thermal circuit" of the diode is shown in Fig. 1. The analogy is based on electrical parameters of voltage, current and resistance; and thermal parameters of ambient temperature, power and temperature per watt. The relationship of these parameters is:

$$T_j = \frac{P_{fd} (R_{td} + R_{tc} + R_{ta})}{R_{tc} R_{ta}} + T_a \text{ deg C} \quad (3)$$

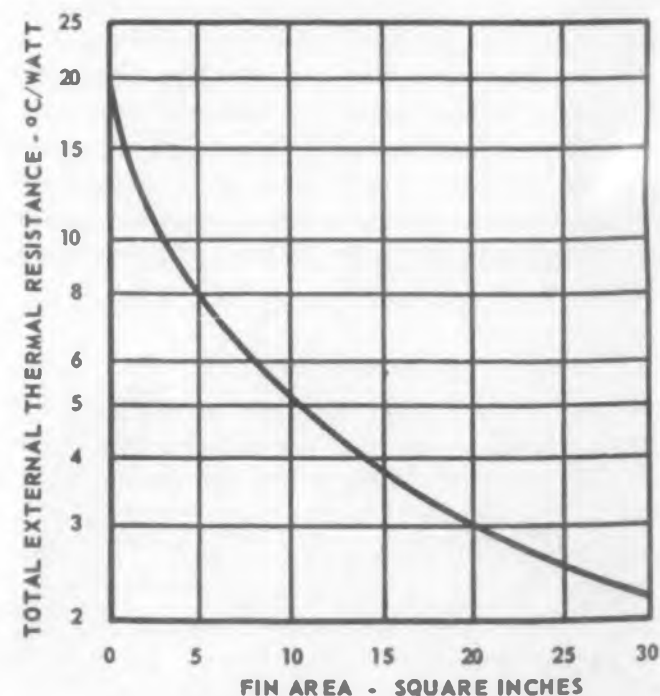


Fig. 3. External thermal resistance vs fin area for free convection cooling in typical diode application.

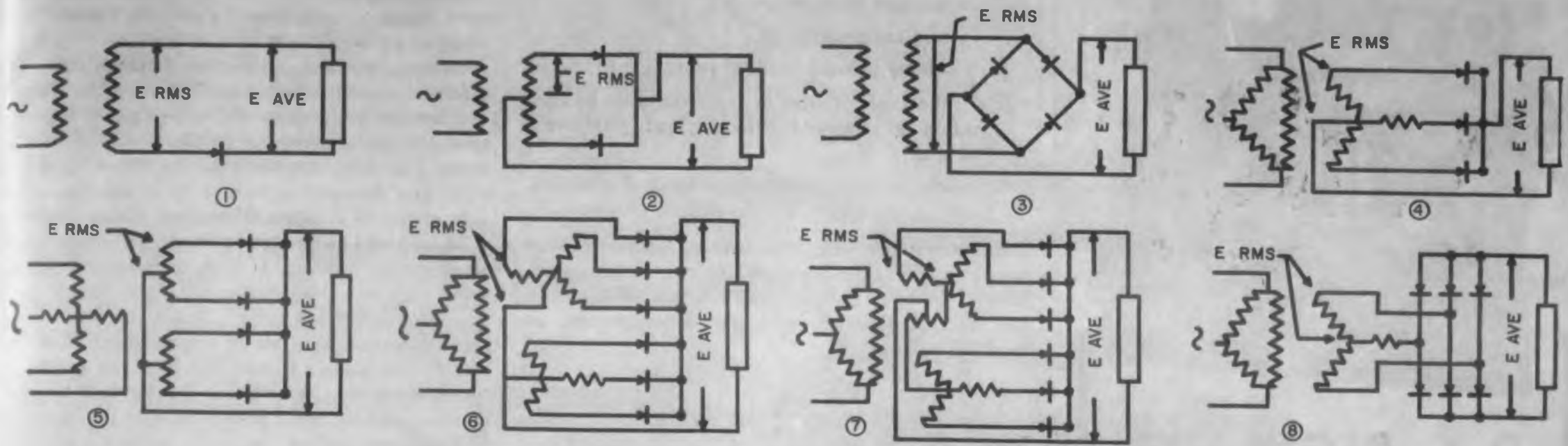
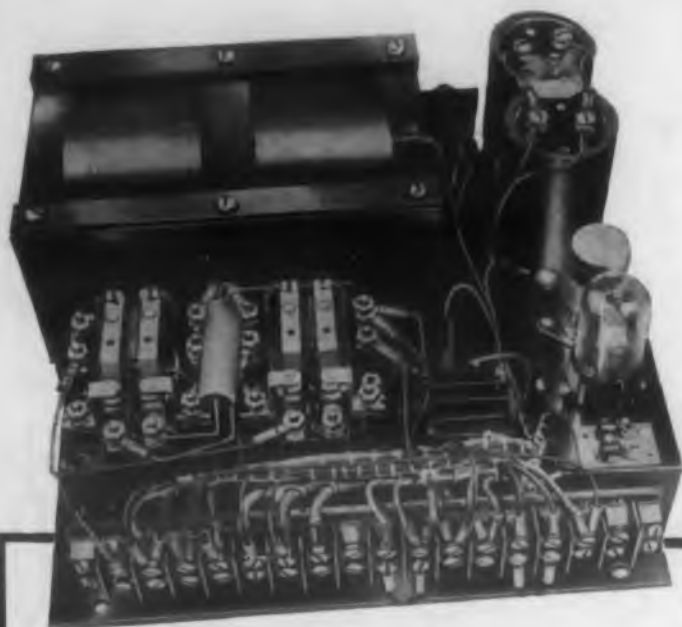


Table of characteristics for fundamental rectifier circuits with resistance loads.

Symbol	Circuit	Output Wave Values					Rectifier Cell Wave Values					Trans. Cap.	
		Wave Form	E (avg)	E (ac)	Form Fact.	dc Ripple %	Wave Form	I (avg)	I (ac)	Form Fact.	E (inverse)	Pri.	Sec.
1-1-1-H	1		0.45 E_{rms}	0.707 E_{rms}	1.57	121		1.00 I_{dc}	1.57 I_{dc}	1.57	1.414 E_{rms}	3.49 EI_{dc}	3.49 EI_{dc}
2-1-1-C	2		0.90 E_{rms}	1.0 E_{rms}	1.11	48		0.500 I_{dc}	0.786 I_{dc}	1.57	2.828 E_{rms}	1.235 EI_{dc}	1.75 EI_{dc}
4-1-1-B	3		0.90 E_{rms}	1.0 E_{rms}	1.11	48		0.500 I_{dc}	0.786 I_{dc}	1.57	1.414 E_{rms}	1.235 EI_{dc}	1.235 EI_{dc}
3-1-1-Y	4		1.17 E_{rms}	1.19 E_{rms}	1.02	18		0.333 I_{dc}	0.587 I_{dc}	1.76	2.45 E_{rms}	1.51 EI_{dc}	1.51 EI_{dc}
4-1-1-C	5		1.27 E_{rms}	1.28 E_{rms}	1.005	11		0.250 I_{dc}	0.502 I_{dc}	2.01	2.828 E_{rms}	1.12 EI_{dc}	1.58 EI_{dc}
6-1-1-S	6		1.35 E_{rms}	1.35 E_{rms}	1.001	4		0.167 I_{dc}	0.408 I_{dc}	2.45	2.828 E_{rms}	1.28 EI_{dc}	1.81 EI_{dc}
6-1-1-Y	7		1.17 E_{rms}	1.17 E_{rms}	1.001	4		0.167 I_{dc}	0.293 I_{dc}	1.76	2.45 E_{rms}	1.07 EI_{dc}	1.51 EI_{dc}
6-1-1-B	8		1.34 E_{rms}	1.34 E_{rms}	1.001	4		0.333 I_{dc}	0.579 I_{dc}	1.74	2.45 E_{rms}	1.05 EI_{dc}	1.05 EI_{dc}



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where,

T_j = junction temperature ($^{\circ}\text{C}$)

T_c = case temperature ($^{\circ}\text{C}$)

R_{td} = diode internal thermal resistance ($^{\circ}\text{C}/\text{watt}$)

R_{tc} = the diode external thermal resistance by convection to air, and through lead conduction ($^{\circ}\text{C}/\text{watt}$)

R_{ta} = the auxiliary thermal resistance due to fins, blast air, liquid cooling, or altitude ($^{\circ}\text{C}/\text{watt}$)

Due to the difficulties in measuring junction parameters, Eq. 3 can be converted to case temperature, thereby eliminating the need for junction temperature, and internal thermal resistance measurements, as shown in Eq. 4:

$$T_c = P_{fd} \left(\frac{R_{tc} R_{ta}}{R_{tc} + R_{ta}} \right) + T_a \text{ deg C} \quad (4)$$

The limiting relationship between junction watts and case temperature is shown in Fig. 2. An example of the use of Eq. 4 is as follows: Determine the maximum allowable power dissipation and the corresponding case temperature for a CK775 diode, operated at 25 C ambient, in free convection at sea level, without an external heat radiator: Locate T_a (point 1) on the abscissa at 25 C. Using an external thermal resistance of 23 C/watt for R_{tc} , assume 5 w dissipation. Calculate case temperature rise to be $5 \times 23 = 115$ C. Therefore, the case temperature at 5 w dissipation will be $25 + 115$ or 140 C (point 2). Connect points 1 and 2 with a straight line and extrapolate to the limiting curve (point 3). Read maximum allowable power dissipation as 6.3 w at a case temperature of 170 C.

This calculation assumed that R_{ta} , the auxiliary thermal resistance, was very high compared to R_{tc} . The addition of auxiliary cooling fins can be made to lower the external thermal resistance substantially, since conduction is generally much more efficient than either convection or radiation. Results are shown in Fig. 3 of an experimental relationship between total external thermal resistance (parallel combination of R_{tc} and R_{ta} of equation (4) and fin area for copper fins 1/16 in. thick in free convection at sea level.

Other parameters causing variation of external thermal resistance include blast air, liquid cooling, and altitude. In the case of the 25 C ambient temperature and a very low thermal resistance, say 1 C per watt, it is possible to dissipate 26 w at a case temperature of about 51 C. At high altitude, without a fin, the external thermal resistance can be considerably higher than the 23 C/watt figure used in the example.

Even with a fine finish on the base of the diode, it is rarely possible to utilize more than a fraction of the available area for heat conduction with direct metal-to-metal contact. In such applications, it has been found that the addition of a drop of 1000 CS, Dow Corning 200 type, silicone oil, or grease has been

sufficient to provide great improvement in the thermal resistance of the joint. The 5.5 C/watt value shown for a 3x3x1/16 in. copper fin may be lowered by as much as 2.5 C per watt by such means.

Both the forward and reverse characteristics of the diode vary with temperature and since the specified characteristics are measured at 25 C, it is important to anticipate changes at ambient temperatures extremes. At low temperatures, the zener breakdown point may decrease in voltage by as much as 20 per cent of the 25 C figure. Therefore, diodes applied at -55 C should be derated to 80 per cent of the 25 deg peak inverse voltage. At high temperatures the forward resistance decreases and the transfer characteristics shows forward voltage at a given forward current decreasing at a rate of approximately 2 mv per deg. C. The leakage current also increases as temperature is increased. The junction leakage is of the order of microamperes at 25 C and roughly doubles every 10 C rise. At present the shunt resistance effect has not been adequately determined, but apparently increases at a much lower rate.

Surges and Overloads

Current surges are permissible for short periods of time within the watt-second thermal capacity of the diode. Compared to selenium rectifiers (having the rectifying element uniformly distributed on a large fin) the silicon diode has a very short thermal time constant. This is due in part to the extremely small thermal mass of the junction and the inherent physical properties of the package. Translating power to current, the limiting relationship is as follows:

$$X = 1/T \quad (5)$$

where, $X = \frac{\text{actual current}}{\text{rated current}} = 10$ for any value of T

$T = \text{surge duration time in seconds} = 1$
(T of 1 second is considered steady state operation)

An example of permissible current surge is as follows: A CK775 is operating at a maximum rated average current of 5 amp. A short circuit current of 25 amp is required to blow a fuse. Determine the maximum allowable surge duration time.

$$X = 25/5 = 5 \text{ and } T = 1/5 = 0.2 \text{ sec, max.}$$

The silicon diode has very little capacity for absorbing over-voltage, since the reverse characteristic breaks very sharply above rated voltage. Inverse power dissipation increases very rapidly from milliwatts to watts as voltage is increased into the zener region. The two limiting specification parameters are $-E_b$, the continuous peak inverse voltage (abbreviated PIV), and e_{ps} , instantaneous, nonrepetitive PIV . Applications where unusual transient or subtran-

sient over-voltage conditions can exist should be explored carefully before writing specifications. Switching or control circuits with inductive load can produce subtransient over-voltages of the order of several times the normal supply *PIV*. In certain instances, these isolated pulses have been detected as persisting for periods of the order of microseconds, but still providing sufficient energy to destroy diodes and puncture the insulation of associated components.

Problem Solution

A current military equipment requires a 150 v, 10 amp d-c supply for a resistive load over the ambient range of from -55 to 125 C. A 115 v, three-phase delta supply is available as a source. The rectifier must be capable of supplying 50 amp for 0.1 sec, in order to blow a fuse under load fault.

Considering the three-phase bridge (611B of the table), the average current per diode, I_a , will be $10/3$ or 3.3 amp. Each diode will be conducting the peak current of 10 amp for $1/3$ of the time, and therefore the diode forward voltage drop from Fig. 3 will be approximately 2 v. The output voltage of the bridge is:

$$E_L = 1.35 E_s - 2 E_f = 1.35 \times 115 - 2 \times 2 = 151 \text{ v dc}$$

The *PIV* across each diode will be $\sqrt{2} E_s$, or about 163 v. Therefore, a CK776 with a *PIV* of 200 v should be used to provide sufficient voltage derating for -55 C operation.

From the table, the current form factor for this circuit, K_f , is 1.74. Using Eq. 1:

$$P_{fd} = 3.3 \times 1.0 + (1.74)^2 (3.3)^2 (0.1) = 6.6 \text{ watts/diode}$$

From Fig. 2, the maximum case temperature corresponding to 6.6 w dissipation is 170 C. The temperature rise per diode would be 170-125 or 45 C. The external thermal resistance must be limited to 45/6.6 or 6.8 C/watt, max. From Fig. 3, this thermal resistance corresponds to a 1/16 in. thick copper fin of about 6 sq in. for conditions of free convection at sea level air density.

In computing the rectification efficiency, it is necessary to compute the load watts (150 x 10 = 1500 w), and all of the losses. The diode losses computed above are 6.6 w/diode or a total of 39.6 w for all six diodes. The ac load losses ($I^2 R_L$) are approximately 4.7 per cent for this circuit. The diode losses are 39.6/1500 or 2.64 per cent. The total losses are 7.3 per cent giving a rectification efficiency of 92.7 per cent.

This bridge with closely balanced forward characteristics for all diodes supplies less than 4 per cent load voltage ripple. Diodes should be matched to within ± 10 per cent forward current at a given voltage to insure good load division, and commutation.

The surge current requirement of 50 amp for 0.1 sec is permissible since:

$$X = 50/10 = 5 \text{ and } T = 1/X = 0.2 \text{ sec max. (Eq. 5)}$$

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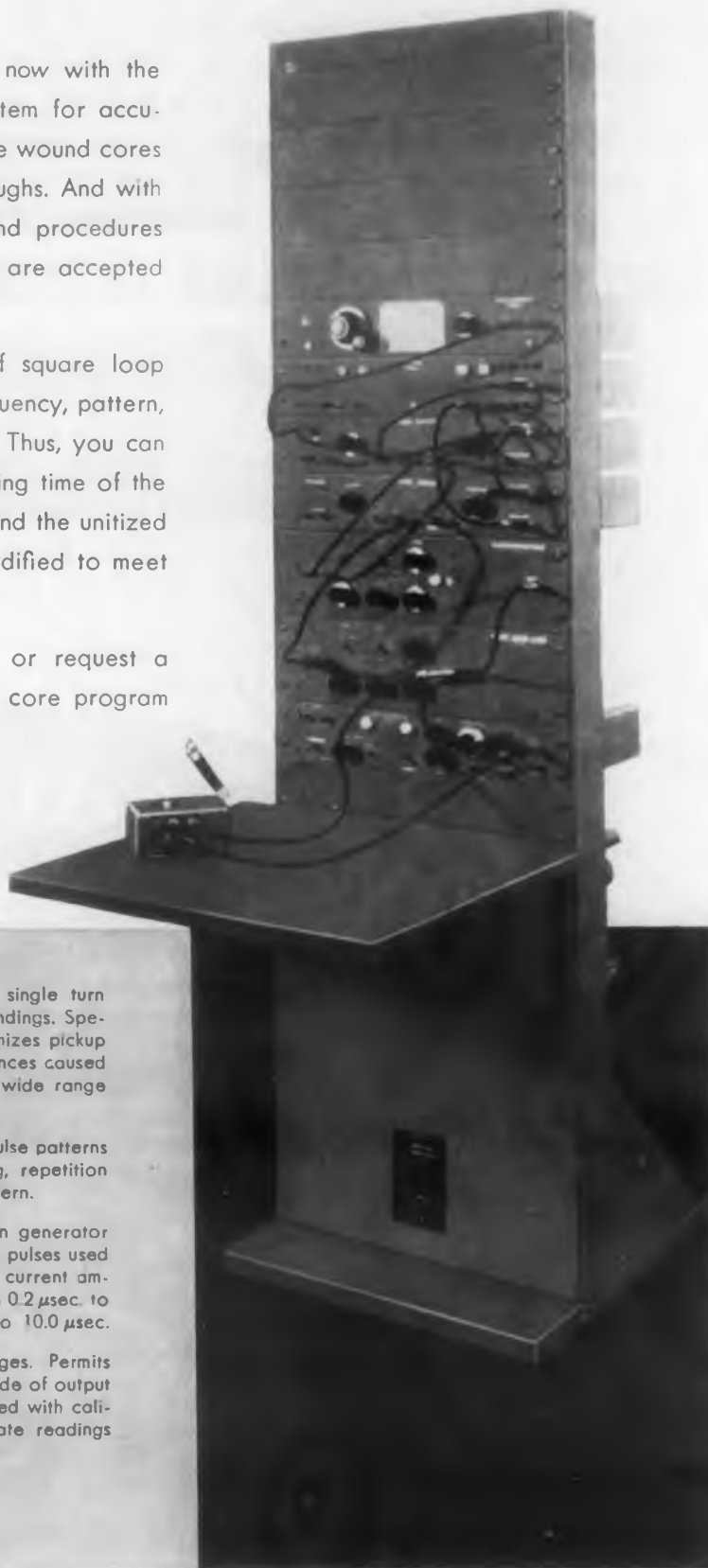
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Military-specification

△ Collet Fitting Knob

INCORPORATED into this newly designed knob is a positive locking collet, which eliminates all possibility of knob slippage due to set screw loosening. The collet snugly grips the shaft, evenly distributing locking pressure on all outside surfaces of the shaft. The bar knob illustrated here meets military spec requirements, MIL-K-25049.

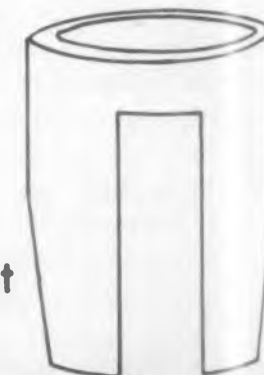
The collet fitting attachment of the new knob produced by Dale Products, Inc., Box 136, Columbus, Neb., consists of three parts: cap screw, slotted collet, and knurled insert. The cap screw is threaded into the knurled insert after the slotted collet is inserted inside the knurled insert. The knurled insert is mounted in the inside diameter of the knob, at the top. The lower surface of the inside diameter of the knob is tapered.

Tightening the cap screw closes the tapered slotted collet jaws on the instrument shaft by forcing it to move into the tapered inside diameter of the knob. This is similar to the operation of a collet attachment on turret lathes.

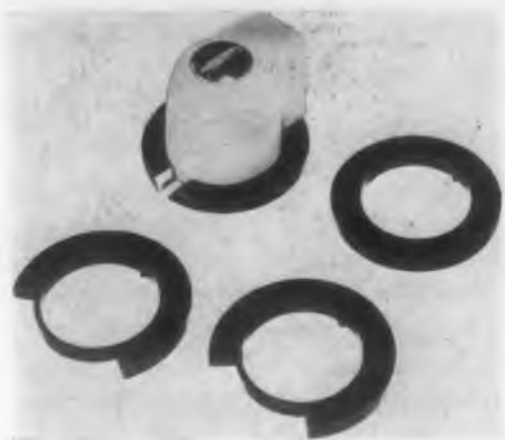
The slotted cap screw is positioned by two keyways on the inside diameter of the knob itself. This



Cap Screw



Slotted Collet



Tightening cap screw secures this collet type knob onto the shaft. Several skirts meeting military specifications are shown

prevents the knob from slipping on the collet. The friction between the collet and inside diameter of the knob, both tapered, also prevents slippage due to the pressure of forcing them together.

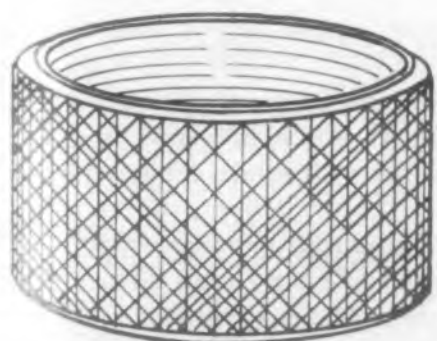
In actual mounting, the knob is positioned on the shaft and the cap screw is tightened in a clockwise direction. The knob is then absolutely secure from slippage without damage to the shaft.

The cap doesn't have to be completely removed to provide for removal. Simply loosen cap screw, push inward on knob to release collet and the knob can then be removed from shaft.

The MS 25170 bar knob has a 7/8 in. diameter and height, fitting on military style 1/4 in. flatted shafts. The knob material is tough thermoplastic, offering properties needed for hard use at high temperatures. It comes in standard gray color. A complete selection of skirts, dial plates and pointers meeting MIL specs are available.

For more information on this bar knob, turn to the Reader's Service Card and circle 41.

This product may be seen at the Radio Engineering Show, Booth 2742-44.



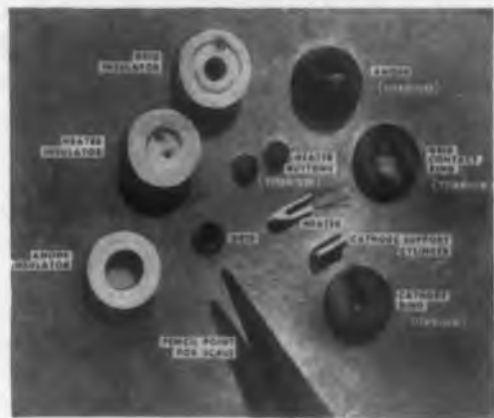
Knurled Insert

The collet jaws clamp shaft as cap screw is threaded into knob insert.



TITANIUM

proves best for micro-miniature tubes... it may for your product, too



These are the essential components of the initial micro-miniature tube General Electric developed for UHF-VHF television receivers. The metal parts are titanium.

Tubes of micro-miniature construction will mean more compact assemblies for everything from TV receivers to guided missile controls.

Nearly all metal parts in this tiny G-E micro-miniature receiving tube are titanium. For among titanium's unique properties is its ability to absorb performance-limiting gases which may be found in vacuum tubes. It makes possible more stable emission, substantially longer tube life.

But titanium's advantages are not limited to the electronics industry. The aircraft designer, for example, likes its light weight and high strength. And its exceptional resistance to most forms of corrosion adds years to the life of products operating in corrosive atmospheres.

Titanium may be the answer to many of your applications. The best way to find out is to talk it over with a REM-CRU engineer. And, remember, although titanium costs more than ordinary metals, its longer life and improved product performance often makes it the most inexpensive material you can use. At REM-CRU, the sizes, grades and shapes you need are promptly available. Better look into the advantages of titanium now.

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Trends in Components

The proceedings of the seventh series of national meetings on electronic component parts and materials, the 1956 Electronic Components Symposium, has recently been published.

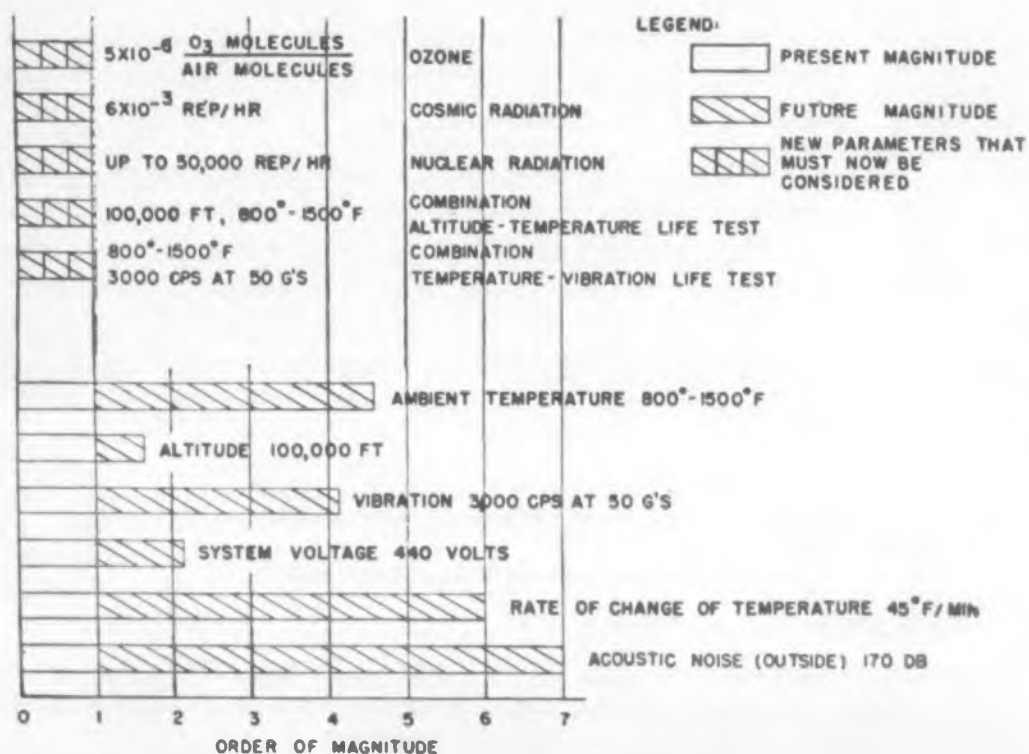
The Proceedings contains much fresh information and covers many novel developments to bring the reader up to date with the latest trends and the state of the art. Forty-three different papers cover a wide variety of subjects such as materials progress, electron tubes, solid state devices, passive components. Papers also include treatment of reliability and instrumentation and measurements.

Several developments in the field of materials, resistors, capacitors, and semiconductors which may shortly affect the equipment designer are reported here briefly. The complete "Proceedings of the 1956 Electronic Components Symposium" may be obtained from Engineering Publishers, GPO Box 1151, New York 1, N. Y. The book is 240 pages long and contains 293 illustrations. Size 8½ x 11 in. Paper bound edition \$5.00.

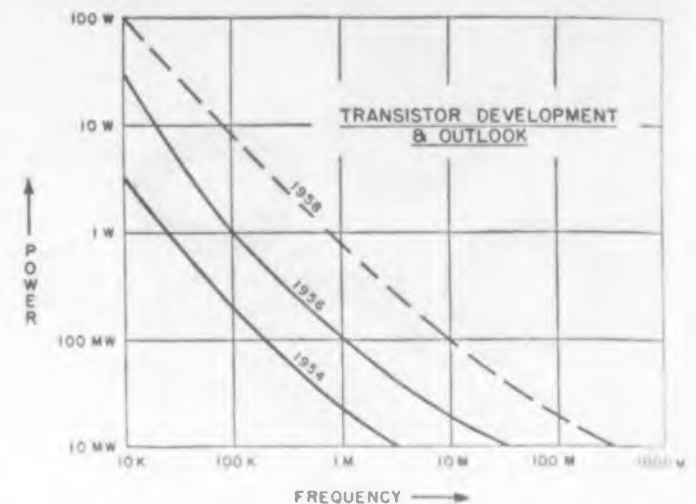
New Environmental Referents

Increased accelerations, Mach number, and higher altitude for airborne equipment mean that electronic components and equipment must withstand altogether new environmental conditions. Reorientation to new

reference points will be helpful in thinking about these conditions. Some of the situations that will be encountered and the order of magnitude of the changes are illustrated in the accompanying graph. *Extracted from "Looking Forward into the Future," Karl Martinez, Boeing Airplane Co.*



New reference points for thinking about environmental conditions.



Projection of logarithmic plot of past transistor advance shows what power and frequency ratings might be in 1958.

Transistors of the Future

General

Future developments in transistors promise an increase in both maximum frequency and maximum power. The history of the development of the transistor as a function of power and frequency is indicated in the accompanying graph where a logarithmic plot of frequency on the abscissa and power on the ordinate is shown. It appears that power can be exchanged for frequency and vice versa and that the exchange may not be severe on future devices. "A Report on the Art of Semiconductor Devices," David B. Kret, Radio Corporation of America.

High Power Silicon

Alpha cut-off high frequency response of a transistor is inversely proportional to W^2 (thin base width). The gain at high current also depends inversely upon W^2 . Since thin base width is essential both for high frequency and high power performance, it is interesting to note whether further requirements of high frequency and high power are necessarily in conflict with each other, or whether a high-frequency high-power transistor is feasible.

As far as high power is concerned, the transistor must be able to safely dissipate enough power to perform its function. Germanium transistors have been operated at more than 100 w dissipation per cm^2 . Silicon permits higher power density and/or higher operating temperature.

Capacitances must be minimized to overcome high-frequency limitation. Also, it is necessary to design a low-capacitance transistor structure for heat flow out of an electrode.

The high-power and high-frequency transistor both share a common requirement for high gain, which in most cases also requires low base resistance. The thin base width in itself tends to raise base resistance, but this can ordinarily be controlled by changing other dimensions.

The maximum useful frequency of a transistor is given roughly by

$$f_o = \sqrt{\frac{f_a}{25r_bC_c}}$$

which demonstrates the need for minimizing r_bC_c , as well as maximizing f_a .

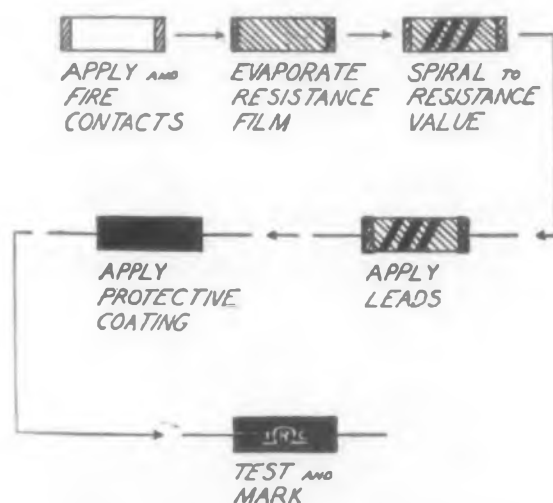
The C_c includes collector junction depletion larger capacitance which increases with collector area. This implies that the high-frequency high-power transistor should be designed for maximum power density. The collector capacitance also includes a diffusion capacitance term which is proportional to current and base width, but independent of area. Specifically, a silicon n-p-n alloy transistor whose base width is one mil, base resistivity 1 amp, will have a diffusion capacitance of about 1500 μmf at 1 v on the collector and 1 amp collector current. In addition to making W small this can be minimized by grading the base resistivity toward the collector junction. Fortunately, this also helps increase the maximum applicable collector voltage as well as improving alpha cut-off frequency. Adapted from "High Power Silicon Transistors," John S. Saby, General Electric Co.

Metal Film Resistor Developments

The following brief report covers recent developments in metal film power resistors, precision high-temperature metal film resistors, and pyrolytic alloy high-temperature resistors. All of these developments are reported by the International Resistance Company, Philadelphia, Pa. For a discussion of a thermally-fused metal-to-ceramic resistor see ELECTRONIC DESIGN, Feb. 1, 1956.

Metal Film Power Resistors

Resistors of this type have been produced that meet all the requirements of specification MIL-R-11804-A. The manufacturing process is described in the flow diagram. The resistance films themselves



Steps in preparing conventional metal film power resistors.

Available now...



HR10211
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HR10213
HR10214
HR10215
HR10251
HR10252
HR10253
HR10254
HR10255

HUGHES SILICON RECTIFIERS

Hughes introduces a new series of high-quality silicon rectifiers, especially designed for use in miniaturized circuitry. These new low-power rectifiers are characterized by low forward voltage drop, together with low back leakage. They are exceptionally efficient units in electronic power supplies and, in such applications, can be used in place of many conventional vacuum tubes.

The new Hughes Rectifiers feature: maximum AC input voltages up to 275 volts RMS; maximum reverse DC working voltages up to 375 volts; maximum average rectified forward current up to 200mA; maximum power dissipation (at 25°C) up to 200mW. Operating temperature range for all types: -75°C to +150°C.

PHYSICAL CHARACTERISTICS

All Hughes Rectifiers are packaged in a one-piece, fusion-sealed glass body. This famous construction is impervious to moisture penetration, ensures stable operation under severe operating conditions. Maximum dimensions, rectifier glass body: length, 0.265-inch; diameter, 0.105-inch.

Our sales engineers will welcome the opportunity to discuss applications of these new rectifiers with you. For the address of our sales office nearest you, or for more complete specifications concerning the new Hughes Rectifiers, visit Booths 2801, 2803, 2805 at the I.R.E. Show, or write:

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SEMICONDUCTORS

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high speed transistors for computer switching circuits

Sprague 2N240 transistors with their fast response time—in the millimicrosecond range—give reliable operation in switching circuits up to 20 megacycles. The ideal electrical characteristics of these surface barrier transistors permit direct coupling for faster operation than any alloy junction type.

And the 2N240 gives you:

- low saturation resistance
- low saturation voltage
- extremely fast rise and fall time
- absolute hermetic seal
- availability

Among these features, the most important to you may well be availability. Sprague is manufacturing 2N240 transistors NOW in production volumes. You can answer today's transistor needs *today* by specifying Sprague surface barrier transistors!

Write for complete data sheets on Sprague 2N240 germanium surface barrier transistors and on Sprague general purpose high-frequency surface barrier types SB 101 and SB 102. All are available on letterhead request to the Technical Literature Section, Sprague Electric Co., 347 Marshall Street, North Adams, Mass.



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are stable at even much higher ratings. These units are capable of being produced in resistance values as low as 50 ohms and as high as 1 megohm with tolerances of ± 2 per cent, temperature coefficient of resistance less than 100 ppm/deg C for the 1-, 2-, and 4-watt units and less than 250 ppm/deg C for the higher wattage ratings. Hot spot temperatures are less than 225 C at the rated wattages, and the units appear to be quite stable at high relative humidities.

Precision and High-Temperature Metal Film Resistors

The summary-type report describes performance of precision film resistors which operate successfully at 250 C. A metal film resistor can be made to do the job of precision wire-bound resistors. Furthermore, it can perform at high temperatures.

Pyrolytic Alloy High-Temperature Resistors

In conventional types of film resistors, the resistance is controlled basically by the film thickness. The resistivity of the carbon is essentially constant. High range films become too thin to be reliable. In the approach reported on here, the carbon-alloying process, controls resistivity while maintaining thick films. Such films have excellent characteristics at elevated temperatures, moisture, abrasion, and other environmental conditions.

Resistance to abrasion is excellent. The alloyed film material is combined with the substrate in the pyrolytic reaction so as to become an integral part of the substrate itself.

In pilot plant operations resistance ranges between 10 ohms and 100 megohms have been produced. Units of 100,000 megohms resistance have been made.

After 1000 hours of storage at 275 C, the average change of one-megohm resistors was less than 1 per cent. This was without overcoat protection; therefore resistance to oxidation is good. Load life tests at high temperatures bear this out.

	10K Avg % Change	100K Avg % Change
1/2 wattage	0.1	0.1
Short Time Overload	0.01	0.02
Temperature Cycle	0.3	0.4
Temperature Exposure 200 C.	0.07	0.03
Load Life 200 C.	0.1	0.1
Temperature Exposure 250 C.	0.1	0.1
Load Life 250 C.	0.2	0.2
Moisture Load 312 hr	0.02	0.01
Temperature Coefficient:	-70 C	71
(ppm/deg C, referred to 25 C.)	125 C	44
	250 C	15
		36

Note: Seven resistors tested in each group.

Circuit of test set for direct reading of B and Ico.

Overloads do not damage the resistors. For example, a two-watt unit dissipating 5 w changed resistance less than 1.5 per cent after 1000 hours.

The paper also covers moisture cycle test data, low temperature tests, etc. Graphs cover these tests. The authors feel there will be a great demand for these resistors as volume production approaches.

New Glasses for Components

Several properties of new glass systems are presented in the accompanying table. These properties were chosen to give a basis for selection of glasses for various dielectric applications.

These glasses possess unique qualities in that:

1. Dielectric constants as high as 30 can be obtained and any of the systems is capable of giving values well in excess of conventional glasses.

2. Dielectric constant values can be varied almost continuously by composition control and, at most values, can be maintained constant while compositional adjustments can be made to give more desirable working properties.

3. Dissipation factor values for most of the glasses are below 0.005 at 1 mc as compared to Mylar with a value of 0.016.

4. Exceptionally high electrical resistivities at elevated temperatures were observed in some systems.

5. Coefficients of linear expansion range from $70 \times 10^{-7}/C$ to $110 \times 10^{-7}/C$; a range of values which includes many of the metals commonly used in glass-to-metal seals.

Several types of initial evaluation tests were performed and indicate that glasses from these systems may find application in one or more of the following applications:

1. Low capacitance general-purpose capacitors (gimmick types).
2. Miniature capacitors.
3. High-temperature capacitors.
4. High-temperature insulators.
5. Glass-to-metal seals or terminals.
6. Feed-through condensers.
7. Sintered glass shapes.

These glasses have been prepared in laboratory batches and can be made available, in small quantities, for evaluation. Inquiries will be welcomed from anyone interested in the above or any other applications. Taken from the paper "New Glasses and Electrical Component Applications," W. E. Hauth and A. L. Pugh, Jr., International Resistance Co., Philadelphia, Pa.

System	K	Dissipation Factor	Dielectric Strength	Resistivity ohm-cm		Coeff. of Expan. $\alpha \times 10^7$ per °C	Sealing Properties
				100 C	300 C		
I. Bi-Cd-Si							
H1D	30	0.006	205	1×10^{13}	4×10^7	108	Dumet
H110	15	0.003	320			88	146
H 5B	17.3	0.004	270	8×10^{14}	1×10^{10}	85	146
II. Bi-Cd-B							
H 149	31	0.002	200			112	
H 153	23	0.004	270	4×10^{14}	1×10^9	89	Dumet
III. K-Si-Ti							
A 354	8.5	0.003	595	6×10^9	1×10^6	102	
A 359	12	0.002	545			110	
A 399	11	0.003	470			94	
IV. Na-Ca-Si-Ti							
E-48	15	0.002	425	1×10^{10}	6×10^6	96	Dumet
V. Pb-Ge							
G-323	19	0.002	300	5×10^{14}	2×10^9	78	146
G-327	9.3	0.002	320	1×10^{15}	5×10^{11}	70	
VI. Commercial*							
Na-Ca-Si (Corning 0800)	7.2	0.006	240	3×10^9	4×10^5	92	
Pyrex 7740	4.6	0.004	535	6×10^{11}	2×10^7	32.5	
High Lead (Corning 8870)	9.5	0.009				91	

*All Data, excepting dielectric strength, catalog values

Glass properties of new glass systems suitable for electronic applications.

high gain, low noise

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the ultimate in sensitivity & performance

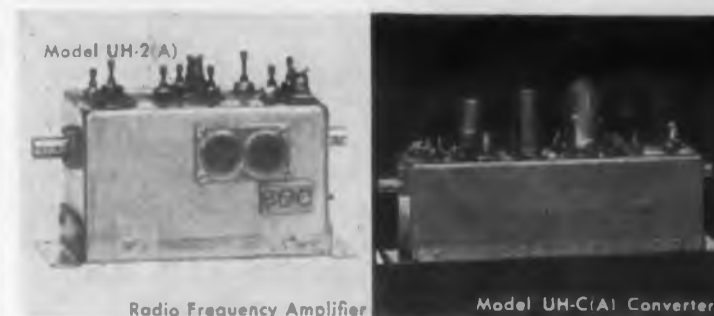
- Communications
- Radar
- Telemetry
- Monitoring systems



Model UHC-R Converter for Rack Mounting

Model UHC-R Converters were developed by Applied Research Inc. to provide the highest level of converter performance for experimental and developmental fixed frequency operations in laboratory and field.

The UHC-R Converter consists of a Model UH-2(A) RF Amplifier and a Model UH-C(A) Converter. The units may be obtained separately and operated remotely, advantageous under many conditions.



Radio Frequency Amplifier

Model UH-C(A) Converter

Specifications

Model:	UHC-R-4.5	UHC-R-6	UHC-R-7	UHC-R-8.2
Input frequency:	400-525 mcs	525-650 mcs	650-775 mcs	775-900 mcs
(Input freq. is factory preset to customer specifications)				
Input impedance:	Factory preset to 50 or 75 ohms			
RF bandwidth:	10 mcs	10 mcs	10 mcs	10 mcs
Noise figure:	5.5 db	6.5 db	7.5 db	8.5 db
Output frequency:	Factory preset to 30 or 60 mcs			
Output bandwidth:	5 mcs	5 mcs	5 mcs	5 mcs
Output impedance:	Factory preset to 50 or 75 ohms			
Converter gain:	50 db (minimum) overall			
Power requirements:	6.3VAC at 2.0 A, +200VDC at 80 Ma (regulated)			
Size (L.W.H.):	19" x 7" x 7"			
Mounting dimensions:	Standard 19" relay rack			
Tube complement:	UH-2(A) Amplifier—2 G.E. Type GL-6299; UH-C(A) Converter—G.E. Type GL-6299, 6AM4, 6AF4, 6BK7A			

Model UHC-R Converters are also available at other frequencies, at RF bandwidths of up to 50 mcs, and to customer specifications. Write for further information.



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Attention! All Users of Nickel Alloys...

New Driver-Harris Vacuum Melting Service Now in Operation

After many years of experience with vacuum melting programs, Driver-Harris now offers a complete vacuum melting service for almost all of the 132 special purpose alloys made by this company.

The specific benefits gained by vacuum melting in the production of nickel-chrome alloys are today clearly established. They are:

1. Much closer control of analysis—particularly in alloying with the highly reactive elements, Titanium, Aluminum, Columbium, Calcium, and Zirconium. The normally high affinity for nitrogen and oxygen these elements have is completely eliminated in vacuum melting, thereby opening new avenues in alloy production.

2. Great reduction in inclusions, especially oxides and nitrides, results in higher ductility and tensile properties. In fine wires, the improvement in properties is frequently so great that wire sizes may be reduced without sacrifice of strength. An example of the greatly improved microstructure is illustrated in the metallographs shown.

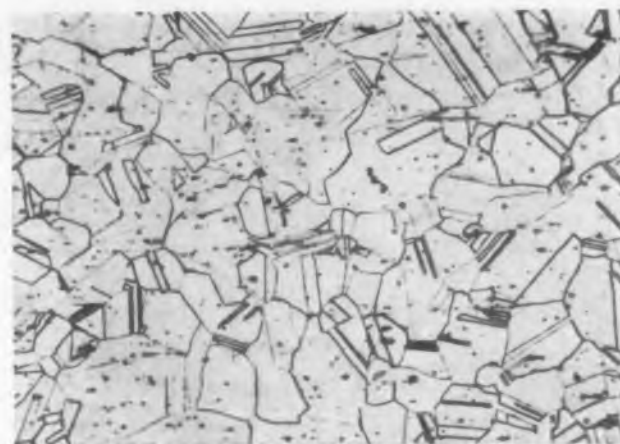
3. Complete elimination of gas, not from the surface only but from the entire mass. Alloys so produced are therefore more desirable in the manufacture of electron tubes.

4. General improvement in electronic, electrical, and mechanical properties to meet specifications. Because closer control of analysis is a primary advantage of vacuum melting, we can now achieve these specific improvements with remarkable certainty.

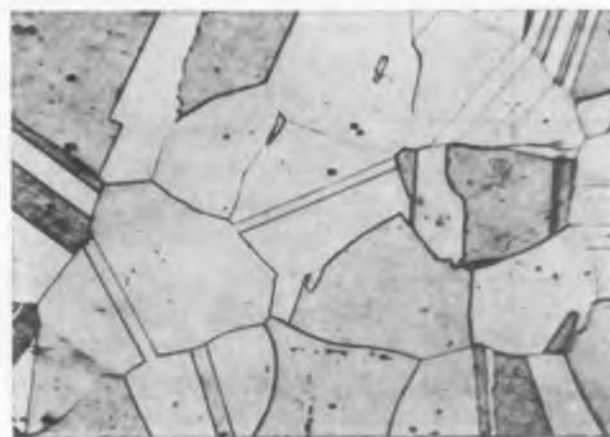
Almost all of the Driver-Harris Alloys now vacuum melted and processed under close physi-

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cal and analytical control show improvement in one or more of the above ways. If you are seeking further improvements in the D-H Alloys you use, inquire now for information on how Driver-Harris Vacuum Melting Service can help you. Address your inquiry to Dept. VMS.



Polished and etched sample of Air Melted NICHROME® V in annealed condition.



Vacuum melted NICHROME V, annealed. Note that reduced inclusions result in much larger grain size for the same annealing treatment.



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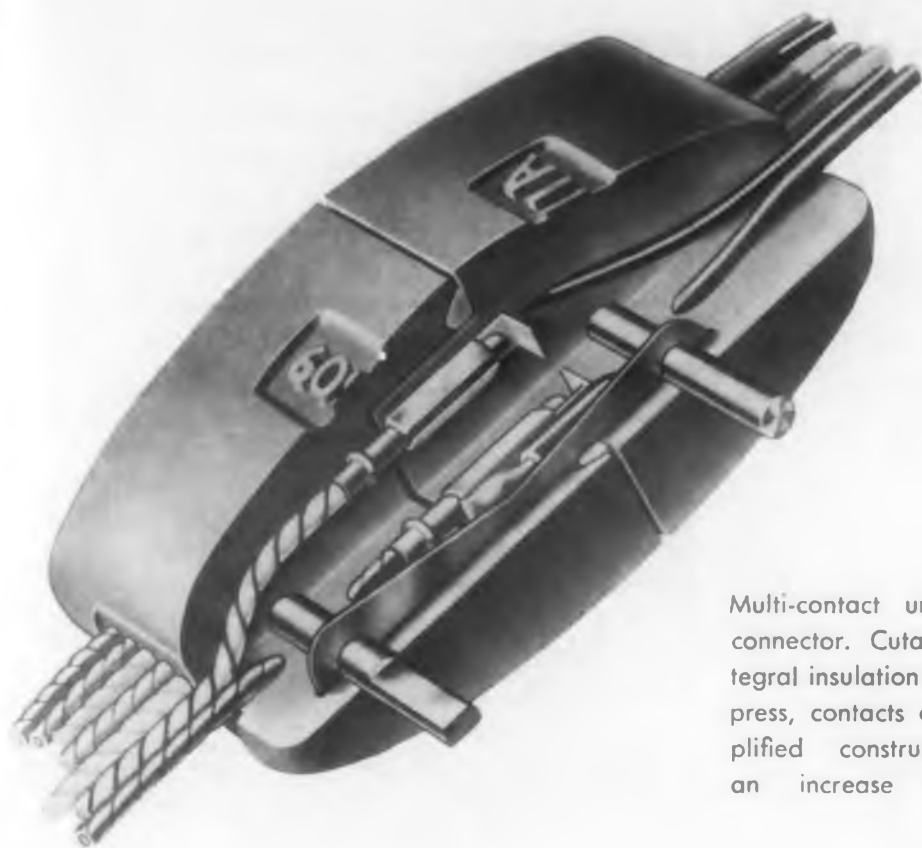
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Integral Mold Connectors

CONTACTS, leads, and even special inserts such as resistors, capacitors or chokes are molded as an entire connector assembly with a new single-shot injection process. With proper choice of insulation material a homogenous lead-insulation-to-connector bond is achieved.

These connectors, manufactured by Alden Products Co., 117 North Main St., Brockton, Mass., provide a good seal against flashback, dust or moisture, and, since the lead wires are integrally molded in the plastic insulating body, excellent strain relief for the leads and contacts. Punch press contacts are used instead of machine-screws, together with a patented crimping and soldering process. The connector may be sealed closed by means of a simple "O" ring. With this simplified construction additional reliability is obtained making these connectors suitable for applications such as the missile connector in the cutaway drawing.

Unit molded cable for high-voltage use. Note circuit resistors incorporated into body of insulation.



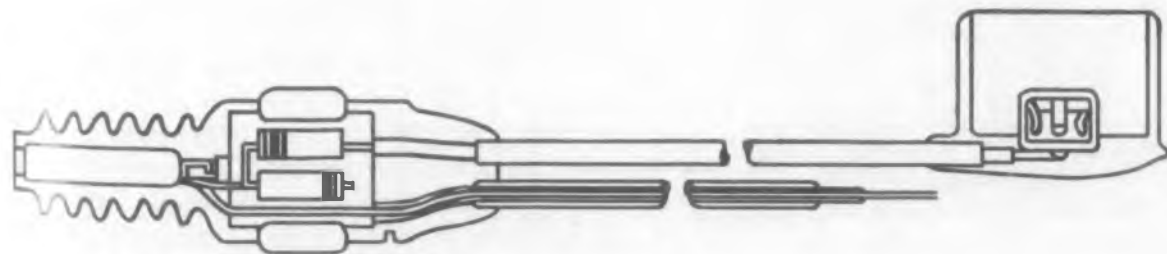
Multi-contact umbilical missile connector. Cutaway shows integral insulation of leads, punch press, contacts and body. Simplified construction provides an increase in reliability.

A variety of insulating materials lend themselves to the company's injection molding techniques. Polyethylene is good for high voltage applications; for other reasons it may be desirable to use nylon or polyvinyl chloride in special applications. Where the connector insulation is the same as or compatible with the wire insulation an integral bond is produced.

The integral molded insulation technique has been used to furnish high voltage tube cap connectors, and to construct unit molded cables as shown in the line drawing at the side for mobile communications, facsimile, and other commercial and military applications.

This product may be seen at Booth No. 1614-1616 at the New York IRE Show.

For more information about these integral molding insulation techniques for making connectors, fill in the Reader's Service Card and circle 47.



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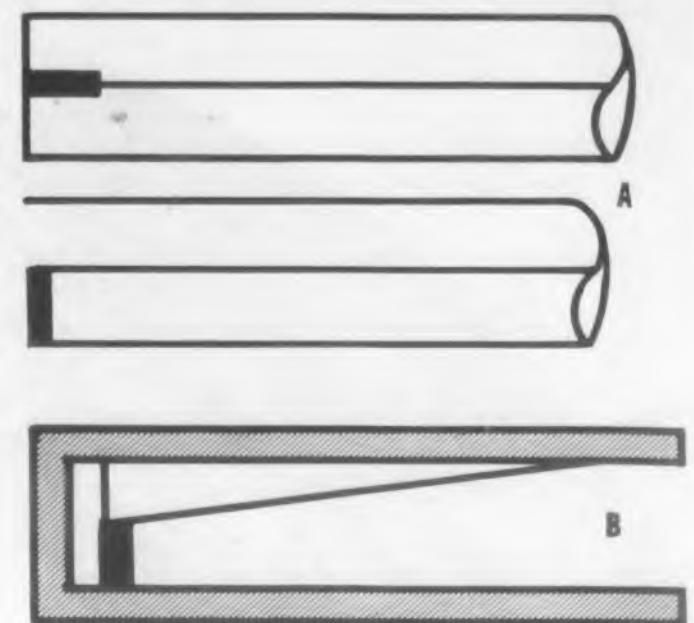
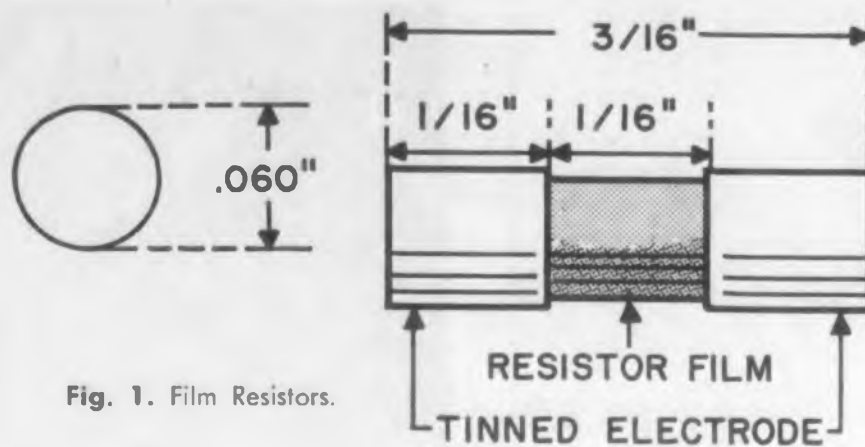


Fig. 3. Film resistor terminations. a. A coaxial termination. b. A waveguide termination.

Microwave Film Resistors

Bernard Rosen and Robert Saul

Polarad Electronics Corp.
Long Island City, N. Y.

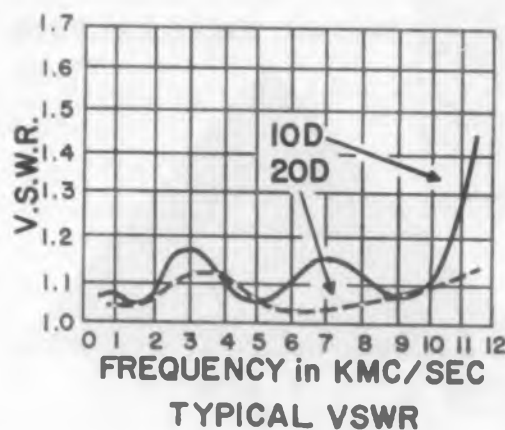
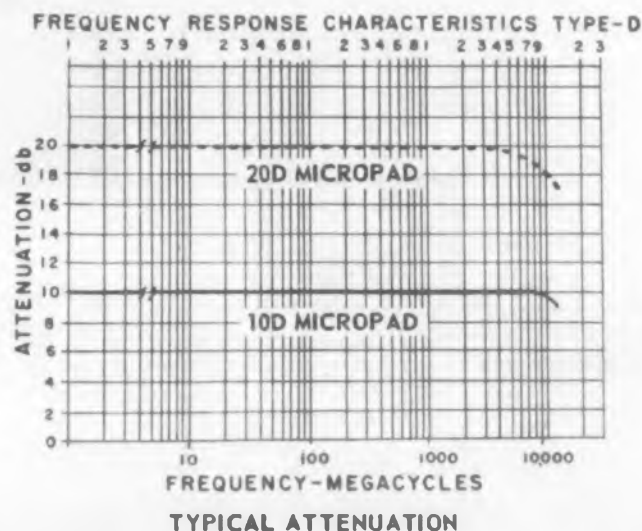


Fig. 2. Performance curves for a Pi-type pad, using a film resistor.



A NEED has long existed for a resistance element with properties alike both at dc and at microwave frequencies. This is especially important in the design of broad-band microwave components, such as cutoff attenuators, series isolating sections, directional couplers and attenuators. The film resistors described here offer a partial solution, at least, to this problem.

Requirements

The general electrical and mechanical properties required of such a resistor are:

- Ability to withstand a maximum voltage standing-wave ratio over the required frequency range. This must include the resistor mount which is also frequency sensitive.
- Minimum possible variation of resistance from one resistor to another. Yet, the resistor must be capable of being made with standard manufacturing methods for ease of construction and reproducibility.
- High power handling capabilities. Since the resistors could be used in some type of pi or T network attenuator, the initial resistor in the circuit must be capable of handling a reasonable amount of power without burn out.
- The physical shape and size of the resistor must be such as to simplify the mounting problem in any type of transmission structure. The size must be considerably smaller than a wavelength at the highest frequency in order not to introduce appreciable reflection.

A new film-type resistor that meets the requirements listed has been developed. It is fabricated with tinned edges to allow for direct soldering into a circuit, and is small enough to be in effect a lumped constant at microwave frequencies. Because of its small cylindrical shape it may be used in shunt or series depending upon the required application.

Construction

Microwave film resistors are formed on pyrex glass rods. Glass is used as the base material because of its stable properties (chemically inert, rigid, low thermal expansion) and for its ability to be metalized. Special drawn glass rods are used to insure a smooth surface of uniform diameter. The glass rods are cleaned thoroughly to remove all dirt and oil and then stored in distilled water until used.

The resistance coat is applied to the rods by a semi-automatic process using a metal-organic oil compound. Resistance value is controlled by the specification of the metal-oil compound. For this reason, it is not necessary to slot or trim the resulting film to achieve a desired value of resistance. The coating is carefully controlled to insure a thin, uniform 0.0015 in. coat on the rod. The coating is such that the current distribution depth will be essentially the same at dc and X Band. Because the skin depth at 10,000 mc is more than ten times the film thickness, a dc measurement will be a good measure of the film resistor's attenuation at the highest frequency of use.

The coated rod is finally baked at a temperature just below the melting point of the glass to burn off the organic oils and to bond the resistive film to the glass. The metalized rod is then coated with bands of platinum which space the resistor along the glass rod and then rebaked at high temperature. The platinum rings are then coated with solder, and a silicone varnish film is painted over the resistance film. The long rod is then cut up into individual resistance segments as indicated by the platinum bands. The resultant resistor is shown in Fig. 1. The resistance film and tinned ends, intimately bonded to the glass, are extremely stable.

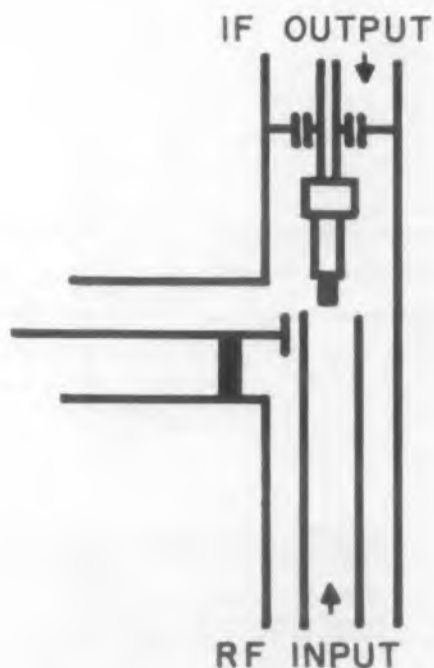


Fig. 4. Local oscillator injection padding with film resistor.

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- improved ignitors to assure accurate ignition.
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Hayden Publications Corp., 19 East 62nd Street
New York, New York TEmpleton 8-1940

Characteristics

The overall length and circumference of the resistor is made small compared to the highest operating wavelength. The length of the resistive film (0.063 in.) at 10,000 mc is approximately one twentieth of a wavelength. Because of the film resistor's small diameter, short length, and microscopically thin resistive film, the resistor can be considered as a lumped element over its entire frequency range. At the upper-frequency end of the band, care must be taken in the physical mounting of the resistors. The resistor can be soldered to the microwave elements directly without any discontinuities.

The maximum temperature rise that the resistor can withstand will determine its power handling ability. Although electrically symmetrical, the part of the resistor closest to the power source will absorb the most power; and, consequently, the temperature will not be constant along its axis. Therefore, the design of the resistor and the electrical circuit will determine the maximum power that an attenuator can dissipate. Film resistors available commercially, such as the Type R, can dissipate 1/4 watt of average CW power. This is considered adequate for most applications where these resistors can be used.

Applications

A pi type pad, using a film resistor, is shown in Fig. 2a. Typical standing-wave ratio and attenuation characteristics are shown in Fig. 2b and 2c, respectively. Type R resistors can be used in waveguides as well as coaxial lines.

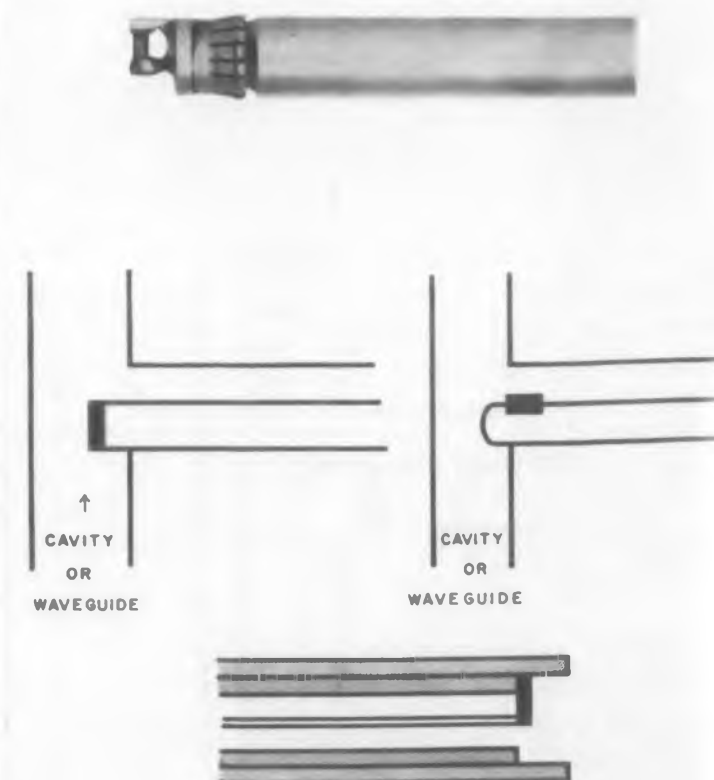


Fig. 5. Film resistors in pickup loops.

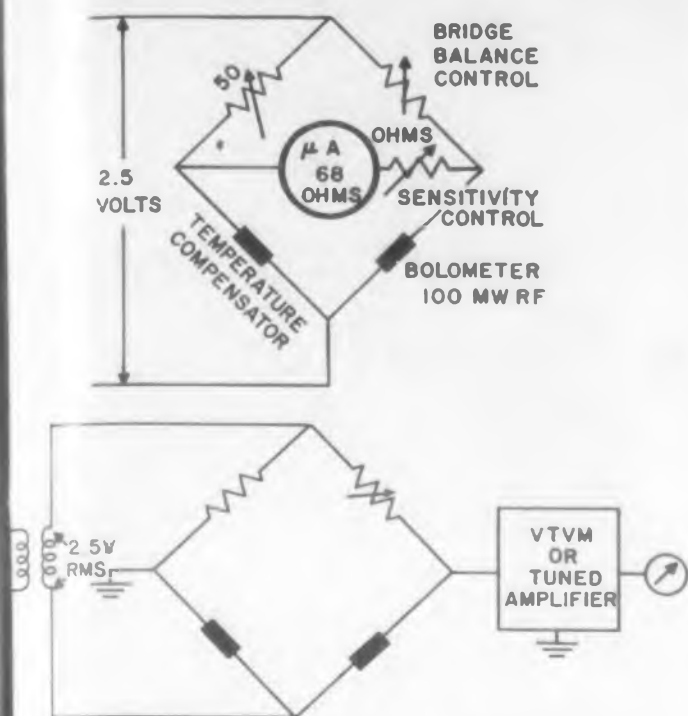


Fig. 6. Power measuring bridge circuits using film resistors.

Film resistors can be used for terminations in coaxial circuits as shown in Fig. 3a—either in series, as part of the inner conductor, or in shunt, across the coaxial line in a symmetrical layout to avoid the introduction of excessive reactance. The frequency insensitivity of these resistors allows low-frequency measurements to predict behavior at high frequencies. Good results as terminations have also been obtained when used with ridged waveguide, Fig. 3b. Values of vswr of less than 6 db have been obtained in frequency ranges up to K band.

An oscillator usually requires a degree of isolation from the device into which it works. If a film resistor is used in the coupling loop, it becomes an efficient means of coupling power with low vswr and with a predictable amount of decoupling. Illustrated in Fig. 4 is the use of a film resistor to isolate the local oscillator from a mixer and signal input line. Illustrated in Fig. 5 are typical uses of a film resistor in the coupling loop for good coupling from such a device as a signal generator.

Type R resistors can be used in power measuring bridges for monitoring power, Fig. 6. They have a lower power sensitivity than thermistors or hot wire barretters; consequently, they can be used for measuring power without the use of pads or attenuators. The circuit at *a* will measure 100 mw rf for full scale deflection. For measuring lower powers, the microammeter should be replaced by a galvanometer, magnetic amplifier, or a dc vacuum-tube millivoltmeter as at *b*. A direct reading a-c bridge can be used for measuring power levels from 10 to 100 mw full scale. Any audio frequency from 1000 to 10,000 cps can be used for this application.

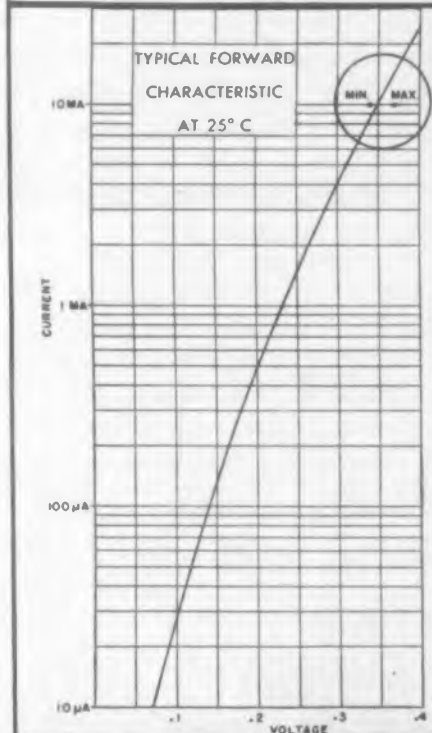
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Characteristics at 25° C

Forward voltage drop @ 10MA	
Minimum	0.34V
Maximum	0.37V
Maximum reverse current at -10V.....	10UA
Peak inverse voltage.....	60V

Maximum Ratings at 25° C

Maximum inverse operating voltage.....	50V
Continuous DC forward current.....	100MA
Surge current for 1 second.....	500MA
Average power dissipation.....	80MW
Derating above 25° C.....	10MW/10° C

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Further information on DR 385, or any other RRco. diode type will be sent you at once upon request to section D-3.



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CIRCLE 51 ON READER-SERVICE CARD FOR MORE INFORMATION

Switching Transistor

A POSSIBLE 1000 w of power can be switched with a single 2N174 transistor when used in the circuit of Fig. 1. The necessary input power for this switching operation is 1 w, giving the transistor a maximum possible power gain of 30 db.

The performance characteristics of the 2N174 transistor manufactured by the Delco Radio Division of General Motors Corp., Kokomo, Ind., include a high collector breakdown voltage, high maximum collector current and a low input impedance. It is an alloy junction PNP power transistor designed for general use with a 28 v power supply, or with a 12 v supply in applications where high voltage transients are encountered.

The transistor can be used in a switching circuit, in d-c power conversion, or as an audio amplifier. The large signal current amplification is relatively constant for collector currents up to 7 amp. The distortion is low, even in the common emitter configuration. A push-pull (matched pair) AB₁ audio amplifier can deliver 80 w of audio power output with 6 per cent total harmonic distortion.

A major application of the transistor is in dc-dc power converters, such as the one shown in Fig. 2. The low saturation voltage of the 2N174 reduces the internal power dissipation of the transistor in this application to an almost insignificant figure. For this reason very little self-heating is ap-

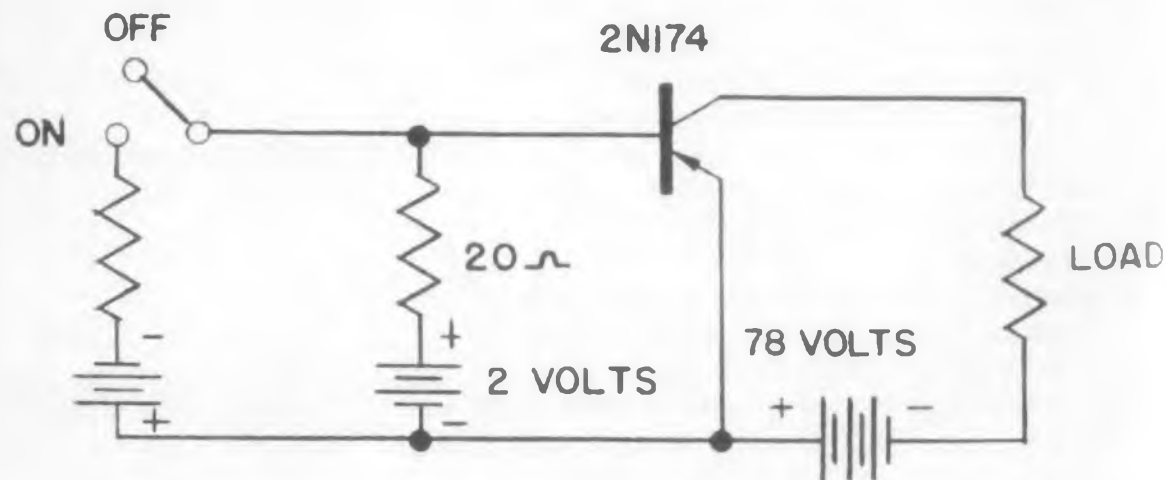
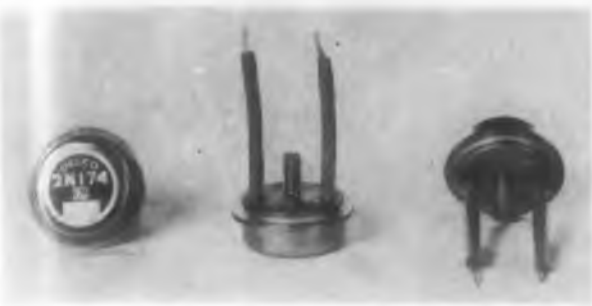


Fig. 1. Kilowatt switching circuit for 2N174 transistor. Input control power is 1 w, current in "on" position is 13 amp, and dissipation in "on" position is 8 w. Switching time is 60 μ secs.

Waldes Truarc grip rings used on die-cast studs eliminate threading, tapping, other costly machining



parent in the transistor, permitting a small heat sink and an overall economy in size.

Maximum ratings are a collector voltage of 80 v (with emitter open), an emitter reverse voltage of 60 v and a collector current of 12 amp. Collector dissipation with 30 C mounting base temperature is 55 w. Junction and storage temperature is 95 C. The 2N174 is cooled by conduction and should be connected to a heat sink, such as an aluminum chassis. The transistor can be supplied in either single units or in matched pairs for dc-ac power conversion such as shown in the circuit of Fig. 2.

For further data about this product, fill out the Reader's Service Card and circle 52. See this product at the IRE Show, Booth 1520.

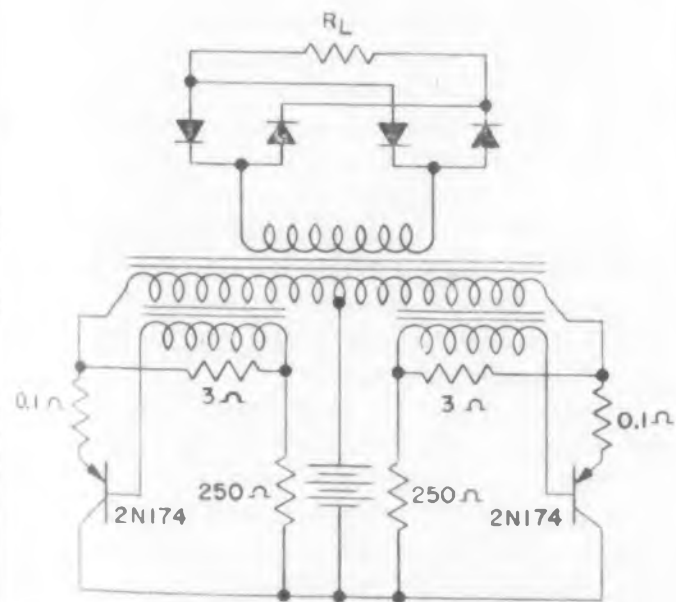
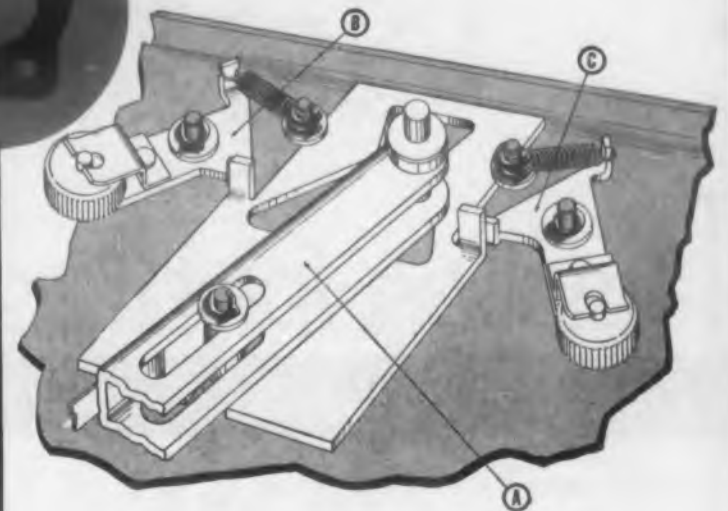


Fig. 2. D-c to d-c converter for conversion of 12 or 28 v to a higher d-c voltage (200 v) using the 2N174 transistor.



Mark Simpson Manufacturing Co., Long Island City, N. Y., uses Waldes Truarc series 5555 Grip Rings to secure parts to studs of the zinc die-cast base of its "Masco 500" portable tape recorder.

The rings—which need no grooves—replace nuts, screws, cotter pins and other types of fastening devices which require threading, tapping, drilling and other expensive machining operations. Because a single cracked or broken stud would render the entire cast base useless—and with it, all assembly completed to that point—the rings also eliminate extremely costly rejects.



Pivot Assembly of shift lever (A) is secured by a single Waldes Truarc Grip Ring and washer. Because the washer must be installed over the shift level in a sliding fit, critical tolerances would have to be maintained if a screw or cotter pin were used. The Truarc Grip Ring eliminates that problem: it requires no groove and may be seated over the washer at any point on the stud, automatically compensating for accumulated tolerances in the parts. BRAKE ASSEMBLIES (B and C) use Grip Rings to secure the brake wheel and spring sub-assemblies. Here again problems of critical tolerances are avoided and expensive rejects eliminated.

Whatever you make, there's a Waldes Truarc Retaining Ring designed to improve your product...to save you material, machining and labor costs. They're quick and easy to assemble and disassemble, and they do a better job of holding parts together. Truarc rings are precision engineered and precision made, quality controlled from raw material to finished ring.

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Coaxial Switching Connector

A BALL locking mechanism permits mating of this coaxial connector with a minimum of motion. The unusual method of connecting also makes possible use of the connector as a single-pole-double-throw switch. This feature is particularly useful in r-f and video applications that require external switching.

Known as the TRU-862, the combination coaxial connector and switch, is manufactured by Tru-Connector Corp., 416 Union Street, Lynn, Mass. Switching is accomplished by mating the two connectors. When the connector is unmated, there is a direct electrical connection between the external terminal and the coaxial center conductor. This connection is through a triangular spring which makes contact with an insulated circular conductor.

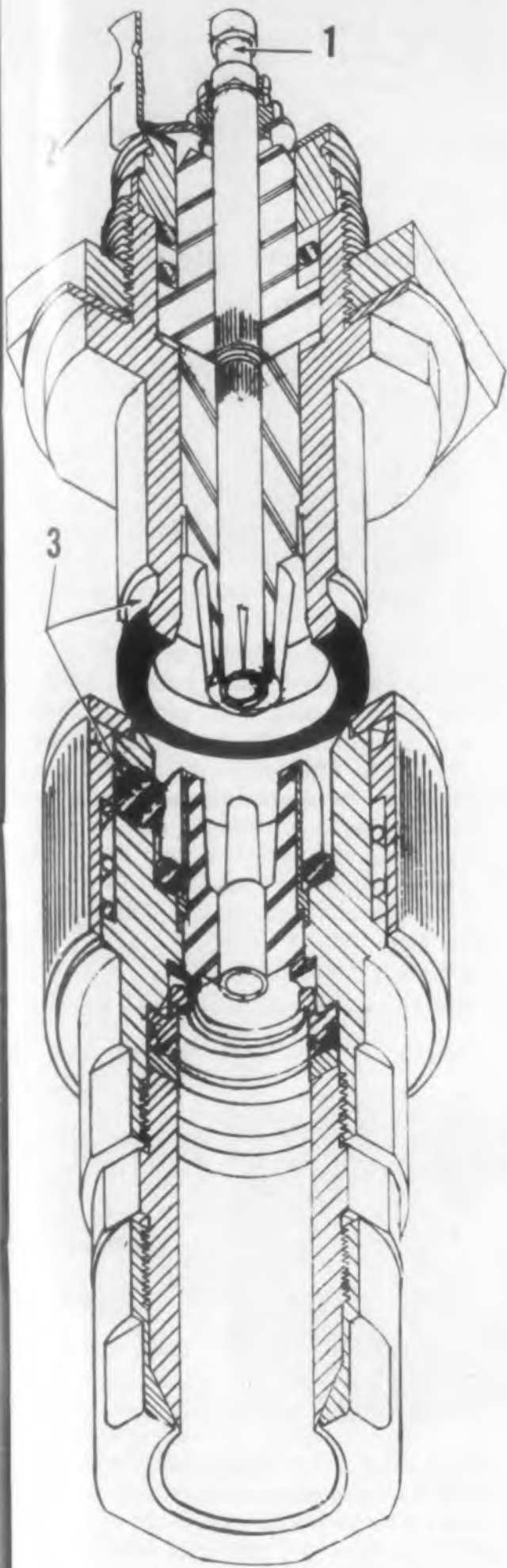
In mating the female connector with the male quick-disconnect the insulator is forced toward the coaxial terminal a distance of .060 in. This causes the triangular contact spring to separate from the circular conductor. The coaxial connector is now directly connected to the male coupling.

The insulator is spring-loaded and slides freely within the connector body. Special flange construction limits the travel of the insulation to approximately 0.060 in. thereby prohibiting it from being pushed out of the connector.

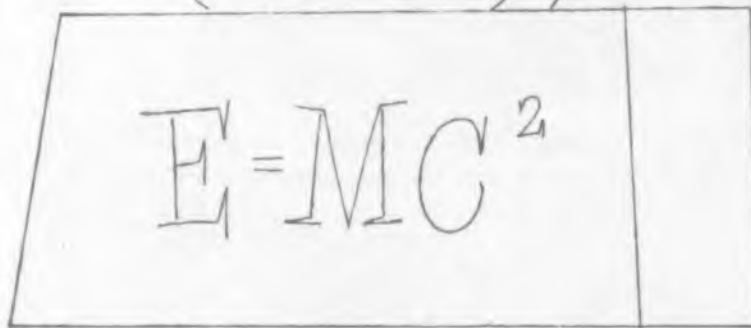
Overall size and electrical features of the TRU-862 compare with "N" and "C" type connectors. The connector is made of brass with teflon insulators and beryllium copper contacts. It is a bulk-head receptacle and mounts from the front of the panel through a 3/4 in. hole.

For more data on this switching connector fill out the Reader's Service card and circle No. 55.

See this product at
Booth 3949, IRE Show.



Coaxial switching connector: 1. center conductor 2. External switching terminal 3. ball locking mechanism



SPOT WRITING RATE:

**FASTER
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Developed to meet the precise needs of nuclear research and investigation, the Du Mont Type K1409 cathode-ray tube develops a spot writing rate exceeding the speed of light.

This is another example of the "can do" spirit and ability of the Du Mont Tube Research Laboratory.

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New Products

Products marked with a triangle are those being exhibited for the first time at the Radio Engineering Show, and include the company's booth number.

△ Crystal Ovens Subminiature



The HC-18 series has been designed for the military CR types utilizing the subminiature BHC-18/U holder. These units will conform to the military warm-up requirement of 3 minutes. The 10 and 15 crystal oven will stabilize within ± 2 C over an ambient of -55 C to below reference temperature.

This series is available in units capable of housing a single crystal, 10 crystals and 15 crystals. The operating voltage for the 10 and 15 crystals is 6 to 115 v ac or dc. The single unit oven is available from 6 to 24 v ac or dc.

Bulova Watch Co., Inc., Dept. ED, Electronics Div., 40-06 62nd St., Woodside 77, N.Y.
Radio Engineering Show, Booth 3930.

CIRCLE 57 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Coax Connectors For Printed Circuits



These subminiature coaxial connectors come in two types, bayonet lock and push-on for multiple unit application. Both are made in straight and right angle for cable attachment or modular unit connections. They are available in three types of insulation, Kel-F, nylon and Teflon.

Automatic Metal Products Corp., Dept. ED, 315 Berry St., Brooklyn 11, N.Y.
Radio Engineering Show, Booth 4426.

CIRCLE 58 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Compact VT Voltmeter 10 Megohms Input

Although it is a vacuum tube voltmeter, this instrument requires no more panel area than any ordinary 4-in. meter. Its housing extends only 3 in. behind the panel. This compactness is achieved by use of latest miniaturization techniques. The meter operates from 115 v 60 or 400 cps; it contains its own power supply and amplifier. Input impedance is 10 megohms. Range is 0.5 v zero center to 300 v full scale. Either zero center or zero left scales are available; and there is a ruggedized military version. The meter can be zeroed while connected.

Trio Laboratories, Inc., Dept. ED, Seaford, N.Y.
Radio Engineering Show, Booth M6.

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△ Traveling Wave Tubes Have Long Life



These traveling wave tubes have frequency ranges in the 2000 mc and 4000 mc bands, and a life of 10,000 hours or more. The type N1001 is a power tube rated at 16 w. N 1002 has a noise factor of 10 db and a gain of 25 db while N1013 has a 35 db gain and 200 mw output.

Marconi Instruments, Dept. ED, 44 New St., New York, N.Y.
Radio Engineering Show, Booth 3315-3317.

CIRCLE 60 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Vibration Testing Machine Range 10 to 55 cps



Developed for vibration testing of small items up to 5 lbs maximum, the Model 14-28 weighs 30 lbs. It has a variable speed drive mechanism and 1/15 hp split phase induction motor housed in a cast aluminum base. Frequency adjustment is provided from the front of the machine and is continuously variable while the machine is running from 10 to 55 cps. Amplitude setting is from 0 to 0.040 in., with double amplitude maximum 0.080 in.

Ahrendt Instrument Co., Dept. ED, 4910 Calvert Rd., College Park, Md.
Radio Engineering Show, Booth 3049.

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△ Rotary Switch Hermetically Sealed

Encased in metal, the Model H10-7 is sealed with a flexible silastic compound and has a leak rate of under one micron per cu ft per hr. This rotary switch can be wired externally from spst to dpdt, four circuit. Designed for aircraft use, its ambient temperature range is -100 to $+250$ F.

Electro Snap Switch & Mfg. Co., Dept. ED, 4218 West Lake St., Chicago 24, Ill.
Radio Engineering Show, Booth 2225.

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△ **Decimal Converter**
Binary Coded

This binary-coded decimal/analog/digital converter uses the 1, 2, 4, 8 pattern, and presents its output in parallel form on 12 terminals. Simultaneous presentation of the complement of the output is a standard feature. Accuracy is 0.1 per cent. Running torque is rated at less than 0.2 oz-in., moment of inertia at 31.4 gm/cm², and resolution up to 10,000. Life is rated at 3 x 10⁸ revolutions at the recommended maximum operating speed of 200 rpm. The converter is mounted in a standard size No. 23 BuOrd synchro mounting arrangement, and is available in sizes weighing less than 5.5 oz.

Norden-Ketay Corp., Dept. ED, Commerce Rd., Stamford, Conn.

Radio Engineering Show, Booth 2401-2403.

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△ **VTVM**
For Low Frequencies

The MV-02B a-c VTVM has a frequency range of 2 cps to 250 kc and a full scale voltage range of 3 mv to 1 kv. The instrument is equipped with a galvanometer-attenuation switch which makes it possible to obtain fast needle response on all measurements above 20 cps while the necessary slow response is being maintained between 2 cps and 20 cps. The plate current supply is electronically regulated. There are individual calibration controls for all 12 ranges of the instrument.

Millivac Instrument Corp., Dept. ED, P.O. Box 997, Schenectady, N.Y.

Radio Engineering Show, Booth 3204-3206.

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ELECTRONIC DESIGN • March 1, 1957



VOLTAGE REGULATED POWER SUPPLIES

*for Transistors • Strain Gages
Relays • Filament Power*

MODEL	Volts	Current	Regulation		Ripple	Recovery Time*	Stability For 8 Hours	Output Impedance		Dimensions			Price
			Line 105-125	Load 0-Max.				DC-20 v	20-100 KC	W	H	D	
2600	0-60	0-2 Amp.	5 Mv.	5 Mv.	1 Mv.	50 μ sec.	10 Mv.	0.002 Ω	0.0005 Ω	19"	10½"	17"	\$400
2650	0-60	0-5 Amp.	5 Mv.	5 Mv.	1 Mv.	50 μ sec.	10 Mv.	0.001 Ω	0.0002 Ω	22½"	28"	19"	\$1100

Good stability
Fast recovery time
Low output impedance
Excellent regulation
Low ripple

POWER REQUIREMENTS: 105-125 volts, 60 cycles.
FUSE PROTECTION: Input and output fuses on front panel. Time delay relay is included to prevent unregulated voltage from appearing at the output terminations.

OUTPUT TERMINATIONS: DC terminals are clearly marked on the front panel. Either positive or negative terminal of the supply may be grounded. DC terminals are isolated from the chassis. A binding post is available for connecting to the chassis. All terminals are also brought out at the rear of the unit. Two terminals are mounted at the rear of the chassis to provide for picking up the error signal directly at the load. This connection compensates for the voltage drop in the wires (and ammeter) connecting the power supply to the load.

METERS: Ammeter: 0-2 amperes, 4" rectangular for Model 2600
0-5 amperes, 4" rectangular for Model 2650

Voltmeter: 0-60 volts. 4" rectangular

CONTROLS: Power on-off switch, DC on-off switch, remote error signal on-off switch, coarse and fine voltage controls. The coarse voltage control is a ten turn potentiometer which varies the voltage from 0-60 volts. The fine voltage control is a ten turn potentiometer which varies the voltage 1 volt. The voltage divider network allows a 61 volt variation in output voltage.

*Recovery time is less than 50 microseconds. The excursion in the output voltage during the recovery period is less than 50 millivolts for line fluctuations from 105-125 volts or load variations from 0-to maximum current.



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△ RF Screen Room
Low Cost Portable

A special screen with sufficient attenuation, 100 db or more from 200 kc to 1000 mc makes it an ideal screen room for a wide range of commercial and military applications. The screen is woven of steel wire, then dipped in a special alloy. The Champion line is available in all popular screen room sizes, and special rooms can be constructed to meet any custom specifications. The door has strong contact fingers and single handle with 3-point pressure contact. Floor construction is extra strong with cross beams every 12 inches. Flooring is 3/4 in. plywood. Interchangeable panels are held in contact with each other with locks which supply continuous pressure of 1200 lbs. The screen room's easy to assemble and knock down for convenient relocation.

Erik A. Lindgren & Assoc Inc.,
Dept. ED, 4515 N. Ravenwood Ave.,
Chicago 40, Ill.

Radio Engineering Show, Booth 1924.

CIRCLE 66 ON READER-SERVICE CARD

△ Cold Punch Laminate
Low Loss

This cold punching laminate has high insulation resistance, low dielectric loss at high frequencies, and low moisture absorption. The laminate, called Insurok XT-896, punches at average room temperatures. This XXXP laminate in copper clad form has a high bond strength and good blister resistance.

The Richardson Co., Dept. ED,
Melrose Park, Ill.

Radio Engineering Show, Booth 1628.

CIRCLE 67 ON READER-SERVICE CARD

△ Insulating Material
High Tensile Strength

The tensile strength of phalene is 2800 to 6400 lbs/sq.in. It provides more heat resistance than standard polyethylene insulation. Hardness, by the Shore Hardness Test is 63 to 70. Dielectric strength in volts per mil is 500 to 700.

Phalo Plastics Corp., Dept. ED,
25-P Foster St., Worcester, Mass.

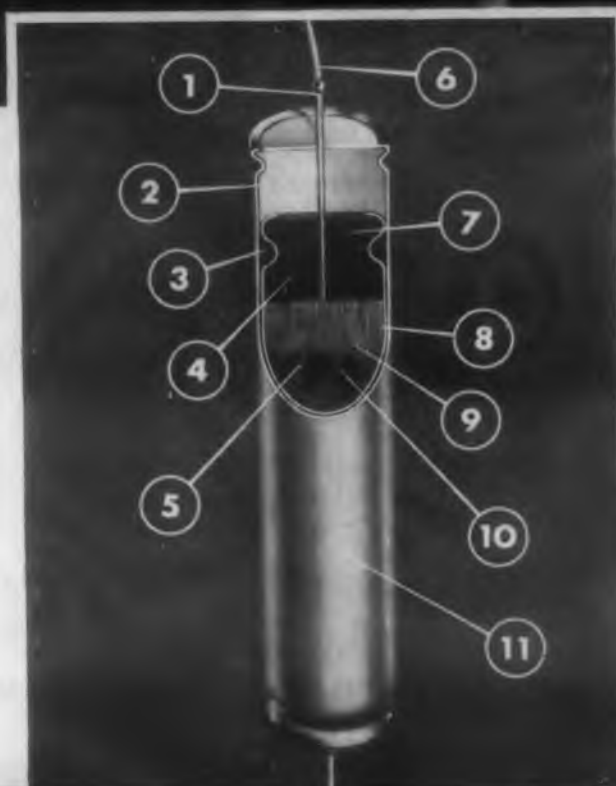
Radio Engineering Show, Booth 4704.

CIRCLE 68 ON READER-SERVICE CARD

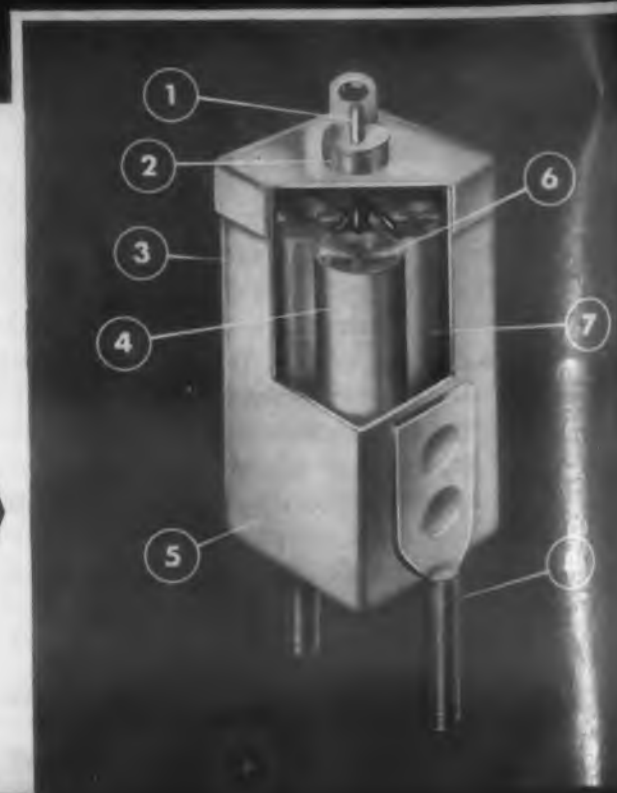
CIRCLE 69 ON READER-SERVICE CARD >



CAPACITORS



HIGH TEMPERATURE TANTALYTIC CAPACITOR — TUBULAR — features: 1 — Tantalum lead, 2 — Teflon[®] bushing, 3 — Mylar[®] insulating sleeving, 4 — Insulation, 5 — Paper and tantalum foil roll, 6 — Solderable nickel lead, 7 — Rubber bushing, 8 — Double metal case construction, 9 — Non-acid electrolyte, 10 — Plain and etched foil, 11 — Polar or non-polar construction.



HIGH TEMPERATURE TANTALYTIC CAPACITOR — RECTANGULAR — features: 1 — Tantalum stud, 2 — Silicone bushing, 3 — Polar or non-polar construction, 4 — Paper and tantalum foil rolls, 5 — Silver-plated metal case, 6 — Plain and etched foil, 7 — Non-acid electrolyte, 8 — Mounting stud (optional).

[®]DuPont Co. Trade Mark

General Electric Tantalytic* capacitors operate at +125 C ambient for 1000 hours at full rated voltage

To help you solve difficult space problems in design functions demanding high reliability miniaturized equipment capable of operating in ambient temperatures ranging from -55C to +125C at full rated voltage, General Electric offers a variety of shapes and sizes of high temperature Tantalytic capacitors.

The Tantalytic capacitor is built for at least 1000 hours operation at +125C with no more than 20% loss in capacity. Below +125C, capacitor life is extended in proportion to the reduction in ambient temperature.

Whatever your capacitor requirements might be, there is a General Electric sub-miniature capacitor for most applications. Take, for example, the metal-clad tubular capacitor—mineral oil impreg-

nated, built to MIL-C-25A—often applied to "work horse" applications in military electronic circuits. Or, capacitor pulse forming networks, adhering to strict capacitance tolerance and temperature range, are engineered for missiles and radar equipment.

New permafil capacitors, built to meet the characteristic "K" requirements of MIL-C-25A, are now available in rectangular case styles. These solid dielectric capacitors can withstand the violent shock and vibration found in today's missile and airborne electronic systems.

For assistance with capacitor applications contact your General Electric Apparatus Sales Engineer or write to the General Electric Company, Section 442-40, Schenectady 5, New York.

*Registered Trade Mark of General Electric Co.

Progress Is Our Most Important Product

GENERAL ELECTRIC



METAL-CLAD TUBULAR CAPACITORS— +85C, mineral oil impregnated. Built to MIL-C-25A. Ratings: .001 to 1.0 uf, 100-600 v. d-c. Tol: $\pm 5\%$, $\pm 10\%$, or $\pm 20\%$. Write for GEC-1390.



PERMAFIL RECTANGULAR solid dielectric in case styles CP50, CP60, and CP70 series. Built to electrical requirements of characteristic "K", MIL-C-25A. Ratings: .01 uf to 10 uf; 100 v. d-c to 1500 v. d-c, Temp. range: -55C to +125C.



CAPACITOR PULSE FORMING NETWORKS—for missiles and radar equipment. Capacitance tolerance: $\pm 7\%$ (at +25C). Temp. range: -55C to +125C. Write for GEA-4996.

△ Ag-Cd Oxide Contacts For Long Wear

Silver-cadmium oxide top-layer contacts are available in clad strip widths of 1/16 to 4-1/2 in. and in base metal thickness from less than 0.010 to 0.250 in. or more. The silver-cadmium oxide metal on the contact section of top-layer varies from 0.015 in. thick by 1/8 in. wide, minimum, up to any practical maximum dimension. Silver-cadmium oxide can be combined with practically any rollable or malleable base metal in top-layer strip or contact form.

Metals & Controls Corp., Dept. ED, General Plate Div., Attleboro, Mass. *Radio Engineering Show, Booth 1226.*

CIRCLE 70 ON READER-SERVICE CARD

△ Silicon Rectifiers

For Miniaturized Circuitry

These low-power, glass packaged silicon rectifiers exhibit low forward voltage drop and low back leakage. They are adaptable to miniaturized circuitry and feature maximum a-c input voltages up to 275 v rms; maximum reverse d-c working voltages up to 375 v; maximum average rectified forward current up to 200 ma; maximum power dissipation at 25 C up to 200 mw. Operating temperature range for all types is -75 C to +150 C. The maximum dimensions, rectifier glass body; length 0.265 in. diam, 0.105 in.

Hughes Products, Div. Hughes Aircraft Co., Dept. ED, Semiconductor Div., International Airport Station Los Angeles 45, Calif.

Radio Engineering Show, Booth 2801-2805.

CIRCLE 71 ON READER-SERVICE CARD

Nylon Bonding Agent Bonds Nylon to Metal

Bonding Agent R-323, an epoxy-based compound designed to bond Nylon to itself, to metal, or to other materials may be used with rubber

Carl H. Biggs Co., Dept. ED, 2255 Barry Ave., W. Los Angeles, Calif.

CIRCLE 72 ON READER-SERVICE CARD

◀ CIRCLE 69 ON READER-SERVICE CARD

four good reasons for specifying

ALSiMAG[®] alumina ceramics!

1 Highly specialized compositions. Complete range of industry-approved ALSiMag Aluminas for exacting applications. New freedom in design from their outstanding performance at elevated temperatures and frequencies . . . superior electrical characteristics . . . higher compressive, tensile and flexural strengths . . . hardness (9 on Mohs' scale) . . . chemical inertness . . . greater resistance to impact, vibration, abrasion and repeated thermal shock. Custom formulations for special needs.

2 More production facilities. Complete manufacturing facilities devoted exclusively to ALSiMag Aluminas, including special high temperature kilns. Rapid delivery in any quantity . . . simplest to most intricate designs. Precision tolerances.

3 More experience. ALSiMag Aluminas are produced by skilled personnel, thoroughly familiar with the most modern methods . . . and highly specialized techniques perfected in over 55 years' experience in the manufacture of quality technical ceramics.

4 Dependable metal-ceramic combinations. Standard or custom designs available in volume. Wide choice of metals combined with strong, rugged Alumina ceramics. Permanent bonding. Close dimensional tolerances. High or low temperature types . . . for hard or soft solder.



For complete information on ALSiMag Aluminas, for your application, send blueprint or sketch with details of your operating procedure.



Ask for a free copy of Bulletin No. 562—ALSiMag Alumina Ceramics.

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A SUBSIDIARY OF MINNESOTA MINING AND MANUFACTURING COMPANY



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25-Watt UHF Twin Tetrode

Useful To 1200 Mc

A new twin tetrode, Type 6907, is intended primarily for service in airborne and mobile communications. It will deliver power up to 1200 mc. The tube has a single cathode and screen, providing full output at unusually low drive. It has all-molybdenum leads for lower rf losses, and powdered glass base and anode support for maximum protection against mechanical and thermal shock. Heater connections may be either 6.3 or 12.6 v.

The tube will deliver up to 25 w in continuous operation when used as a Class C amplifier at 462 mc. It will deliver 20 w continuously in the 225-400 mc military bands, and in such use it does not require air cooling or special sockets. It is rated as an amplifier or frequency tripler up to 600 mc.

Amperex Electronic Corp., Dept. ED, 230 Duffy Avenue, Hicksville, Long Island, N.Y.

CIRCLE 74 ON READER-SERVICE CARD

Silicone Sponge Rubber

Flexible to -100 F

A silicone sponge rubber made of 50 durometer base stock is primarily of closed cell count and possesses the same general qualities as the base material. The new sponge, Style 9383, has extreme flexibility at low temperatures down to a minus 100 F, yet it has good heat resistance up to 500 F. Having good compression set characteristics, this silicone sponge is tough and strongly resists tearing and abrasions. Orange in color, Style 9383 sheds cold water well and resists adhesion to ice. Its aging and weathering qualities are excellent. This silicone sponge is available in sheets, round, odd and simple extruded cross sections.

The Garlock Packing Co., Dept. ED, 405 Main St., Palmyra, N.Y.

CIRCLE 75 ON READER-SERVICE CARD

CIRCLE 73 ON READER-SERVICE CARD

△ Beam Power Tube

For 110 Degree Systems

The 5CZ5 is a high-perveance beam power tube of the 9-pin miniature type. It is designed for use as a vertical-deflection amplifier in TV receivers utilizing picture tubes having diagonal deflection angles of 110 deg and operating at voltages up to 18,000 v. The 4.7 v/0.6 amp heater has controlled warm-up time. The 5CZ5 has a maximum peak cathode current of 140 ma, and a maximum plate dissipation of 10 w.

Utilizing a T-6-1/2 miniature envelope, the 5CZ5 has an electrically isolated base-pin, and double base-pin connections for grid No. 1.

Radio Corp. of America, Dept. ED, Tube Div., Harrison, N.J.
Radio Engineering Show, Booth 1602, 1707.

CIRCLE 89 ON READER-SERVICE CARD

△ Servo Damper

Viscous Coupled Inertia Type



Designed to mount compactly without external support on either end of the Diehl FPE-25, 5 w servomotor, the Model CD-60 consists of a heavy cylindrical slug free to rotate inside a thin, low-inertia shell rigidly fastened to the servomotor shaft. Viscous silicone fluid between the inside slug and the shell provides the desired damping. All the necessary servo compensation is provided by the damper. Stabilizing dynamics are independent of line frequency shift and each damper is adjusted to the specified value of time constant.

Feedback Controls, Inc., Dept. ED, 899 Main St., Waltham 54, Mass.
Radio Engineering Show, Booth 3013.

CIRCLE 90 ON READER-SERVICE CARD

CIRCLE 91 ON READER-SERVICE CARD >

WHERE ELECTRONICS MEETS THE EYE



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MEDALIST
meters



marion
advancement
in instrument
design



Three things set Medalists apart from other panel instruments: style, color and readability. Their distinctive shape enhances whatever equipment they become a part of; standard or custom-matched case and dial colors further improve equipment appearance. Longer scale length, larger numerals and better over-all dial illumination vastly increase their readability.

Medalists are made in all standard ranges, in 1 1/4", 2 1/2", and 3 1/2" sizes. They provide a functional beauty that is unique among panel instruments today.

marion electrical instrument company

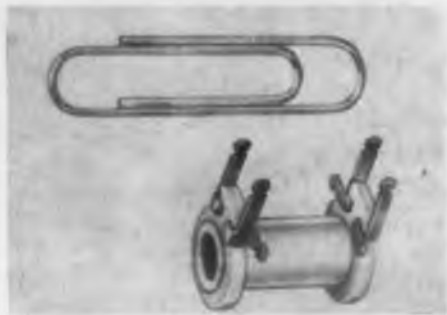
GRENIER FIELD, MANCHESTER, NEW HAMPSHIRE

At the I. R. E. Show, March 18-21:
Booth 2126

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CIRCLE 79 ON READER-SERVICE CARD FOR MORE INFORMATION

△ **Printed Circuit Coil Forms**
In One Style, Two Lengths



These horizontally-mounted printed circuit coil forms are made with 1/4 in. o.d. internally-threaded ceramic tubing, impregnated with grade L5 silicone. They are slug tuned by a powdered iron core. Each form has two silicone fibreglass collars and four solder terminals attached to the collars. The forms come in two sizes; No. 2270 is 5/8 in. long overall and mounts on 0.5 in. x 0.2 in. mounting centers; No. 2271 is 13/16 in. long and mounts on 0.7 in. x 0.2 in. centers. The terminals for soldering are attached to the fibreglass collars and are so designed that coil leads can be attached to them separately from the printed circuitry, or the leads may be attached to the circuitry with the terminals.

Cambridge Thermionic Corp., Dept. ED, 445 Concord Ave., Cambridge 38, Mass.
Radio Engineering Show, Booth 2219.

CIRCLE 81 ON READER-SERVICE CARD FOR MORE INFORMATION

△ **Potentiometer**
Precision Resistance

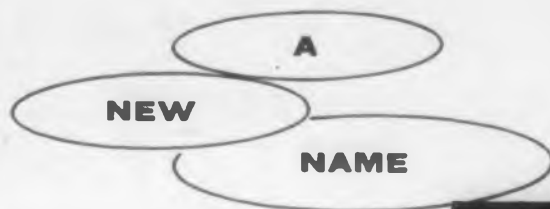


This 10-turn potentiometer measures 7/8 in. in diameter, and provides resistance values from 25 ohms to 125 k ohms at ± 3 per cent tolerance. Its power rating is 2 w and it can accommodate 40 taps. Both mechanical and electrical rotation is 3600 deg. $+5 -0$ deg. The potentiometer's maximum starting torque is 0.6 oz./in. for bushing and 0.5 oz./in. for servo. Running torque is 0.5 oz./in. bushing and 0.4 oz./in. servo. Designed to operate over an ambient of -55 to 85°C , this unit weighs 1 oz and has a voltage breakdown rating of 1000 v rms. Mechanical and electrical rotation of $+1$ and -0 deg. is available on request.

Spectrol Electronics Div., Carrier Corp., Dept. ED, 1704 So. Del Mar Ave., San Gabriel, Calif.
Radio Engineering Show, Booth 1726.

CIRCLE 82 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 83 ON READER-SERVICE CARD >



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THE ONE UNIVERSAL METER

MICROVOLTS TO KILOVOLT



The KINTEL Model 203 is a combination DC microvolt-ammeter and amplifier. It provides an exceptionally wide range of measurements. Fifteen voltage ranges cover from 100 microvolts full scale to 1000 volts full scale, with 100 megohms input impedance. Ten current ranges cover from 100 micro-microamperes full scale to 100 milliamperes full scale. As little as 10 microvolts or 10 micro-microamperes may be measured with accuracy. The uncluttered zero-center meter face instantly indicates polarity on a mirrored scale. When used as a DC amplifier, the instrument features exceptionally low drift with high gain, very high input impedance and low output impedance. Gains up to 80 db with less than 10 microvolts drift may be obtained. The Model 203 utilizes KINTEL's unique chopper stabilized circuit to provide high sensitivity with previously unobtainable drift-free stability and high input impedance.

APPLICATIONS: Electronic, medical, geophysical, chemical, metallurgical research and development... transistor production and circuit design... thermocouple calibration... null detector... recorder driver amplifier... and as a general purpose laboratory instrument wherever dc voltage and currents are measured or amplified.

SPECIFICATIONS

Voltage Range (full scale).....	100 μ v to 1000v	Accuracy on All Ranges.....	\pm 3% of full scale
Current Range (full scale).....	100 μ ma to 100 ma	Maximum Gain as Amplifier.....	80 db \pm 1.5%
Input Impedance.....	10 megohms below 10 mv, 30 megohms at 30mv, 100 megohms above 30mv	Output Rating.....	1v across 1000 Ω
Impedance Accuracy.....	\pm 1.5%	Output Impedance.....	less than 5 Ω
		Drift (after 15 min. warmup)....	10 μ v equivalent input
		Price.....	\$550.00

Rack Mounting available as Model 203R

KINTEL

[KAY LAB]

STABILITY



Locked in!

WITH CHOPPER AMPLIFIERS

5725 KEARNY VILLA ROAD • SAN DIEGO 11, CALIFORNIA • BROWNING 7-6700



△ Switching Transistors

For High Currents

Three high speed germanium PNP computer transistors, the 2N-315, 2N-316 and 2N-317 are designed for high current switching applications.

The 2N-317 has, with a minimum of drive current, a typical switching speed of 0.3 microseconds at 400 ma of collector current. The series resistance of these transistors when conducting is 1/2 ohm; the nonconducting series resistance is 10 megohms.

General Transistor Corp., Dept. ED, 91-27 138th Pl., Jamaica, N. Y.

Radio Engineering Show, Booth 3828.

CIRCLE 84 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Multi-Switch Modified Design

This switch can be manufactured economically in any multiple of stations from 1 to 37. A choice of functions are possible including interlock, nonlocking, all lock, interlock and nonlock combination, and an all lock and nonlock combination. This design offers a choice of mounting centers, center to center distance between buttons 5/8 in., and plungers designed to accept standard push-on buttons. Up to 4 stacks of stock switches can be mounted on a separate plate and operated by each button.

The flexible design makes it possible to connect together two or more rows of Multi-Switches and provide interlock action between all the buttons. A feature of the ganged assemblies is the lock-out bars which can be provided in switches of 1 to 37 stations so that only 1 station can be depressed at one time.

Switches can be provided with silver contacts or with welded cross bar Palladium contacts.

Switchcraft, Inc., Dept. ED, 1328 N. Halsted St., Chicago 22, Ill.

Radio Engineering Show, Booth 2228.

CIRCLE 85 ON READER-SERVICE CARD FOR MORE INFORMATION

◀ CIRCLE 83 ON READER-SERVICE CARD

**GARLOCK and
UNITED STATES GASKET**
integrate their sales forces

United States Gasket Company—pioneers and leaders in the fabrication and application of TEFLON*, KEL-F†, Nylon and other Engineered Plastics—now will be known as *United States Gasket Company, Plastics Division of The Garlock Packing Company.*

The U.S.G. sales organization of plastics specialists has been integrated with the 125 Garlock salesmen at 30 sales offices and warehouses, strategically located in the principal industrial areas of the United States and Canada. The assistance of these men and large stocks of our products are now as near as your telephone.

Other Advantages to You

EVEN GREATER KNOW-HOW . . . To United States Gasket's unique knowledge of the Engineered Plastics for electrical, chemical, and mechanical services, throughout Industry, Garlock now adds its 70 years of experience and research in solving the sealing problems of Industry with packings, gaskets and closures for every conceivable need.

INFINITELY GREATER LINE . . . offers greater selection in suiting each problem—one reliable source for more of your requirements, simplified purchasing.

GREATER RESOURCES FOR FURTHER RESEARCH AND DEVELOPMENT . . . assures that U.S.G. will continue to lead the Engineered Plastics Industry. Continue to produce most of the advanced ideas and practices in the application of these plastics to commercial A.E.C. and military requirements.

With these greater facilities, we look forward to serving an even larger proportion of your requirements, helpfully, promptly, and economically.

UNITED STATES GASKET COMPANY, Camden 1, New Jersey



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CANADIAN OFFICES AND WAREHOUSES: EDMONTON, Alta., 8407 103rd St.; HAMILTON, Ont., 200 Queen St., North; VANCOUVER 5, B. C., 1925 West Georgia St.; MONTREAL 9, Que., 5215 De La Savane St.; TORONTO 2, Ont., 750 Bay St.; WINNIPEG 3, Man., 1436 Erin St.

**United
States
Gasket** *Plastics Division*
OF THE GARLOCK PACKING COMPANY

CIRCLE 86 ON READER-SERVICE CARD FOR MORE INFORMATION

**△ 20 Kw Klystron
225-400 Mc**



The 3KM50,000PA has a 20 kw cw power output in the range of 225 to 400 mc.

Eitel-McCullough, Inc., Dept. ED, San Bruno, Calif.

Radio Engineering Show, Booth 2410-2412.

CIRCLE 87 ON READER-SERVICE CARD FOR MORE INFORMATION

**△ Goniometer
Precision Angle Measurements**



This unit has a machine-engraved, 4-1/2 in. diameter protractor which, by means of a vernier, can be read to one minute of arc. The accuracy of the graduation is ± 15 sec. The angle head turns in a tapered steel bearing and a surveyor's transit. There is means to take up wear when required. The goniometer provides a means of mounting the instrument to be tested and it will accommodate six different diameters of locating boss in the range 0.750 up to 2.875 in. diam. All the standard size synchro and potentiometer mounting diameters fit without any alteration. Adaptors are available to accommodate nonstandard diameters. Shaft diameters from 0.078 up to 0.250 in. can be accommodated by means of collets. Shaft lengths up to 2 in. fit the fixture without alteration.

The goniometer is made of stainless steel and nonferrous materials. It is 8 x 10 x 9 in. and weighs 10 lbs. It is supplied in an instrument-type wood case, with collets to accommodate various diameters of shaft.

Electro-Mec Laboratory, Inc., Dept. ED, 47 51 33rd St., Long Island City 1, N.Y.

Radio Engineering Show, Booth 2713.

CIRCLE 88 ON READER-SERVICE CARD FOR MORE INFORMATION



Encapsulated Resistors

Microminiature, Wirewound

Measuring 3/32 in. dia x 5/16 in. long, this new resistor, designated HA00, is available in the range 0.1 ohm to 25k ohms. Standard tolerance is ± 1 per cent. Tolerances as low as 0.1 per cent are available on special order. Wattage rating is 1/10 w full load at 85 C, meeting the environmental conditions of MIL-R-93A. The HA 33 resistor shown in the picture for comparative purposes measures 3/8 in. dia x 1 in. long.

General Resistance, Inc., Dept. ED, 577 East 156 St., New York 55, N.Y.

CIRCLE 366 ON READER-SERVICE CARD FOR MORE INFORMATION

Transducer Limiter For Automatic Operations



Stable repeatability to 0.000025 in. is one of the features of this limit controller. Any quantity measurable by differential transformer transducers, such as pressure, flow, acceleration, stress, size or weight can be controlled by the limit controller in highly accurate automatic operation.

The limit controller is preset to any desired control point in the cycle of the standard transducer. Whenever input quantity equals or exceeds the preset limit a relay closes. When the output quantity falls short of the preset limit, the relay opens. Panel indicators, alarm devices or control devices are thus operated.

Operating time is approximately 0.05 seconds. Linearity is 0.1 per cent. The limit control is available in either portable or rack mounting models, both designated Model 561.

Daytronic Corp., Dept. ED, 216 S. Main St., Dayton 3, Ohio.

CIRCLE 367 ON READER-SERVICE CARD FOR MORE INFORMATION

NO
CHANCE
FOR
ERROR



* If conductors are branded with Turbo Identification markers!

Positive Identification . . . is sure and easy when Turbo identification markers code your circuits, wiring, cable or connections. You're assured of an efficient low-cost operation wherever a multiplicity of electrical operations must be performed with speed and accuracy. They just slip on, yet fit so snugly they will not slide from position.

Permanent Identification . . . special inks used in the manufacturing of Turbo Identification Markers provide permanent legibility resisting the effect of high and low temperature, abrasion, chemical action and humidity. Markers are manufactured from Turbo varnished cambric tubing and Turbo extruded plastic tubing and meet all applicable Army, Navy and Air Force specifications.

Merchandise your product . . . with Turbo Markers your trade mark or whatever imprint you want can be applied longitudinally or circumferentially in a variety of colors. Anything that can be drawn, in fact, can be printed. Use them to code component parts or to brand any wire, cable, tube, rod, pipe or hose.

Available . . . in all standard sizes from No. 14 to 1 1/2" I.D. in lengths from 3/8" to 4". Longer lengths or special non-standard sizes or colors furnished upon request. Write for samples.



Permanent identification — available in a wide range of sizes and colors.

WILLIAM BRAND
AND COMPANY, INCORPORATED

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QUALITY ELECTRICAL AND ELECTRONIC WIRE
AND TUBING SINCE 1920

Be sure to visit the William Brand Suite at the Plaza Hotel, New York, during the I R E Show—March 18-20

CIRCLE 368 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Computer Packages
Plug-In Type



This family of transistorized, digital computer units, designated 3C-PACS Series L, comes in plug-in packages and includes flip-flops, emitter-followers, pulse amplifiers, gating packages and others. Features are compact size, low power consumption, printed circuit wiring, complete transistorization and high reliability. Full compatibility between packages permits user to assemble digital systems merely by proper inter-package point-to-point wiring.

Computer Control Co., Inc., Dept. ED, 92 Broad St., Wellesley 57, Mass. *Radio Engineering Show, Booth 1322.*

CIRCLE 93 ON READER-SERVICE CARD

RF Preamplifiers
Have High Gain



The Model I preamplifier provides a gain of 35 db at band center and the Model 2 50 db, both with a maximum noise figure of 3.5 db. Frequency response is within 3 db over the band of 215-247 Mc. The unit occupies a volume of 1/3 cu ft and weighs 3-1/2 pounds.

Radiation, Inc., Dept. ED, Melbourne, Fla.

CIRCLE 94 ON READER-SERVICE CARD

CIRCLE 15 ON READER-SERVICE CARD ➤

See What's New...

with BECKMAN / BERKELEY TEST INSTRUMENTS • BOOTHS 3416-18

NEW APPLICATIONS

★ **FERRISTORS* AND HOW TO USE THEM**



Data File #110 gives detailed examples of 14 magnetic circuits, plus complete technical data on FERRISTORS* and how to use them.

★ **FREQUENCY MEASUREMENTS AND HOW TO MAKE THEM**



Data File #111 covers Berkeley EPUT* meter techniques for low and medium frequencies; Berkeley EPUT* and heterodyne techniques for RF, VHF and UHF; preset counter and time interval meter techniques for rapid low frequency measurements; measurement of rpm, flow, pressure, temperature and strain; setting up a standard of frequency, and nuclear counting techniques.

★ **TIME INTERVAL MEASUREMENTS AND HOW TO MAKE THEM**



Data File #112 gives detailed descriptions of techniques for measuring elapsed time between pulses, timing relay operation, camera shutter speed measurements, velocity measurements, precise phase angle measurements and low frequency measurements.

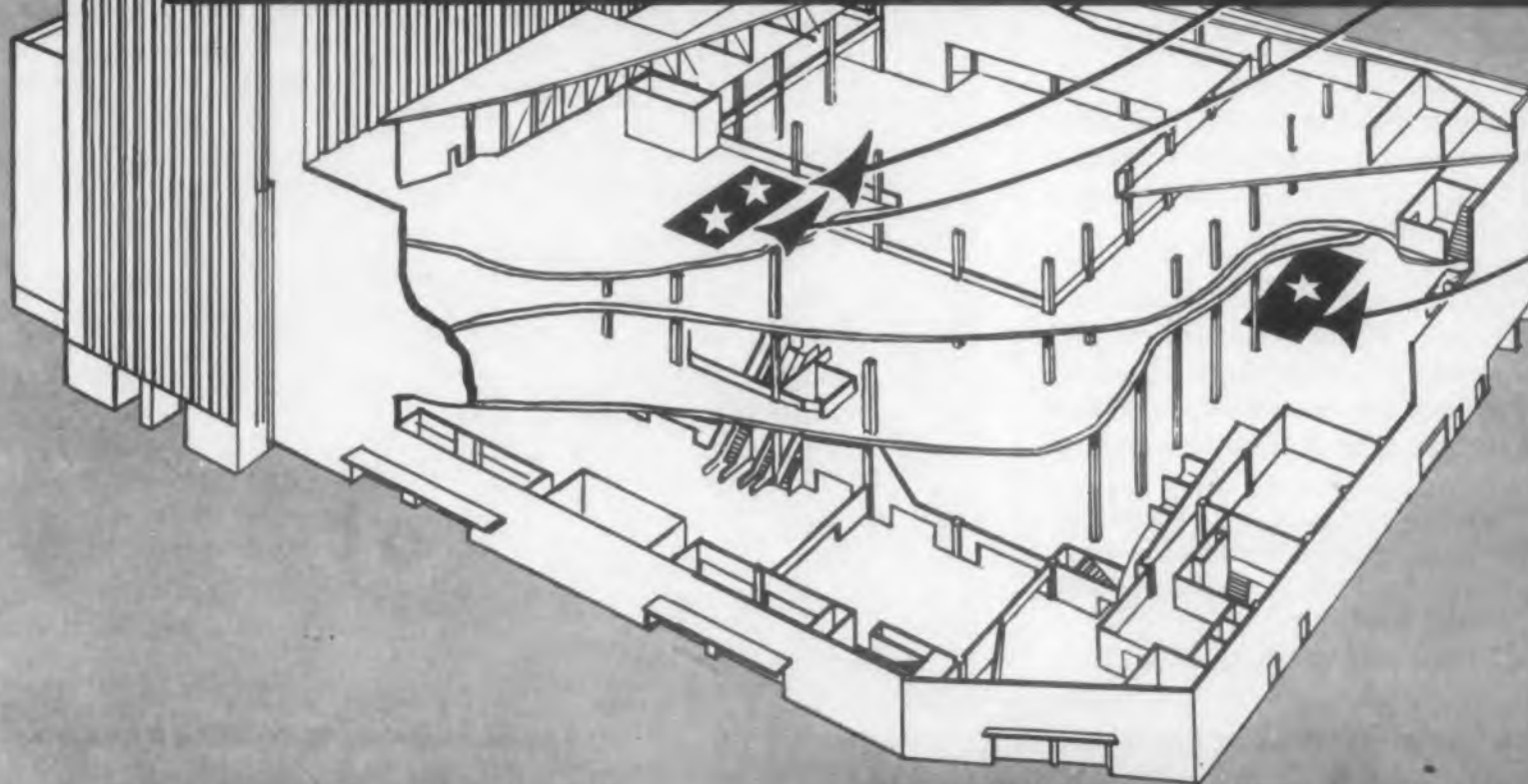
NEW PRODUCTS ON DISPLAY



ALL-NEW GATING COUNTERS

Models 7050 (100 kc) and 7060 (1 mc) counters offer both manual and electronic gating for extreme versatility. Gate control signals may be of any frequency from d.c. to maximum counting rate of the instrument, with no restrictions as to input waveform.

Sensitivity is 0.1 rms; input impedance 10 megohms, dc or ac coupled. Input circuits have step attenuators with ± 1 , ± 10 or ± 100 v adjustable trigger level ranges. Will operate directly into Berkeley remote readout units, digital printers or data converters. Price (at factory), Model 7050, \$545; Model 7060, \$645.



with BECKMAN / SHASTA INSTRUMENTS • BOOTH 3414

NEW APPLICATIONS

★ WWV RECEIVERS AND HOW TO USE THEM

Shasta Data File #10 describes the functions of NBS radio broadcasts from WWV and WWVH, explains in detail how these broadcasts can be utilized for the precise calibration of standard radio frequencies, audio frequencies, time intervals, and musical pitch.

NEW PRODUCTS ON DISPLAY



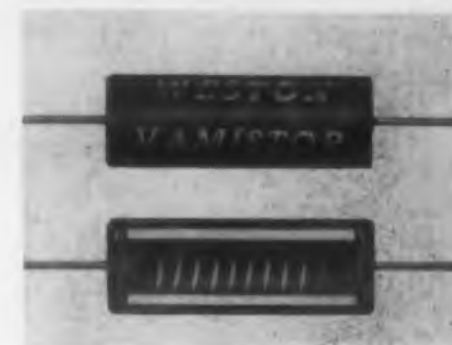
Model 905 WWV Receiver — covers all six WWV and WWVH frequencies with separate crystals for each; has built-in audio filters for 440, 600, 1000 cps discrimination, and 300 ohm antenna input matcher. Bands and audio discriminators selectable by panel switch — no plug-ins. Rock mounted; modular construction with blower cooling.



Model 100 Transformation Ratio Meter — an rms-reading expanded scale voltmeter with precision voltage divider and input switching for rapid testing of synchros to $\pm 0.2\%$ accuracy. Nominal input voltages are 57.3, 78, 90, 105 and 115; input frequency, 50 to 1,000 cps, impedance 10,000 ohm/v.

△ Nickel-Chromium Resistors

Fused to Steatite Tube



Utilizing a new alloy of the nickel-chromium family, thermally fused to the inner surface of a steatite tube, this new line of resistors is intended to replace the wire-wound type and to offer superior quality and stability. The Vamistor units are available in 1/2-w and 1-w ratings, from 1000 to 100,000 ohms, and with temperature coefficients of ± 50 ppm. They meet or surpass MIL-R-93A, MIL-R-19074A and MIL-R-10509B. They are rated substantially non-inductive, and have a distributed capacitance of only 0.9 μf . Noise level at 50 v d-c input is -200 db. Tolerance is ± 1 per cent. Also available are variants with temperature coefficients of ± 25 ppm and tolerances of ± 5 per cent. Dimensions are 5/16 in. outside diameter by 3/4 in. long. The resistor is molded in epoxy resin.

Weston Electrical Instrument Corp., Dept. ED, Newark 12, N.J.

Radio Engineering Show, Booth 2907-2915.

CIRCLE 97 ON READER-SERVICE CARD

△ Terminal Blocks

Have Mylar Insulation

A mylar insulation strip on the back of these terminal blocks covers and seals in all counterbores having screw ends. The mylar used is one mil thick, plus 1-1/2 mils for cement, thus making the over-all thickness 2-1/2 mils. The dielectric strength is 5000 v.

Kulka Electric Mfg. Co., Inc., Dept. ED, Mt. Vernon, N.Y.

Radio Engineering Show, Booth 2901.

CIRCLE 98 ON READER-SERVICE CARD

◀ CIRCLE 15 ON READER-SERVICE CARD

with BECKMAN / BERKELEY COMPUTERS & SYSTEMS • BOOTH 1728

NEW PRODUCTS ON DISPLAY



New EASE* 1100 Series Computers with DO/IT (Digital Output — Input Translator system) — a wholly-new concept in analog computation. Provides digital input-output by means of punched tape or electric typewriter, automatic static or dynamic problem checking, complete pushbutton monitoring, fully shielded color-coded patchboard, and many other advanced-design features.

New Analog-Digital Tachometry Systems measure rotational speed, indicate in both analog and digital form. System displayed is similar to those used by Ford Motor Co., and Allison division of General Motors. Analog uses 2-meter indication; first (full scale) has accuracy of 1%; second expanded-scale meter (covers 5% of full scale) has 0.25% accuracy. Digital data is displayed on remote in-line read-out with accuracy of ± 1 count, 1 part in 10,000.



New Automatic Radioassay Equipment — complete systems for automatic sample counting and data recording. Two detector sample changer takes up to 250 samples; data may be recorded by digital printer or fed to card punch for automatic data processing.



Model 5699 Digital Flow Indicator — gives direct-reading digital indication of transducer output frequency or percentage ratio of speed and volume, etc. Features higher sensitivity (ranges from 5 mv @ 5 cps to 1 v @ 100 kc), improved pulse resolution (10 μsec paired input pulses, 100 μsec on totalizing), dual range preset time (0-1 sec in 0.1 millisecond increments or 1 to 10 sec in 1 millisecond increments), time base stability of 1 part in 10^6 per day, 5 digit presentation, and versatility to drive digital recorders, remote indicators, data converters, etc.

DON'T MISS THESE TWO BECKMAN/BERKELEY EXHIBITS if you attend the IRE show. If you can't attend, please write us for application data and technical bulletins on the new techniques and new products that interest you. For prompt action, please address Dept. D3.

*Trademark

Beckman / Berkeley Division
Richmond 3, California
a division of Beckman Instruments, Inc.



THE "150" DESIGN CONCEPT

1. A system starts with an 8-, 6-, 4-, 2- or 1-channel basic assembly which includes a complete recorder assembly, and a Driver Amplifier and Power Supply (A) for each channel.
2. To this basic assembly are added interchangeable plug-in type preamplifiers (B) according to the measurement requirements.

HERE'S REAL oscillographic RECORDING VERSATILITY

A Sanborn "150 Series" System can be set up to record any of these inputs in any of the channels

AC or DC Signals,



AC-DC Preamp

balanced or single-ended, with sensitivity of 1 mv to 2 v/cm (AC), 1 mv to 2 v/mm (DC).

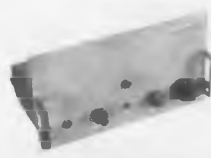
Voltage Levels Recorded Logarithmically



LOG-AUDIO Preamp

Audio signals (20 cycles to 20 KC) or DC voltages recorded in logarithmic fashion on 50 decibel chart.

Higher Level Signals,



INPUT COUPLING NETWORK

where maximum sensitivity of 1 v/cm, and input impedance of about 200,000 ohms are adequate.

Magnitude and Direction of Physical Variables.



CARRIER Preamp

with variable resistance, differential transformer or variable reluctance transducers.

Extremely Low Voltages and Currents,



LOW LEVEL Preamp

at sensitivities of 100 μ v and 1 μ a per cm. (with external shunt of 100 ohms), by means of DC chopper circuit.

RMS Values of AC Voltages, Currents,



VOLT/AMMETER Preamp

from 25-250 volts, 50 ma — 1 amp.

AC Voltage Components



SERVO MONITOR Preamp

in phase or 180° out of phase with a reference voltage (e.g., servo error signal).

Low Level Signals,



STABILIZED DC Preamp

with extreme stability, high gain, and greater bandwidth than with 150-1500 Low Level Preamplifier.

Symmetric or Asymmetric Wave Form Inputs,



FREQUENCY DEVIATION Preamp

in 350-450 cycles (2 cycles/mm) and 375-425 cycles (1 cycle/mm) ranges.

DC Signals



DC COUPLING Preamp

(push-pull, single-ended or difference between two). Basic sensitivity 50 mv/cm to 50 v/cm.

Average Value of AC Watts in a Circuit,



AC WATTMETER Preamp

in ranges from 25 volts x 40 ma to 250 volts x 2 amps. (with internal multipliers and shunts which can handle up to 4 amps).

AND, in addition to this great versatility, *equally valuable* to the user are the basic design features of Sanborn oscillographic recording systems, many of them available *only* in Sanborn equipment. They include inkless recording in true rectangular co-ordinates; improved overall linearity; numerous chart speeds; a choice of vertical mobile-cabinet or portable-cas; packaging; availability of 2-, 4-, 6- and 8-channel systems especially designed for recording analog computer outputs.

Sanborn engineers will be glad to help you select the equipment best suited to your needs. Contact them with confidence, and ask for a copy of the new and complete "150 Series" catalog.

INTRODUCED
AT I.R.E. SHOW

COMPLETE, SELF-CONTAINED EIGHT-CHANNEL SYSTEM ADDED TO 150 SERIES

Model 158-5490 is intended primarily for use with analog computers but capable of other types of recording. Features include 0.1v/cm sensitivity, push-pull or single-ended input, 5 meg. input impedance each input lead to ground. Frequency response is flat to 20 cps, down 2 db at 60 cps for all amplitudes to 4 cm peak to peak.



Liquid Metal Level Indicator Withstands High Radiation



Level height of liquid metals, such as liquid sodium, at temperatures up to 1300 F can be sensed by the transducer here shown. The device has no moving parts; it is built in the form of a hollow probe, which is so welded to the top of a receptacle that it extends downward into the liquid. Changes in the level of the liquid within the bore of the probe are sensed by the pickup coil system that surrounds the bore. When the transducer is connected to suitable circuitry, such as its maker's Model EWA-1M Control System it can be used for high-and-low-level control or alarm, for measurement of liquid height, or for driving a recorder, etc. The Liquid Metal Level Indicator is built exclusively of materials that have been approved for use in areas of high radiation. It is available in level ranges from a few inches to thirty feet.

Crescent Engineering & Research Co., 5440 N. Peck Rd., El Monte, Calif.

CIRCLE 101 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Resistor Bobbins Of Epoxide Resin



These resistor bobbins are made of the same resin used for encapsulating the finished resistors. Consequently resistors made with them are not affected by extremes of humidity, altitude or temperature. Seal is hermetic, and bobbin and encapsulation expand and contract to the same degree. The bobbins can be manufactured to 1/16 in. OD and critical tolerances maintained.

Norrish Plastics Corp., Dept. ED, 35 East 32 St., New York, N. Y.

Radio Engineering Show, Booth 4032.

CIRCLE 102 ON READER-SERVICE CARD FOR MORE INFORMATION

Don't miss an issue
of **ELECTRONIC DESIGN**;
return your renewal card today.

SANBORN COMPANY,

CAMBRIDGE 39,
MASSACHUSETTS

CIRCLE 100 ON READER-SERVICE CARD FOR MORE INFORMATION



△ **Transistor Tester**
Self-Contained Unit

Completely self-contained (although a scope may be plugged in if desired) this transistor tester measures grounded emitter current gain, collector saturation current, and input impedance. It embodies its own mercury cell power supply, with a rated battery life of about 1000 hours, and its own 1 kc oscillator. Printed circuitry has been used throughout to conserve weight, which is 3 lb.

Ranges and accuracies are: grounded emitter current gain, 0-200, ± 3 per cent; input impedance, 0-10 k ohms, ± 10 per cent; collector saturation current, 0-50 μ amp, ± 2 per cent. Emitter current is 0.5-10 ma.

Baird-Atomic, Inc., Dept. ED, 33 University Rd., Cambridge 38, Mass. *Radio Engineering Show, Booth 3219, 3221.*

CIRCLE 103 ON READER-SERVICE CARD

△ **Oscillograph Tubes**
1-1/4 in. Diameter

This new series of 1-1/4 in. oscillograph tubes is intended for use in light, portable equipment, or in continuous monitoring service for larger installations. The IEP1 has a medium-persistence phosphor, the IEP2 has a long-persistence characteristic, and the IEP11 display is of short persistence. All have separate base-pin terminals for each deflecting electron to permit use of balanced deflection, all utilize electrostatic focus and deflection; all have a flat face, a minimum useful screen diameter of 1-16 in. a maximum overall length of 4-1/16 in., and weigh 2 oz.

Radio Corp. of Amer., Tube Div., Dept. ED, Harrison, N. J.
Radio Engineering Show, Booths 1602, 1707.

CIRCLE 104 ON READER-SERVICE CARD

CIRCLE 105 ON READER-SERVICE CARD ➤



NOW...

two superior-quality

POWER TRANSISTORS!

RCA-2N301 and 2N301-A offer high power output with low distortion at high power gain

RCA's modern quality controls, production techniques, and test procedures continue to set high standards for transistor quality. The new RCA-2N301 germanium p-n-p alloy type is designed specifically for audio-power output stages of auto radio, marine, military and other mobile communications equipment. The new 2N301-A is similar to the 2N301, but is designed especially for use in military and commercial equipment requiring operation at peak collector voltages as high as 60 volts.

Especially well suited to applications in mass-produced equipment, RCA-2N301 and 2N301-A can deliver up to 2.7 watts in class A operation; 12 watts in class B push-pull operation—with a DC supply voltage of -14.4 volts. Total harmonic distortion at maximum-signal power output is less than 10%.

For good electrical contact and excellent thermal conductivity to the heat sink, RCA-2N301 and 2N301-A utilize a special mount structure in which the collector is electrically and thermally connected to a mounting flange.

Among the outstanding design features are: high gain • high alpha cutoff frequency • low thermal resistance • low leakage and low saturation currents • excellent current gain linearity over the full range of the collector current • high operating stability • excellent electrical uniformity.



TRANSISTORS

RADIO CORPORATION OF AMERICA

Semiconductor Division • Somerville, N. J.

TECHNICAL DATA—MAX. RATINGS (ABSOLUTE VALUE)		
	2N301	2N301-A
Collector-to-Base Voltage DC (for inductive load)	-20 max.	-30 max. volts
Peak	-40 max.	-60 max. volts
Dissipation (mounting flange temp. 55°C)	12 max.	12 max. watts
TYPICAL OPERATION FOR 2N301 & 2N301-A (AMBIENT TEMP. 55°C)		
	CLASS A	CLASS B
DC Supply Voltage	-14.4	-14.4 volts
Max.-Sig. Power Output	2.7	12 watts
Power Gain	32.5 db	30 db
Circuit Efficiency	47%	67%
Total Harmonic Dist.	10%	10% max.
CHARACTERISTICS AT MOUNT. FLANGE TEMP. 25°C		
DC Collector-to-Emitter Voltage		-1.5 volts
DC Collector Current		-1.0 amp
Large-Signal DC Current Transfer Ratio		70

Your RCA Field Representative will be glad to discuss the many advantages offered by RCA Power Transistors for your specific designs. Contact him at the RCA office nearest you.

EAST 744 Broad Street, Newark, N. J. Humboldt 5-3900

MIDWEST . . . Suite 1181, Merchandise Mart Plaza, Chicago, Illinois Whitehall 4-2900

WEST 6355 E. Washington Blvd. Los Angeles, Calif. RAymond 3-8361

GOVERNMENT 224 N. Wilkinson Street Dayton, Ohio HEMlock 5-1625 "K" Street, N.W. Washington, D.C. District 7-12

For technical data on RCA-2N301 and 2N301 write RCA Commercial Engineering, Section CI 6000 Somerville, N. J.

Open Rack Cabinet Prefab For Assembly

All-steel in construction, an open desk rack cabinet comes in black wrinkle finish as standard, gray wrinkle or gray hammertone to order. Cabinets are shipped in knockdown form. It will mount standard 19 in. panel chassis and panels for adapted uses in public address systems, table mountings of low or medium powered transmitters and other electronic instruments and assemblies.

Sturdy and rugged in construction, dimensions are 21 x 32 x 12 in. on the model DOR-28 and 28 x 19 in. panel space. It accommodates 28 in. panels. It is open air type, with no cover or back. Model DOR-21 is for 21 in. panel space. Larger open air telephone racks are also available with panel space up to 77 in.

California Chassis Co., Dept. ED, Lynwood, Calif.

CIRCLE 107 ON READER-SERVICE CARD

Self-Adhesive Printed Plates Easily Hand Handled

Aluminum printed plates with pressure-sensitive adhesive on the back and which can be picked off the backing paper by hand for application are now available. A split along one edge is cut through to the backing paper forming a release tab. Formerly this type of identification material had the adhesive covered with cellophane film. To apply the plates, they had to be immersed in water to loosen the cellophane.

When applied, Pick-Off Permi-Cal becomes a semi-permanent identification piece; the adhesive is very aggressive.

Printing may be in one or two colors and pieces may be as large as 2-3/4 x 16 in. Permi-Cals are used as nameplates, instruction labels and for general identification purposes.

Topflight Corp., Permi-Cal Div., Dept. ED, York, Pa.

CIRCLE 108 ON READER-SERVICE CARD

CIRCLE 110 ON READER-SERVICE CARD ➤

Transitron

Silicon

Transitron's diodes, voltage regulators and rectifiers are designed to operate over wide environmental extremes and meet the many varied requirements of electronic circuitry. Reliability is assured through hermetic sealing and exacting manufacturing standards.

Transitron's silicon units have established a record of dependability in such critical applications as guided missiles and jet aircraft. They feature low inverse leakages and high voltage operation and are recommended for high temperature applications where germanium and selenium are unreliable.



- Current ratings up to 2 amps
- Superior regulating qualities
- Rugged construction
- Small size
- Axial mounting

Send for Bulletin TE-1352

VOLTAGE REGULATORS

	Type	Voltage Range	Dynamic Resistance	Maximum Current	
				@ 25°C (ma)	@ 125°C (ma)
Subminiature	SV-6	5.2 - 6.4	20	40	8
	SV-9	7.5 - 10.0	15	25	5
	SV-15	13.5 - 18.0	120	14	3
	SV-24	20.0 - 27.0	300	10	2
Miniature	SV-805	5.2 - 6.4	20	120	24
	SV-808	7.5 - 10.0	15	75	15
	SV-815	13.5 - 18.0	120	40	8
	SV-824	20.0 - 27.0	300	27	5
Power	SV-905	5.2 - 6.4	.7	(amps) 1.6	(ma) 400
	SV-908	7.5 - 10.0	.8	1.0	250
	SV-915	13.5 - 18.0	3.0	.6	150
	SV-924	20.0 - 27.0	8.0	.4	100



"Leadership in semiconductors"



Germanium Diodes

Transistors

Silicon Diodes

Silicon Rectifiers

RECTIFIERS

	Type	Maximum Inverse Voltage	Maximum Forward Current (ma) @ 150°C	Maximum Inverse Current (ma) @ 150°C
Military	*1N256	570	200	.25
	*1N255	380	400	.15
	*1N254	190	400	.1
	*1N253	95	1000	.1
Miniature	TJ40A	400	200	.5
	TJ30A	300	200	.5
	TJ20A	200	200	.5
Stud Mounted	TM64	600	1000	.5
	TM47	400	3000	.5
	1N332	400	400	.2
	1N338	100	1000	.2
Medium Power	TR402	400	(amps) 20	(ma) 5
	1N250A	200	20	5
	1N249B	100	20	5
High Power	TH402	400	35	5
	1N413A	200	35	5
	1N412A	100	35	5

*JAN types specified at 135°C

DIODES

	Type	Maximum Operating Voltage (volts)	Maximum Average Forward Current (ma) (@ 150°C)	Maximum Inverse Current (ua) @ volts (@ 150°C)
Military	*1N457	60	25	5 @ 60
	*1N458	125	25	5 @ 125
	*1N459	175	25	5 @ 175
High Conductance	1N484B	130	50	5 @ 125
	1N486A	225	50	25 @ 225
	1N488A	380	50	25 @ 380
High Frequency	*1N251	30	30	10 @ 10
	1N252	20	40	10 @ 5
	S9G	40	25	10 @ 20
Recovery time .15 usec				
Fast Switching	SG213	200	12	50 @ 175
	SG211	80	12	20 @ 60
	Recovery time .3 usec			
Fast Switching	SG228	200	35	50 @ 175
	SG226	80	35	20 @ 60
	Recovery time 1 usec			

*JAN types



- Reliability at high temperature
- High power handling ability
- High efficiency
- Rugged construction
- Hermetic sealing

Send for Bulletin TE-1351



- Recovery times under .15 us
- High voltage ratings
- Operation up to 200°C
- High inverse resistance
- Subminiature size

Send for Bulletin TE-1350

Visit us at IRE Show Booth 3912-14

Corrosion Coating in Colors For Metal, Masonry or Wood

Profilm, a silicate modified coating having the appearance of paint, is applied by conventional spray equipment, yet dries to the touch on most applications in a few minutes. Profilm is designed for use where corrosive elements such as acids, alkalies, humidity, moisture, salt, etc., are a source of coating failure and excessive maintenance cost.

Profilm is available in colors, and also comes in black, clear, white and metallics, in both baking and air-dry grades. Profilm can be applied to virtually any coatable surface including metal (ferrous and nonferrous) masonry, wood, asbestos, etc. Because of its essentially inert composition, Profilm provides a uniform, continuous and low porosity film which lends resistance to a wide variety of chemical environments.

Allied Porcenell, Inc., Dept. ED, 851 S. Market St., Waukegan, Ill.

CIRCLE 111 ON READER-SERVICE CARD

△ FM Deviation Monitor 4 to 540 kc



The Model 791C covers 50 cps to 35 kc at carrier frequencies from 4 to 540 Mc. Deviation ranges are 0 to 5, 25, 75 and 125 kc. The instrument uses the counter type discriminator and has an accuracy of 3 per cent. Harmonic distortion is less than 0.2 per cent. The instrument doubles as a fm receiver.

Marconi Instruments, Dept. ED, 44 New St., New York, N.Y.

Radio Engineering Show, Booth 3315-3317.

CIRCLE 112 ON READER-SERVICE CARD

◀ CIRCLE 110 ON READER-SERVICE CARD

Transitron

electronic corporation

wakefield, massachusetts

T

*Miniature
Thermal Relays
Hermetically Sealed
in Glass*

99.99% PLUS RELIABILITY

**FIRING TIME...
0.1 SECOND**

*or any delay time
specified*

Miniaturized units are hermetically sealed by our EXCLUSIVE method of bonding metal headers to glass housing. Relay design is based upon the "fuse burnout" principle and permits wide latitude in systems design.

**GUIDED MISSILES, ROCKETS
SUPERSONIC AIRCRAFT**

TYPICAL CHARACTERISTICS

TEMPERATURE: -100°F to +450°F

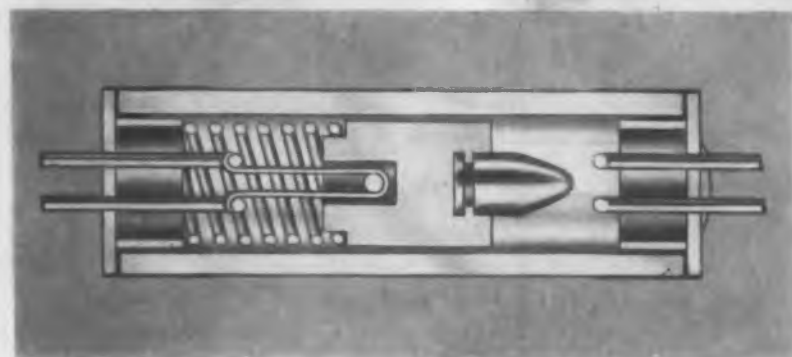
VIBRATION: 20-3000 CPS

SHOCK: 200 G's

Another example of the ONE and ONLY process of bonding metal to glass for better, more efficient hermetically sealed electronic components.

WHAT ARE YOUR REQUIREMENTS?

Write TODAY for samples and detailed specifications on how these Relays fit your specific needs.



EXACT SIZE

NETWORKS ELECTRONIC CORPORATION

14806 OXNARD STREET, VAN NUYS, CALIFORNIA

ORIGINAL DESIGNS FOR HIGHER RELIABILITY IN GLASS-HOUSED RESISTORS AND MINIATURE RELAYS FOR ALL PURPOSES

CIRCLE 114 ON READER-SERVICE CARD FOR MORE INFORMATION



**△ Bistable
Time Delay
Relay**

20-30 Second Cycle

Thermally controlled by two separate heater circuits, this "memory relay" operates spdt snap-action switch contacts. Each heater transfers a movable arm from one contact to the other. The relay remains in either of the two contact positions until operated by the other heater circuit. Operating time is factory preset for either 20 or 30 sec on both transfers. The bimetal strips are matched, thus cancelling any effect of ambient temperature on relative deflection. The relays are temperature compensated between -55 C to +100 C. Standard voltage ratings are 6.3, 26.5 and 117 v; other values available on request. Each heater requires 2.7 w.

Curtiss-Wright Corp., Electronics Div., Dept. ED, Carlstadt, N.J.

Radio Engineering Show, Booth 1327.

CIRCLE 115 ON READER-SERVICE CARD FOR MORE INFORMATION



**△ Stainless
Steel Grid Cups**

In Any Design

Grid cups are made to order of many metals, including stainless steel, and with one or more apertures of precise size, shape and location as specified. Openings may be as small as 0.0001 in., and filaments of a thickness of 0.0001 in., with tolerances in each case of ± 0.0002 . Apertures and filaments are formed by etching processes. The cup metal also may be etched to varying thickness, if required.

Buckbee Mears Co., Dept. ED, Lindeke Bldg., St. Paul 1, Minn.

Radio Engineering Show, Booth 3809.

CIRCLE 116 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 117 ON READER-SERVICE CARD

TUBE DESIGN NEWS

GENERAL  ELECTRIC



RECEIVING • POWER • CATHODE RAY

Snow-White Cleanliness Extends to 5-Star Tube Parts Manufacture, Inspection, Handling

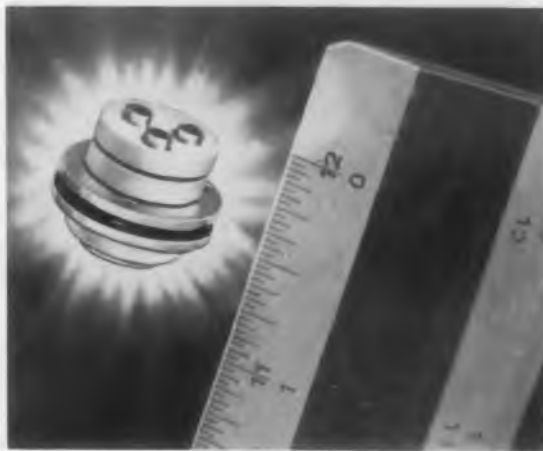
Broadened facilities for building G-E 5-Star high-reliability tubes under conditions of immaculate cleanliness, include dirt- and lint-free manufacture of the tube sub-assemblies.

All areas of General Electric's 5-Star Tube factory now are air-conditioned and pressurized to keep out dust. Workers, inspectors, and foremen who build and handle parts, wear the same lint-free Nylon and Dacron garments as employees who assemble and test 5-Star Tubes.

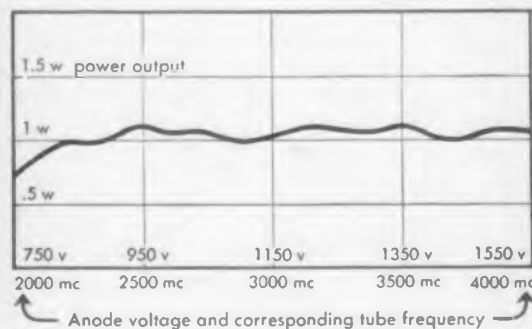
Grids are wound and cleaned with virtually no chance that a particle of dust or thread of lint will adhere, to cause tube "shorting". Heaters are formed, coated,

(Continued on Page 2, Column 1)

New G-E Voltage-Tunable Magnetrons in Development Permit Fast Tuning over Wide Range with Steady Output



ABOVE, LEFT: the developmental Z-5112 voltage-tunable magnetron is only $\frac{5}{8}$ in. high and $\frac{3}{4}$ in. wide. ABOVE, RIGHT: preliminary tests prove essentially stable power output throughout 2000-mc tuning range.



Latest developmental type in a series of voltage-tunable magnetrons pioneered by General Electric, the Z-5112 indicates the advantages which this group of tubes offers to designers of military equipment. Recent tests of the Z-5112 prove its capability for rapid, efficient tuning over an extended frequency range, from 2000 mc to 4000 mc—with power output .5 w to 1 w throughout.

Counter-measures can benefit from this threefold tube advantage. Also, enemy jamming can be effectively circumvented by rapid tuning over a broad frequency spectrum with little or no reduction in signal power. With tube frequency a linear function of the anode voltage, the Z-5112 and other VTM types can be tuned merely by changing the potential of the anode. This makes for circuit simplicity.

Design benefits of General Electric voltage-tunable magnetrons now in development, are small size, light weight, and metal-ceramic construction. The latter adds strength, and gives high-temperature resistance. Tubes are designed to operate up to 60,000 feet altitude.

Besides being directly useful for counter-measure work, voltage-tunable magnetrons are suited to telemetering—for example, missile tracking; to FM altimeters; to air-navigation applications, broadband test equipment, and microwave communications generally.

Ask any G-E office listed on the next page for information on the development status of voltage-tunable magnetrons.

G-E Snow-White Workers Check Progress on Their 5-Star Tube "Factory", to Operate at March I.R.E. Show



Featured at General Electric's exhibit at the New York I.R.E. Show, will be the actual assembly of 5-Star Tubes in an air-conditioned, pressurized working area, housed in a transparent plastic "factory". Trained operators from General Electric's 5-Star Owensboro, Ky., factory will assemble the tubes . . . Another G-E show highlight: first public demonstration of voltage-tunable magnetrons, described elsewhere on this page.

'Lightning-Rod' Filament Shield for G-E High-Voltage Rectifier Tubes Increases TV Dependability



ABOVE: a special tungsten post shields G-E tube filaments from electrostatic pull of high anode voltages. BELOW: checking 1B3-GT and 1X2-A/B rectifier types during G-E flyback life test that further safeguards tube performance.



Among numerous steps taken to increase the reliability and long life of General Electric 1B3-GT and 1X2-A/B high-voltage rectifier tubes, mounting a "lightning-rod" shield beside the filament is important. Manufacturers of TV receivers thus are better protected against picture failures in sets in production, on test, and in owners' hands.

G.E.'s tungsten shield, or post wards off electrostatic pull on the tube filament thus minimizing pull-out and filament-to-anode shorts, and sharply reducing the incidence of broken filaments.

In addition, a highly adhesive filament coating further protects against arc-overs. Another special feature: the bulbs of G-E high-voltage rectifier tubes are ringed with conductive material to prevent vertical picture streaking that is caused by bulb charging.

To make sure that tube performance meets design targets, 1B3-GT's and 1X2-A/B's receive a 100% flyback test and a dynamic flyback life test—both at the top ratings for big-screen operation.

Realizing the importance to the TV industry of dependable, long-life rectifier tubes, General Electric is continuously improving its design, production, and test methods for these types.



Special bulb design of Z-4399 optimizes resolution, accommodates several types of magnetic deflection yoke for presenting various kinds of information on face plate.

New Z-4399 High-Resolution Tube Accents General Electric's Facilities For Special C-R Tube Development

Used primarily in equipment to pinpoint enemy mortar locations for quick counter-fire, General Electric's Z-4399 C-R tube combines a group of features essential for its purpose—a 5½-in. square face plate that lends itself to a rectilinear coordinate display system; extremely high resolution; magnetic focus and deflection; a bright image brought about by aluminizing.

The tube's neck has been specially lengthened in order to (1) increase image resolution to a new standard of fineness and sharp definition, (2) accommodate several types of deflection yoke.

Designing C-R tubes such as the Z-4399 for specific military or industrial functions, is a job for which General Electric has extensive facilities in research, engineering skill, and equipment. Problems calling for the selection or origination of special C-R types are welcomed.

Snow-White Cleanliness, 5-Star Parts

(Continued from Page 1)

and heat-treated other parts built and processed under the same strict conditions of near-surgical cleanliness.

There are 35 General Electric 5-Star Tubes, 11 of them subminiatures, meeting substantially every military and industrial need. Two new miniature types for computers are included in the line.

RIGHT: 5-Star Tube heaters, after forming and coating, are placed in individual glass cylinders for inspection. This helps guard heaters from contact with dust or lint until the tubes are assembled, exhausted, and sealed off.



EASTERN REGION

General Electric Company, Tube Sales
200 Main Avenue, Clifton, N. J.
Phones: (Clifton) GRegory 3-6387
(N.Y.C.) Wlscnson 7-4065, 6, 7, 8

CENTRAL REGION

General Electric Company, Tube Sales
3800 North Milwaukee Avenue
Chicago 41, Ill.
Phone: SPring 7-1600

WESTERN REGION

General Electric Company, Tube Sales
11840 West Olympic Boulevard
Los Angeles 64, Calif.
Phones: GRanite 9-7765; BRadshaw 2-8566

JUST PRINTED!



New, complete booklet on General Electric 5-Star Tubes — their design, manufacture, and testing. A "must" for designers who require maximum reliability in critical tube sockets. Ask for Booklet ETD-1425!

Progress Is Our Most Important Product

GENERAL  ELECTRIC

162-103

ELECTRONIC COMPONENTS DIVISION, GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

△ **High Frequency Antenna**
Adjustable Polarization



Dipoles of this antenna can be adjusted for either horizontal or vertical polarization. One of the dipoles pictured here, and the dish, cover the range from 1000 to 1350 mc; the other combination covers 2750 to 3000 mc. Similar units can be supplied in other frequency bands. Diameter of the dish shown is 24 in. The antenna combinations are designed and constructed to yield maximum possible performance in their respective bands. A type N coaxial fitting is provided on the dipole unit.

Sage Laboratories, Inc., Dept. ED, Waltham, Mass.

Radio Engineering Show, Booth 3946.

CIRCLE 118 ON READER-SERVICE CARD FOR MORE INFORMATION

△ **Two-Pen Recorder**
For Comparative Measurement



Housed in a case 17-3/4 in. wide to fit standard racks, this Weston Model 6791 double recorder utilizes two separate amplifiers and two separate measuring circuits. It is intended for comparative measurements in the laboratory or on the production line. The range standards of either one of both zones are easily replaceable for quick range change. Alarm switches are available for each zone, and can be set in a matter of seconds. The two amplifiers are of plug-in construction for easier servicing.

Weston Electrical Instrument Corp., Dept. ED, Newark 12, N. J.

Radio Engineering Show, Booth 2907-2915.

CIRCLE 119 ON READER-SERVICE CARD FOR MORE INFORMATION

← CIRCLE 117 ON READER-SERVICE CARD



FROM DATA TO DIGITS...

Today Hughes is developing systems which convert radar data and other information to digital form and process it for use in performing control functions.

These systems will be able to receive and store vast quantities of data from many different sources and distribute it, after processing, over large and complex ground nets.

Special-purpose digital computers are employed, utilizing magnetic drum memory and novel programming techniques. The systems will also include visual displays and employ the latest concepts of human engineering to simplify equipment operation and minimize the possibility of human error. Vacuum tubes are being replaced by transistors or ferrite cores in flip-flops, registers, and amplifiers; and diode matrices are being replaced by ferro-magnetic circuitry.

These and other features of the new systems promise to maintain and extend Hughes leadership in the fields of digital computers and processing systems. In order to design and build these and future systems, Hughes requires engineers with experience in electronic circuit design, logical design, electronic packaging, radar systems, and many others.

For further information write us at the address below.

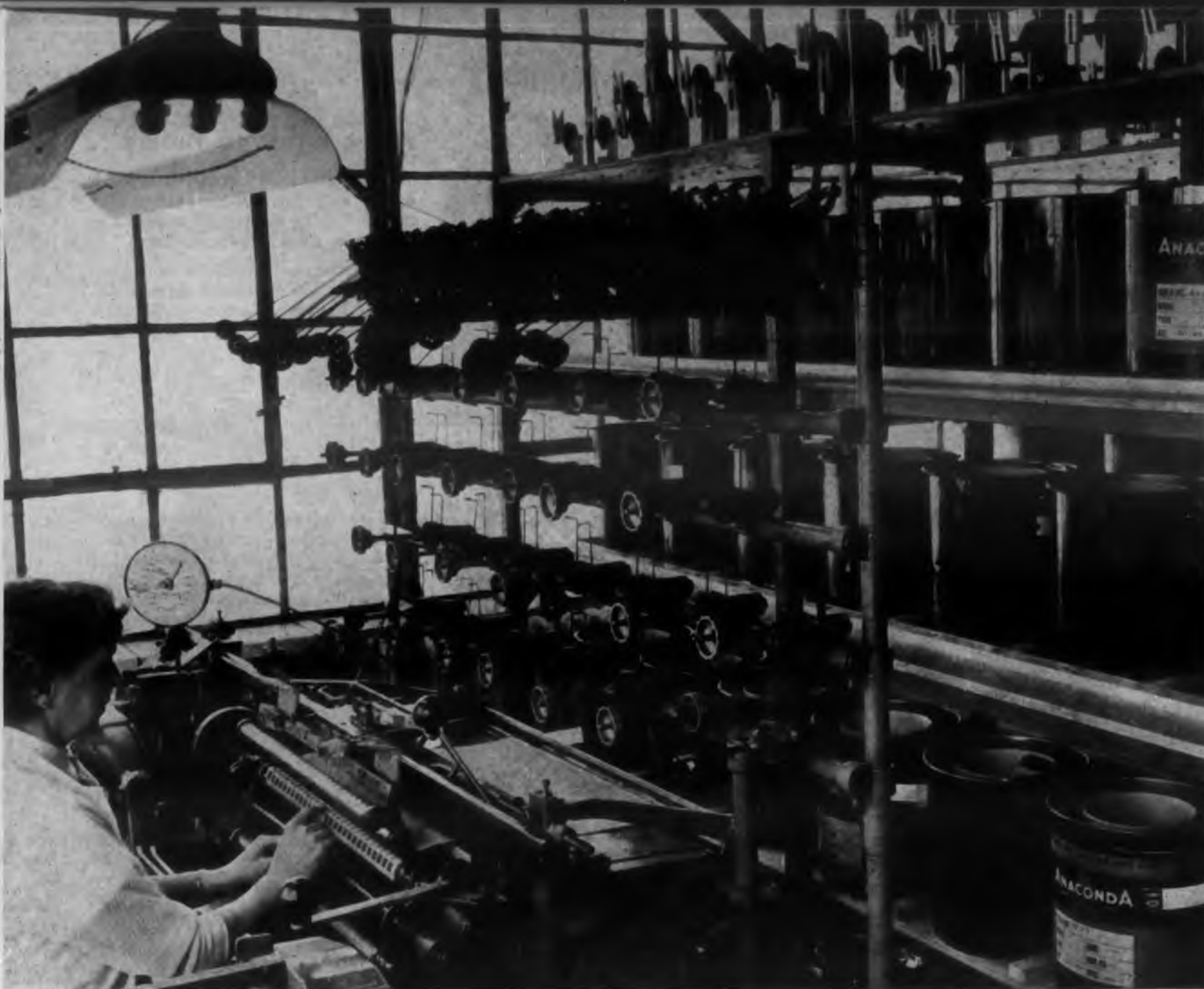
HUGHES

RESEARCH AND DEVELOPMENT LABORATORIES

SCIENTIFIC STAFF RELATIONS

Hughes Aircraft Company, Culver City, Calif.

CIRCLE 567 ON READER-SERVICE CARD FOR MORE INFORMATION



28 pails — mounted on racks behind coil-winding machines — are used at a time in fabrication of coils by control manufacturer. Wire passes through tensioning devices and enters the winding machine in the normal manner. Company saves \$2500 a year alone by ending handling and returning of empty spools.

\$15,000 a year saved by switching to Anaconda magnet wire in pails!

A YEAR AGO, a well-known control manufacturer's coil-winding department operators used—and replaced—60 to 70 spools on machines a day. Each change meant production time lost . . . and waste of 5 to 50 feet of wire on the end of each spool. Empty spools, too, had to be collected, packed and returned to wire suppliers.

Then the decision was made to switch from magnet wire on spools to

Anaconda quality wire in pails!

TODAY, these same operators are saving the hour or hour-and-a-half a day they used to spend changing spools. Coil production has increased from 270 to 320 coils per hour per machine. And wire waste is almost nil. The Company estimates the change will save \$15,000 a year.

THE MAN FROM ANACONDA will

be glad to show you how Anaconda leadership in magnet wire packaging can bring greater profit to you, too. Let him explain the advantages of Anaconda drums, pails, reels . . . and how Anaconda's spool rehabilitation program can save you money in the winding room. Write or call today: Anaconda Wire & Cable Company, Magnet Wire Headquarters, Muskegon, Michigan. 57379

SEE THE MAN FROM **ANACONDA**[®]
FOR **MAGNET WIRE**

△ Nylon Thrust Washers High Dimensional Stability

Where the best possible wear resistance is required under light thrust conditions (as in association with fractional horsepower motors, for example) these Nylatron "GS" thrust washers are recommended. Patents have been applied for for the material, a molybdenum disulphide filled nylon formulation, having better dimensional stability and lower deformation under load than standard nylon, a lower coefficient of friction and higher wear resistance in many applications. The washers can be used to advantage where lubrication is difficult. Outside diameters currently available are 3/8 in. to 1-5/16 in.; inside diameters 1/8 in. to 1 in. Thicknesses currently available are 1/64 in., 1/32 in. and 1/16 in.

Polymer Corp. of Pa., Dept. ED, 2140 Fairmont Ave., Reading, Pa.
Radio Engineering Show, Booth 4309.

CIRCLE 122 ON READER-SERVICE CARD

Two Circuits Controlled By One Time Switch

A time switch recently introduced controls two electrical circuits at different times. Known as the Series V22000, they are especially well-suited for controlling lighting circuits.

The intermatic V22000 Series time switches permit varying timing periods from 30 mins. to 23-1/2 hrs. Actually, the time dial will accommodate up to 24 sets of ON-OFF trippers.

Housed in a steel case measuring 10 x 4-7/8 x 4 in. deep, it has a black crackle, rustproof finish. A permanently hinged door (with hasp) provides a dust and moisture-proof seal. Models are available for 125 or 250 v operation and carry a full guarantee against defects.

International Register Co., Dept. ED, 2624 W. Washington Blvd., Chicago 12, Ill.

CIRCLE 123 ON READER-SERVICE CARD

Epoxy Resin Hardener For Rapid Mold Stripping

More efficient use of epoxy resin mold forms is made possible by curing the epoxy resin with Sonite No. 21, an acid anhydride available in pint, quart and gallon containers.

◀ CIRCLE 121 ON READER-SERVICE CARD

Epoxies cured with this hardener can be stripped from the molds within one hour and post-cured for desirable properties; they need not remain on the molds for the entire curing period. Typical physical properties of castings so made (post-cured for 23 hours, after one hour on the molds) are: 168 C heat distortion temperature, 12,000 psi tensile strength; 17,000 psi flexural strength, and 20,500 psi compressive strength.

Smooth-On Mfg. Co., Dept. ED,
572 Communipaw Ave., Jersey City
4, N.J.

CIRCLE 124 ON READER-SERVICE CARD

Dial, Name Plate, Adhesive Bonds Without Fasteners

Name plates, meter dial faces, clock dial faces and similar items of metal can readily be affixed to metal, wood or ceramic surfaces by a resin adhesive known as Furane Resin XV. Strong and permanent bond is effected. The Resin XV is applied to the reverse side of the name plate or dial, and air dried. The adhesive film becomes dry and loses its tackiness. It is affixed to the surface on which it is to adhere by heating the plate or dial momentarily to 250 to 300 F and pressing it firmly against the surface. A firm bond is obtained without any compliaction of metallic fastening devices.

Furane Plastics, Inc., Dept. ED,
4516 Brazil St., Los Angeles 39, Calif.

CIRCLE 125 ON READER-SERVICE CARD

Soil-Moisture Block Low Cost and Simple

A patent dealing with apparatus for measuring moisture of soil has been issued. The main claim of the issued patent is the use of platinized electrodes in absorption blocks used in measuring soil moisture, thereby eliminating the use of a capacitor in the associated Wheatstone Bridge type instruments. The improved-soil-moisture blocks permit simpler and less costly associated equipment to be used with them. Such blocks are buried in the soil at approximately root levels with their insulated leads extending up to the surface for connections with the measuring instruments.

Industrial Instruments Inc., Dept.
ED, 89 Commerce Rd., Cedar Grove,
N.J.

CIRCLE 126 ON READER-SERVICE CARD

CIRCLE 127 ON READER-SERVICE CARD ➤



New stacked ceramic receiving tubes that can withstand heavy shock and vibration

2CL40A A new, small ceramic high vacuum rectifier or clipper diode that can be air or liquid cooled



3CX100A5 A premium quality ceramic and metal 100 watt triode



4CX300A General purpose tetrode with 300 watts plate dissipation up to 500 MC

EIMAC FIRST
with ceramic tubes
that can take it...

In recent years equipment manufacturers and users have been introduced by Eimac to a series of ceramic tube firsts unequalled in the industry: klystrons, negative grid tubes, rectifiers and receiving tubes.

Clean, and rugged... these tubes can stand up to shocks and temperatures no glass tube can. Design and production advantages are a boon to equipment manufacturers and users alike.

As first in the field, Eimac has developed ceramic tube manufacturing techniques that have evolved into well established processes.

See this line of "tubes that can take it" at the Eimac exhibit, Booth 2410-12, National I.R.E. Show and Convention, March 18-21.

4K50,000LQ Four cavity klystron that delivers 10,000 watts of power at frequencies of 700 to 1000 MC



4CX5000A High power radial-beam tetrode especially suitable for single sideband operation



EITEL-McCULLOUGH, INC.
SAN BRUNO - CALIFORNIA
The World's Largest Manufacturer of Transmitting Tubes

Research and development at Lockheed Missile Systems Division laboratories in Palo Alto is of a most advanced nature. Particular areas of interest include microwaves, telemetering, radar, guidance, reliability, data processing, electronic systems, instrumentation, servomechanisms. Inquiries are invited from those qualified by ability and experience for exploratory efforts of utmost importance.

Here members of the Electronics Division discuss systems radar problems related to measurement of missile trajectories. Left to right: K. T. Larkin, radar and command guidance; Dr. S. B. Batdorf, head of the Electronics Division; Dr. H. N. Leifer (standing), solid state; Dr. R. J. Burke, telemetering; S. Janken, product engineering.

Lockheed

MISSILE SYSTEMS DIVISION

research and engineering staff

LOCKHEED AIRCRAFT CORPORATION

PALO ALTO • SUNNYVALE • VAN NUYS

CALIFORNIA



**I·R·E
NATIONAL
CONVENTION
AND
RADIO SHOW**

Significant developments at Lockheed Missile Systems Division have created new openings for:

- Controls Systems Engineers** — to analyze and synthesize complex automatic control systems.
- Inertial Guidance Engineers** — to perform systems analysis and design of inertial guidance systems.
- Infrared Specialists** — to perform preliminary systems design and parametric optimization of advanced infrared detection systems.
- Data Processing Systems Specialists** — to perform advanced system development and design in new techniques of automatic data processing.
- Weapons Systems Specialists** — to perform basic analysis and systems evaluation of advanced weapons systems.
- Electronic Product Engineers** — to translate laboratory electronic systems into prototype models meeting the rigid requirements of modern weapons systems.
- Radar Systems Engineers** — to develop advanced radar systems associated with guided missiles.
- Theoretical Physicists** — to analyze propagation of electromagnetic waves through the ionosphere and through dielectric materials and study radiation problems pertaining to advanced antennas in the microwave and millimeter domain, including scattering problems related to the reflection of electromagnetic waves from simple and complex boundaries.
- Experimental Physicists** — to investigate microwave circuit components including ferrites and various millimeter wave techniques such as MAZUR.
- Antenna Specialists** — to design and develop airborne antennas and radomes for high speed missiles for telemetering, radar, and guidance systems application.
- Video Specialists** — to develop advanced systems for the transmission of visual data by electronic means.
- Circuit Design Specialists** — to design telemetering and guidance systems utilizing advanced circuit components.

Positions are open at the Palo Alto Research Center and Sunnyvale and Van Nuys Engineering Centers. M. H. Hodge, M. W. Peterson and senior members of the technical staff will be available for consultation at the convention hotel. Phone PLaza 14860 or 14861.

Lockheed

MISSILE SYSTEMS DIVISION

Liquid Vinyl

Mixed on the Job

Mixing a liquid plasticizer with vinyl resin powder makes a fluid plastisol. When heated, the mix becomes a resilient solid, with wide application in the electro-mechanical field. Requires no expensive processing equipment or trained workers. Liquid Chemiflex vinyl, being "job mixed" prevents viscosity build-up, as with pre-mixed compounds. Altering ratio of ingredients permits control of flexibility or strength in the fabricated product. Substantial cost savings compared to pre-mixed vinyl plastisols. Available in production units from 2 to 32 lbs, with directions. Evaluation Experimental Kit is available.

Technicraft Co., Dept. ED, 1156 Commonwealth Ave., Boston 34, Mass.

CIRCLE 133 ON READER-SERVICE CARD

Portable Anechoic Chamber

For Testing Acoustical Equipment

Portable AN-ECK-IOC chamber is designed for scaled-down testing of small microphones, hearing aids, signal devices, and miniaturized electronic and mechanical equipment. Measuring 42 x 48 x 60 in. over-all, the portable AN-ECK-OIC chamber can be easily moved between widely spaced or remote industrial test areas. The test chamber, 16 x 20 x 32 in., is designed for a low frequency cutoff of 250 cps.

Sound absorption is accomplished by wedge-shaped, wire-enclosed fibrous glass units mounted on the walls, ceiling, and floor of the chamber.

The unit is designed to mount easily on the walls, ceiling, and floor of the chamber. AN-ECK-OIC wedge units are designed for low-frequency cutoffs ranging from 60 to 400 cps. The depths of the wedge units, including the necessary air space and the structural framing for the support, are 56 in. at 60 cps frequency cutoff, 34 in. at 100 cps, 22 in. at 150 cps, 16 in. at 200 cps, 10-1/2 in. at 300 cps, and 8 in. at 400 cps.

Eckel Corp., Dept. ED, 155 Fawcett St., Cambridge, Mass.

CIRCLE 134 ON READER-SERVICE CARD

CIRCLE 135 ON READER-SERVICE CARD >

< CIRCLE 569 ON READER-SERVICE CARD

TI PROGRESS REPORT ON PRECISION DEPOSITED CARBON RESISTORS



TI MIL-Line Precision Resistors

HOLD TOLERANCE...EVEN WHEN DRIPPING WET!

Soaking wet, dried out, or 'shook up' — TI MIL-Line deposited carbon resistors still far exceed MIL-R 10509B... emerge from one acceptance test after another — by major electronics manufacturers — with performance records that have not been equalled. *It's the seal that makes the difference*... an exclusive Texas Instruments process that snugly wraps these precision resistors in tough jackets of a special coating with high dielectric strength.

For ease in design, production, and maintenance

Visit our booths
No. 2816 to 2820 at the
1957 I.R.E. Show,
New York

Here is a typical TI reel pack designed to speed production. TI precision deposited carbon resistors are mass produced and packaged in five sizes from 1/2 watt to 2 watts with resistance values from 25 ohms to 30 megohms.

For complete data, write for
Bulletin DL-C 539.

TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVENUE DALLAS 9, TEXAS



Microton hardness test typifies quality control measures that leave nothing to chance at Automatic Electric

STANDARDS THAT DETERMINE RELAY QUALITY

the ideal relay iron

Only soft, pure iron assures proper release, even after millions of operations.

In service, many relays get progressively slower to release, until finally the armature hangs up permanently. Excessively "hard" magnetic relay iron often is to blame. But in all Automatic Electric relays, the magnetic iron is so soft and pure that it saturates quickly, yet the flux dies out instantly. Even after millions of operations!

This improved relay iron is made and rolled to our own exacting speci-

fications. Chemical analysis then makes certain that no magnetic capabilities have been lost. Annealing is rigidly controlled, and grain size and temper carefully checked. Elongation, hardness, permeability, and density tests further safeguard this pampered material. Result: not the ideal relay iron, but the most nearly perfect iron available.

This is no isolated example. Exhaustive tests prove that all our raw material is equally fine. It's one of the many reasons why Automatic Electric relays enjoy far longer life.



Series SQPC Relay for printed circuitry applications. Write today for Bulletin RH-9. Automatic Electric Sales Corporation, Chicago 7. In Canada: Automatic Electric Sales (Canada) Ltd., Toronto. Offices in principal cities.

AUTOMATIC ELECTRIC

Originators of the dial telephone • Pioneers in automatic control



CIRCLE 137 ON READER-SERVICE CARD FOR MORE INFORMATION

△ KiloMc Load Isolator Up to 100 Kw Peak



With an operating range of 34 to 36 kiloMc, the Model KA-131 "Uniline" load isolator has an average power rating of 50 w, peak power rating in an unpressurized system up to 8 kw, and peak power rating in a pressurized system of 100 kw. Isolation is 20 db at band center, 15 db at edges. VSWR into matched load is less than 1.2 over the entire operating range; maximum insertion loss is 0.8 db. Largest dimension is 2 in. overall; weight 1 lb 9 oz.

Cascade Research Corp., Dept. ED, 53 Victory Lane, Los Gatos, Calif.

Radio Engineering Show, Booth 3607-3609.

CIRCLE 138 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Self-Sealing Screws Resist Vibration



The combination of sealing and locking can be maintained even under conditions of vibrations by use of these O-ring-screw combination. Sealscrews are standard machine screws, in a broad range of standard and special sizes and threads, with an O-ring pressed into a groove under the fastener head. They come as one piece, are used in the usual way, and after installation is complete they look like conventional screws. But the act of tightening these screws compresses the O-ring, thus achieving high pressure sealing and vibration resistance. It maintains its seal even after frequent removals and replacements. The basic sealing material used in the O-ring is not impaired by weathering, salt water, sunlight or elevated temperatures, and resists petroleum and petroleum products.

Automatic & Precision Mfg. Co., Dept. ED, 252 Hawthorne Ave., Yonkers, N. Y.

Radio Engineering Show, Booth 3824.

CIRCLE 139 ON READER-SERVICE CARD FOR MORE INFORMATION

Square-Body Resistors

7 and 10 W Rating

A line of wire-wound, miniature, square-body resistors, available from 1 ohm to 6,000 ohms in 7-w rating, and from 1 ohm to 11,000 ohms in 10-w rating, is announced by Clarostat. The square-body shape facilitates certain types of assembly and wiring operations; and the new line supplements the manufacturer's previous round-body resistor family.

In these new units, the resistance element is placed in a square-body steatite casing and there imbedded in inorganic cement. Axial pigtailed provide both support and connections.

Dimensions are 3/8 in. x 11/32 in.; with lengths of 1-3/8 in. in the case of the 7-w units and 1-7/8 in for the 10-w line.

Clarostat Mfg. Co., Inc., Dept. ED, Dover, N.H.

CIRCLE 140 ON READER-SERVICE CARD

Low Cost Sintered Iron

Superior Machinability

Powdiron fm, pure sintered iron material, combines excellent machining properties with low cost.

Prior to the development of Powdiron fm, the machining of sintered iron has been the material's greatest drawback. It had been necessary to use special tools at low speeds when machining iron parts. Otherwise iron particles were torn out rather than cut through, and as each cut was an interrupted cut tools wore out rapidly.

The new powdiron fm part is clean and smooth with a mirror-like surface finish, comparable to mild steel. In addition to its unique machining properties new fm is inexpensive and readily available. Powdiron fm also has especially high ductility and triples tool life over ordinary sintered iron, including iron-copper.

Bound Brook Oil-Less Bearing Co., Dept. ED, Bound Brook, N.J.

CIRCLE 141 ON READER-SERVICE CARD

CIRCLE 142 ON READER-SERVICE CARD

BURTON BROWNE/New York



EXCLUSIVE WITH
FILTORS, INC.

ONLY PRECISION MACHINED ROTARY RELAY

NO STAMPED PARTS IN THE MOTOR. MACHINED PARTS—ONLY ONE OF THE ADDITIONAL QUALITY CONTROL STEPS TAKEN BY FILTORS IN THE MANUFACTURE OF HERMETICALLY SEALED SUB-MINIATURE RELAYS... YOUR ASSURANCE OF EXTREME RELIABILITY.

WRITE FOR CATALOG, FILTORS, INC., PORT WASHINGTON, LONG ISLAND, NEW YORK, PORT WASHINGTON 7-3850

AC POWER

COMPLETELY ELECTRONIC

The Behlman Invertron® is a completely electronic source of AC power. It is silent and dependable in operation. All Invertrons® feature excellent frequency stability and regulation. The Invertron is available in a variety of models that cover the range from milliwatts to kilowatts, from subsonic to supersonic frequencies, single or multi-phase output.



MODEL 161-D-1

POWER OUTPUT: 160 VA single phase
 FREQUENCY: 350 to 450 cps variable
 FREQUENCY ACCURACY: 0.5% (0.2% and 0.1% available)
 INPUT: 115v 60 cps single phase
 OVERALL SIZE: 22" wide x 10" high x 15" deep



MODEL 2003-D-1

POWER OUTPUT: 2000 va three phase
 FREQUENCY: 350 to 450 cps variable
 FREQUENCY ACCURACY: 0.5% (0.2% and 0.1% available)
 INPUT: 230v 60 cps Single Phase
 OVERALL SIZE: 24" wide x 73" high x 24" deep

INVERTRON®

Standard Specifications
 Applicable to all Invertrons

Regulation: 1% max. no load to full load

Distortion: 2% max. at full load

Regulation and Distortion as low as .1% obtainable on special order



MODEL 751-E-1

POWER OUTPUT: 750 va Single Phase
 FREQUENCY: 300 to 500 cps variable
 FREQUENCY ACCURACY: 0.5% (0.2% available)
 INPUT: 230v 60 cps Single Phase
 OVERALL SIZE: 22" wide x 28" high x 15" deep

BEHLMAN
 ENGINEERING COMPANY

ELECTRONICS • MECHANICS • OPTICS
 DESIGN • DEVELOPMENT • PROTOTYPE

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 BURBANK, CALIFORNIA

See us at the
 IRE CONVENTION
 BOOTH #3837

WRITE NOW FOR FURTHER INFORMATION

CIRCLE 144 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Miniature Trimmer 500-20,000 Ohms



Available in two models, one of which is encapsulated, this miniaturized trimmer utilizes a glass-film resistance element fused to a tough ceramic frame. The adjusting shaft is stainless steel and the contact spring is multi-fingered precious metal. Simplicity of design and economy of parts make the potentiometer insensitive to shock, vibration or heat: it functions efficiently at temperatures up to 120 C. The encapsulated model meets the humidity resistance requirements of MIL-E-5272A. Power handling capacity is 1.5 w. The basic Model 50 weighs 0.25 oz and measures 9/32 in. x 5/16 in. x 1-1/4 in.; the encapsulated model, Model 52, is 1/4 in. longer.

Beckman/Helipot Corp., Dept. ED, Newport Beach, Calif.

Radio Engineering Show, Booth 2602-2606.

CIRCLE 145 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Magnetic Amplifier Range DC to 1000 cps



This magnetic amplifier, C-150-223, is intended for use with instrument and computing servo systems. It is suited to driving BuOrd Mk 7 or Mk 8 servo motors or equivalent without a vacuum tube or transistor driving stage in the servo loop. Although designed for self-contained input signals of 400 cps, it is adaptable, with addition of a reference transformer, to inputs ranging from dc to 1000 cps. The amplifier is potted and hermetically sealed in a MIL-T-27A size HA can. It meets the shock and vibration requirements of MIL-STD-202.

Ahrendt Instrument Co., Subsidiary of Litton Industries, Dept. ED, 4910 Calvert Road, College Park, Md.

Radio Engineering Show, Booth 3049.

CIRCLE 146 ON READER-SERVICE CARD FOR MORE INFORMATION

△ 5 W Potentiometer
Fine Resolution



Prototypes of this 910 Series single turn Micropot meet applicable military and commercial requirements. This precision potentiometer is linear in function, highly accurate, has fine resolution, low torque, consistent reliability and long life. Resistance element and terminal leads are moulded into one unit. Shafts are mounted on ball bearings. When units are ganged, each cup may be individually phased in the field. Standard resistance range is 50 to 10 k ohms (50 k ohms special); standard tolerance ± 0.5 per cent; standard linearity accuracy ± 0.5 per cent independent. Continuous mechanical rotation covers 340 deg; starting torque is 0.5 in.-oz per section. Net weight is 4 oz per single unit, 1 additional oz for each additional unit. A single unit measures 1-3/64 in. x 1-7/8 in. diam. Standard shafts protrude 5/8 in.; special lengths are available.

Geo. W. Borg Corp., Dept. ED, Janesville, Wisc.
Radio Engineering Show, Booth 3840-3842.

CIRCLE 147 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Microwave Generators
18,000 to 50,000 Mc



Sources of extremely high frequency, utilizing interchangeable tuning units, provide known frequency output for testing microwave equipment, components and systems. They cover the band 18,000 to 50,000 mc. The tuning units plug in, and need no further adjustment. They provide cw or modulated signals of known frequency.

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

Radio Engineering Show, Booth 3210-3214.

CIRCLE 148 ON READER-SERVICE CARD FOR MORE INFORMATION



I.R.E. Booth 3828

GT's-34S magnified 10½ times.

**WHEN CAN ONE
TRANSISTOR
REPLACE 2?**

In computer or in other applications where current must be amplified in either direction, you can now specify General Transistor's new GT-34S bi-directional transistor.

As developed by GT, this symmetrical transistor can also be used as a bi-directional switch when placed in series with the load. For greater reliability, to save production time, and for compactness you should examine GT's-34S... another reason for General's leadership in the manufacture and development of transistors for computers.

Write for Bulletin GT-34S for complete specifications.

Maximum collector to base voltage 40 volts
Maximum emitter to base voltage 40 volts
Peak current ½ amp
DC current gain is > 10 when $I_b = 20$ ma, $V_{ce} \leq .3$ V.



GENERAL TRANSISTOR CORP. 91-27 138th Place, Jamaica 35, N. Y.

CIRCLE 149 ON READER-SERVICE CARD FOR MORE INFORMATION



Olympia 7-9700

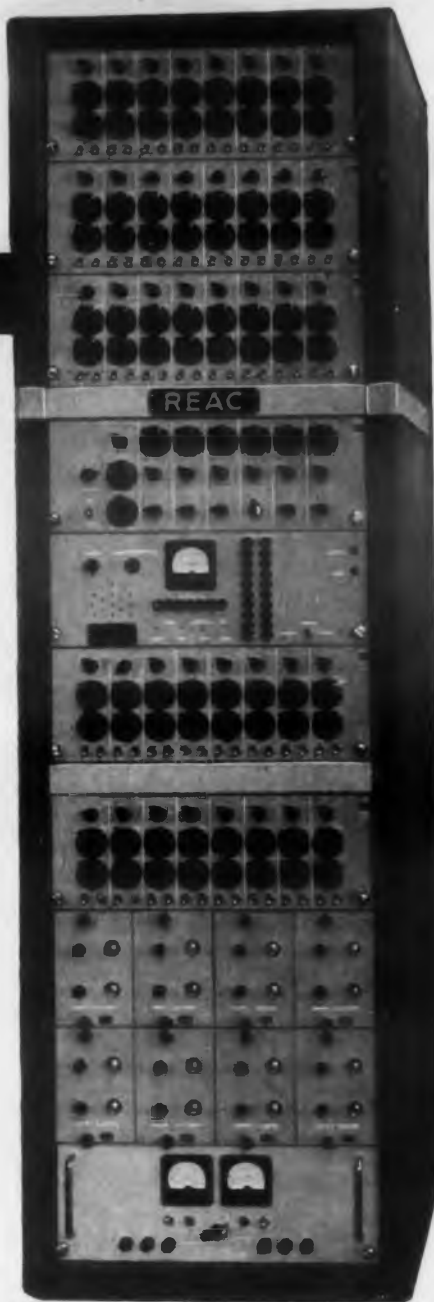
Generation of Functions of *Two or More* Variables

with the

400 series REAC[®]

DIODE FUNCTION GENERATOR

- Allows direct generation of slopes up to 12 volts/volt without paralleling diode segments.
- 10-turn potentiometers for both "slope" and "break point" give excellent resolution. Still further improvement in resolution is obtained by splitting slope adjustment into two ranges.
- 1000-division direct read-out 10-turn dials permit logging of function for fast reproduction later.
- Flexible switching system allows number of segments per channel to be varied from 2 to 30.
- Built-in calibration circuit permits functions to be set up quickly and easily without use of external plotting board.



... a complete self-contained unit

The DFG-401 is a completely self-contained unit consisting of 5 channels of function generation, 15 DC amplifiers (with VTVM and all control circuits for monitoring and balancing), and all necessary power supplies (except relay and reference voltages). In the event that any amplifiers supplied are not needed in the problem, they can be made available in groups at the patchbay as inverters with one gain of one.

This unit is ideal for the addition of up-to-date diode function generation equipment to an existing analog computer installation.

Electronic generation of functions of two or more variables is another outstanding Reeves contribution to the flexibility and efficiency of the electronic analog computer. Before installing new equipment, it will pay you to consult us. A comprehensive new REAC "400" series computer technical brochure will be sent upon request.

REEVES INSTRUMENT CORPORATION

A Subsidiary of Dynamics Corp. of America, 223 East 91st St., New York 28, New York

See our Booths 1702-1708

I.R.E. SHOW

New York Coliseum

March 18-21, 1957

2RV57



REAC Analog
Computers



Precision
Floated
Gyros



Precision
Resolvers and
Phase Shifters



Servo
Mechanical
Parts



CIRCLE 150 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Ball and Disc Integrator For Servo Breadboards



Used to solve differential equations for computers, as a sensing or control element in servo systems, or as a servo system output in rate generators, this accurate ball and disc integrator has been added to a line of electromechanical breadboard parts. For durability and accuracy, the integrator disc is hardened to Rockwell C65 and precision lapped. The ball carriage has a two-inch maximum travel; the torque at its input shaft required to move the ball carriage is 1 oz-in. Maximum disc input torque required at zero load is 3 oz-in. Recommended maximum output torque is 5 oz-in; recommended maximum speed is 1000 rpm.

Helipot Corp., Dept. ED, Newport Beach, Calif.
Radio Engineering Show, Booth 2602-2606.

CIRCLE 151 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Information Indicators Several Colors



Over 40 of these rectangular units will fit into a panel space only 5 x 9 in. Lenses are available in amber, blue, green, white or red plastic. The body of the unit is anodized aluminum, which mounts by two machine screws. Any message, abbreviation, word or entire phrase can be engraved on the plastic lens face. The lens is backlighted by two AN 3140 lamps; the indicator remains operative even though one lamp burns out. Each lens face measures 1-3/8 in. x 9/16 in. The Type L5500 Indicator is intended for use in annunciator, control or aircraft panels, to permit instant and accurate comprehension of any message.

Hetherington, Inc., Dept. ED, Sharon Hill, Pa.
Radio Engineering Show, Booth 2337.

CIRCLE 152 ON READER-SERVICE CARD FOR MORE INFORMATION



△ **Control Amplifier**
Transistorized

Used for aircraft fire power, this transistorized control amplifier weighs 11 oz and has a life expectancy of 10,000 hours. It is designed to operate in an ambient of from -65 to $+125$ C. The unit is adaptable to voltages of ± 50 to ± 1000 v, has a ripple less than 50 mv peak-to-peak, and an overall circuit gain of 60 to 80 db. The voltage regulation is ± 1 per cent from 30 per cent to 100 per cent load, with appropriate external reference.

Packard-Bell Electronics Corp., Dept. ED, 12333 W. Olympic Blvd., Los Angeles 64, Calif.
Radio Engineering Show, Booth 3705-3707.

CIRCLE 153 ON READER-SERVICE CARD FOR MORE INFORMATION

△ **Dual Recording Galvanometer**
10-Speed Chart Drive



For simultaneous recording of two independent wave-forms this Dual rectifier utilizes one chart drive and one chart, two fine-line pens and two galvanometers. The galvanometers are available in 1, 5, 10 or 25 ma movements, have 4-1/2 in. scales, accuracy ± 1 per cent of full scale, and a rise time of 0.25 sec. Charts are 100 ft long; drives may be ac, dc, spring or external. Closed inking systems are non-spill, non-skip; ink is protected against contamination or evaporation. Additional event marker pens can be mounted on either side of the chart; and manual notations can be made accurately by use of the convenient "writing desk" rest provided by the instrument's construction. The front panel mounts the terminals and controls, including the 10-speed drive gear control. This dual recorder is a further development of a single-pen, single-galvanometer instrument that has been in satisfactory use for a year. The dual instrument comes in a portable case that measures 15 in. long, 13-1/2 in. wide and 9-1/4 in. high. Weight is 47 lb.

Texas Instruments, Inc., Industrial Instruments Div., Dept. ED, P. O. Box 6027, Houston, Tex.
Radio Engineering Show, Booth 2816-2820.

CIRCLE 154 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1, 1957

Belden 8411

If It's worth Engineer's time . . .

Belden 8422

. . . It's worth Engineered Cable

Belden 8412

Belden
microphone
cables

Whatever the installation,
whatever the requirements,
there is an accurately
rated Belden Microphone
Cable built for the job.

Belden

WIREMAKER FOR INDUSTRY
SINCE 1902
CHICAGO

1001 WIRES FOR EVERY ELECTRONIC NEED

CIRCLE 155 ON READER-SERVICE CARD FOR MORE INFORMATION

4-8



FAMOUS NYLON JOINS NATIONAL'S MATERIALS FAMILY. Proved in thousands of tough applications, versatile Nylon now becomes more useful to the designer than ever. National makes it so in extruded rods and 100% usable finished fabricated parts. Standard rod sizes range from 1/4" through 2" in 3 and 6-foot lengths. Inquiries on other sizes and shapes are invited. National's expert engineering counsel assures the commercial soundness and economy of your product. And men, machines and capacity place National in a unique position to serve your immediate needs.

NATIONAL CAN HELP YOU reduce unit product cost or improve product performance at no added cost. Here's why: You can select the "one best material" from over 100 grades of PHENOLITE®, Vulcanized Fibre and NATIONAL Nylon—without compromise in properties or cost. You can simplify production and purchasing with the *timed delivery* of 100%

usable parts—from a single reliable source. You gain competitively with National's new materials and grades—the direct results of programmed materials-research.

You benefit by calling National first. Check Sweet's PD File 2b/Na, the Telephone Directory Yellow Pages, or write Wilmington 99, Delaware, Dept. E.

CIRCLE 156 ON READER-SERVICE CARD FOR MORE INFORMATION

INTRODUCING 5 NEW superior PHENOLITE® Laminated Plastic Grades:



E-2040—A new low cold flow, hot punching paper base grade with good dielectric strength.



Y-2500—A good arc resistant paper base grade with excellent flame resistance plus superior punching and shaving characteristics.



G-8-881—A melamine bonded glass mat grade with excellent flame and arc resistant characteristics and good flexural and impact strength. Has high dimensional stability under humid conditions.



G-7-3604—A new thick-walled silicone fiber glass tubing material with exceptional heat resistance and electrical properties.



G-10-865—A new epoxy resin-bonded glass cloth sheet laminate with very low water absorption and excellent electrical properties.

THESE FIVE NEW PHENOLITE GRADES bring to over 80 the number of standard and special grades of this versatile laminated plastic. See them on display at the I.R.E. show, booth 4507-4509.

NATIONAL
VULCANIZED FIBRE CO.
WILMINGTON 99, DELAWARE

In Canada:
NATIONAL FIBRE COMPANY OF CANADA, LTD., Toronto 3, Ontario

△ Dish Antenna 1700-2400 MC



This dish antenna handles 190 w in the 1700-2400 mc range, withstands 250 mph windload, and has a gain of approximately 34 db over isotropic source. Beamwidth is 4 deg at half power point; impedance is 50 ohms. Designated AS-554/U dish, the antenna is formed of heat-treated, cast aluminum frames and expanded mesh, irradiated and painted for weather protection. It can be rotated 360 deg in azimuth and ± 10 deg in elevation. Shipment is in four sections for easier portability. The antenna conforms to MIL-R-13963. It is one of an extensive line of aircraft, submarine, telemetering, glide-path, disc cone and dish antennas by the same maker.

Technical Appliance Corp., Dept. ED, Sherburne, N. Y.

Radio Engineering Show, Booth 1428.

CIRCLE 157 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Semiconductor Inverters

150 VA Rating

New semiconductor inverter and converter models which will convert low voltage dc to ac or higher voltage dc are intended to replace vibrator and rotating machinery equivalents. They feature improved circuitry and incorporate the latest types of transistors. Additions to the line include six inverter models which convert 6, 12, or 24 v dc battery input to 115 v ac, 60 or 400 cps. These new inverters are available in power ratings up to 150 va. Additional models provide outputs of 150 v dc and 300 v dc at current ratings of 100 or 200 ma, and available in regulated or unregulated designs.

All models are potted in transformer housings but transistors are located on an inner header for servicing or replacement purposes. A choice of octal plug-in type or solder loop terminal is available.

Electronic Research Associates, Inc., Dept. ED, 67 East Centre St., Nutley 10, N. J.

Radio Engineering Show, Booth 2705.

CIRCLE 158 ON READER-SERVICE CARD FOR MORE INFORMATION



△ High Ambient Resistors
Carbon on Ceramic

The 1/2 w PT501 and 1 w PT1001 are usable to ambient temperatures of at least 400 C, and exceed MIL-10509B load life requirements at 160 C, derated 50 per cent. These resistors are made by pyrolytic deposition of carbon on ceramic rods. The leads are weldable tinned copper clad iron, 1-1/2 in. long. The two resistors measure 3/16 in. in diameter, the PT501 being 1/2 in. long, and the PT1001 1 in. long.

Pyrofilm Resistor Co., Dept. ED, 8 Whippany St., Morristown, N. J.

Radio Engineering Show, Booth 3938.

CIRCLE 159 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Narrow Band FM Detector
Hermetically Sealed



Providing an output current linearly proportional to frequency, this F-992 Magmeter detector operates in the band 375-425 cps. Other similar detectors can be supplied that will cover a 10 per cent bandwidth at any center frequency from 30 to 5000 cps. The output is suited to operating a d'Arsonval indicator, servo type recorder, or a control circuit, and may be used for instrumentation, telemetering or automatic control.

Linearity is within 1/4 per cent of midband frequency. Temperature range is -55 C to +72 C. The unit withstands 10 g vibrations to 2000 cps and omni-directional shocks to 30 g. Output at the low frequency end of the band is zero, thereby indicating absence of input.

The standard type Magmeter fits a standard octal socket, but special mounting and terminal arrangements can be supplied. Height, seated, is 2 in., diam 1-1/2 in. Weight, 6 oz.

Airfax Products Co., Dept. ED, Middle River, Baltimore 20, Md.

Radio Engineering Show, Booth 2505.

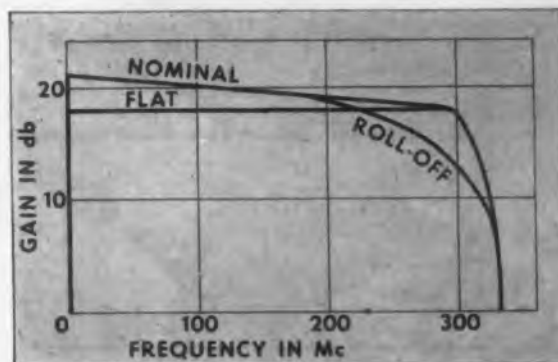
CIRCLE 160 ON READER-SERVICE CARD FOR MORE INFORMATION

SKL introduces

NEW ULTRA WIDE-BAND AMPLIFIER

for fast rise pulse reproduction

320 Mc



SPECIFICATIONS

Bandwidth:
300 Mc at 3 db point

Gain:
18 to 20 db depending on plug-in accessory

Rise Time:
Less than .002 μ seconds

Output:
Panel switch selects
(a) Linear: 5 volts, rms
(b) Pulse: 30 volts, negative
(c) High Pulse: Greater than 100 volts, negative, open circuit

Gain Regulation:
 ± 0.5 db for line voltage between 105 and 125 volts

Gain Control:
Panel control varies gain 6 db

Phase:
Linear to 300 Mc

Impedance:
180 ohms input, 200 ohms output

Size:
19" wide, 8 3/8" deep, 7" high

Power Requirements:
115 volts, 60 cycles

Write for Bulletin 206-1

Here is another advance in the art . . . Spencer-Kennedy's new Ultra Wide Band Amplifier, Model 206. Now for the first time fast-rise-time pulses can be faithfully reproduced by providing a stable 20 db gain over a 320 Mc band! . . . Although nominal gain for Model 206 is 20 db, sloping to 18 db at 300 Mc and 14 db at 320 Mc, flat and gradual roll-off characteristics are readily available by means of small, inexpensive plug-in accessories (see curves above). Three output modes . . . linear, pulse and high pulse . . . are selectable by means of a front panel switch. Integral regulated power supply and rack mounting are also provided. Applications include amplification of the following: short fast-rise-time pulses from pulse generators, input to wide-band vacuum tube voltmeters, output of scintillation detectors, multi-channel VHF signals, wide-band IF signals, narrow band IF signals with wide range for choice of center frequency. Model 206 also serves ideally as a distribution amplifier for wide band receiving systems feeding multiple diverse channel receivers.

IRE Show — Booths 3502 and 3504

SKL
**SPENCER - KENNEDY
LABORATORIES, INC.**
1320 SOLDIERS FIELD ROAD
BOSTON 35, MASS.

CIRCLE 161 ON READER-SERVICE CARD FOR MORE INFORMATION

Looking for reliability?

Where there must be no slipups, there will be no slipups, if you depend on CTC.

These components are guaranteed unconditionally in quantities from one to millions.

For samples, prices, write CAMBRIDGE THERMIONIC CORPORATION, 457 Concord Ave., Cambridge 38, Mass. West Coast stocks maintained by E. V. Roberts & Associates, 5068 West Washington Blvd., Los Angeles 16 and 988 Market St., San Francisco, California.



See CTC's Guaranteed Components on Display at Booth 2219, IRE Show, New York Coliseum, March 18-21

CTC QUALITY SHIELDED COIL FORMS

Miniaturized. Highly shock resistant. Mechanically enclosed, completely shielded for maximum reliability.



CTC QUALITY CAPACITORS

Miniaturized Variable Ceramic Capacitors that outperform much bigger capacitors. (Extreme right): Stand-Off Capacitors with ceramic dielectric. Rugged R-F by-pass capacitors for high quality equipment. Shock-, vibration-, humidity-resistant.



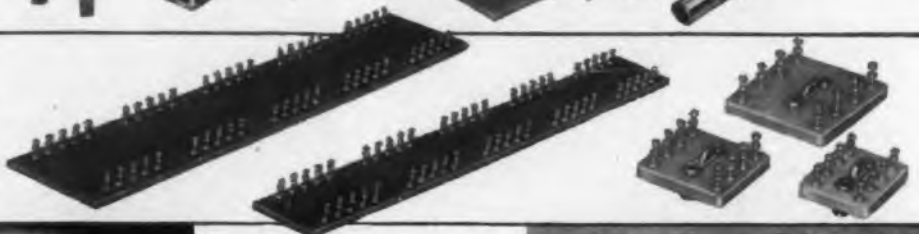
CTC QUALITY DIODE CLIPS

Seven different types, including spring-loaded units primarily for holding fragile diode pigtail leads from .005" to .085" in diameter. CTC also offers lines of quality battery clips and miniature plugs and jacks.



CTC QUALITY TERMINAL BOARDS

Custom-made, standard all-sets, standard ceramics. Variety of materials available — paper, cloth, nylon, glass laminates — phenolic, melamine, epoxy, silicone resins. Moisture — and fungus-proofed.



CTC QUALITY PERMA-TORQ COIL FORMS

Constant-tensioning devices for tuning cores of standard CTC ceramic coil forms. Keeps coils tuned as set despite shock, vibration.



CTC QUALITY KNOBS AND PANEL HARDWARE

Selected materials, carefully processed and finished. Metal parts polished before plating. Hard-wearing surfaces, lasting lusters.



CTC QUALITY INSULATED TERMINALS

Wide variety of stand-off and feed-through models in Teflon and ceramic. Extremely resistant to shock, vibration, moisture and temperature. Solder terminals hold even after prolonged soldering operations.



CTC QUALITY PRINTED CIRCUIT COIL FORMS

Phenolic and ceramic types. Can be soldered after mounting. Available as forms alone or wound as specified. Two- to six-terminal models.



CIRCLE 162 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Variable Autotransformer For Aircraft Controls



Designed to replace resistive-type light controls in aircraft, these variable autotransformers accept 115 v 400 cps and deliver an output which is variable between 0 and 28 v, ac. The Vari-lite PA-1028, has a 4-amp capacity; measures 2-3/4 in. x 2-3/8 in. diam, weighs 19 oz, and meets MIL-T-9219 and MIL-E-5272A.

United Transformer Corp., Pacific Div., Dept. ED, 4008 W. Jefferson Blvd., Los Angeles 16, Calif. Radio Engineering Show, Booth 2413, 14.

CIRCLE 163 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Rugged 2-W Pot Teflon Shaft Seal



The 75-M30 Maureypot potentiometer here shown exceeds the requirements of JAN-R-19, and is recommended for rugged service of a precision instrument. The mechanical stops withstand a torque of 8 in.-lb. A standard 3/8-32 bushing provides firm panel mounting. The shaft is sealed with a Teflon bushing. An internal spring keeps the shaft at its assigned setting during even severe operating conditions. Independent linearity of ± 1 per cent is available, and for values of 10,000 ohms and above a resolution of 1/3 deg can be attained.

Maurey Instrument Corp., Dept. ED, 7924 S. Exchange Avenue, Chicago 17, Ill. Radio Engineering Show, Booth 3845.

CIRCLE 164 ON READER-SERVICE CARD FOR MORE INFORMATION



△ **Rack and Panel Connector**
Gold Plated Contacts

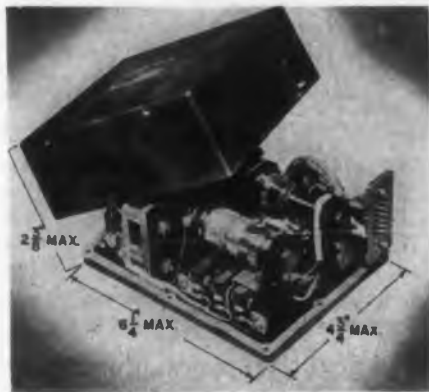
A resilient insert to facilitate pressurization and to give maximum protection against vibration is one of the features of this rack and panel connector, which is designated Type SR. Other features include heavily gold-plated contacts, solid shells, low contact engagement forces (easily pressurized to latest MIL specs), closed entry sockets and cadmium-plated clear irridite finish. Insert patterns will mate with equipment now in service. Temperature range is -67 to $+250$ F.

Scintilla Div. Bendix Aviation Corp., Dept. ED, Sidney, N.Y.

Radio Engineering Show, Booths 2332, 2425.

CIRCLE 165 ON READER-SERVICE CARD FOR MORE INFORMATION

△ **Multiple Sequence Timer**
For Cyclic Switching



Up to 6 separate timing sequence operations can be controlled simultaneously by this rapid response multiple sequence timer. A magnetic clutch and cam arrangement, which resets to zero upon completion of a timing cycle, controls some operations, while others are subject to switches that pulse continuously. One of the latter remains in open position during 0.450 ± 0.040 seconds, and in closed position during 0.050 ± 0.010 seconds, thus completing one cycle every half-second. Switches operate under 0.250 amp load at 115 v 400 cps over an input voltage range from 24 to 30 v dc. There are no tubes nor other electronic equipment. All contacting devices are readily accessible for adjustment and servicing. Designated Type ST-9610-01, the controller conforms to MIL-E-5400.

John Oster Mfg. Co., Avionic Div., Dept. ED, Racine, Wis.

Radio Engineering Show, Booth 2129.

CIRCLE 166 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1, 1957

A complete line of power transistors—to meet your specific needs

New rugged terminals—
permit easy soldering of
connections.



New welded case—gives
a hermetic seal for
superior ruggedness and
durability.

Honeywell

High Gain

Weld-Seal

Transistors!

The H5, H6, and H7

They're welded—so you can build new ruggedness and durability into your equipment! And the new line of Honeywell transistors gives you superior electrical performance and high, uniform power gain over a wide range of collector current values. You get long life along with outstanding performance.

Take advantage of these new and improved transistors *now*.

Note these new specifications—developed with the design engineer in mind

	H5	H6	H7
Input Resistance	24 —48 ohms	27—54 ohms	30—60 ohms
Power Conductance	17.5—35 mhos	35—71 mhos	71—141 mhos
Current Gain, Median	30	40	60

(for collector current of 2 amps.)

Also the famous XH10 HIGH POWER WELD-SEAL TRANSISTOR. The giant of the industry—with 10 Amp. maximum collector current.

MINNEAPOLIS Honeywell



First in Power Transistors

See the Honeywell display at the I.R.E. Show,
Booths 2202-2212.

For additional information on the Honeywell transistor line, write or phone for complete specifications, prices and list of current available literature.

UNION, N. J.
MURdock 8-9000
P. O. Box 161

CHICAGO
IRving 8-9266
7350 N. Lincoln Ave.

BOSTON
ALgonquin 4-8730
1230 Soldier Field Rd.

MINNEAPOLIS
FEderal 2-5225
2749 4th Ave. So.

LOS ANGELES
RAmond 3-6611 or
PARKview 8-7311
6620 Telegraph Road

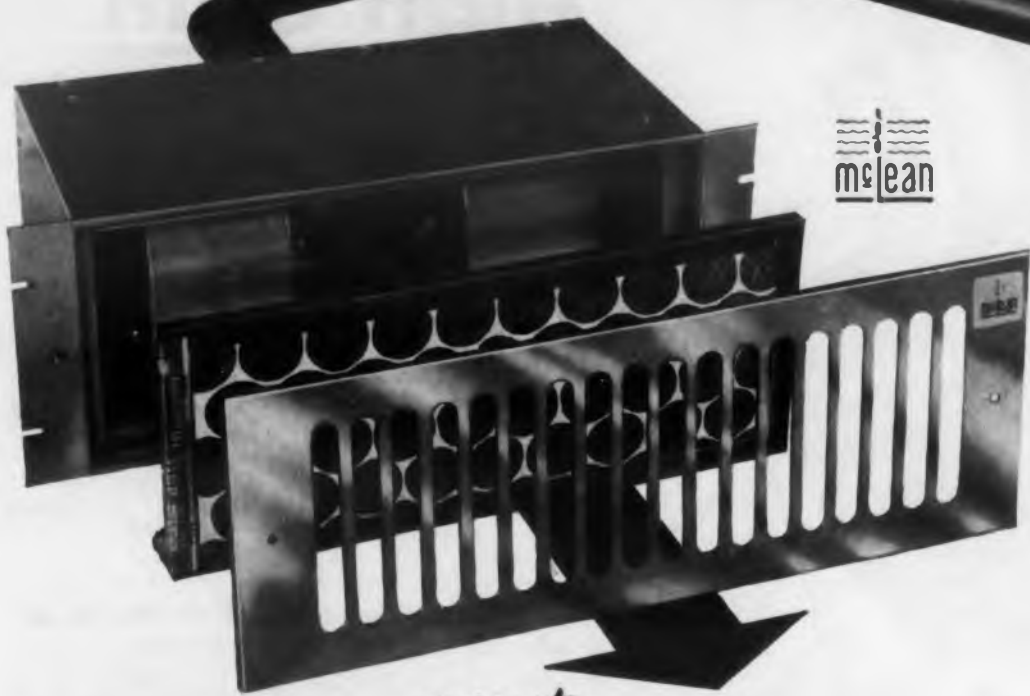
CLEVELAND
TOwer 1-0400
1900 Superior Ave.

CIRCLE 167 ON READER-SERVICE CARD FOR MORE INFORMATION

Cool That Cabinet—Save Sensitive Components

GENERAL FEATURES

- Pressurizes Cabinet With Filtered Air
- Rubber Isolated Motors For Quieter Operation
- Widely Accepted for Use In Military Equipment
- Maximum Air Delivery For Efficient Filter Action



mclean

ADDITIONAL FEATURES FOR BLOWER TYPE UNITS

- Provide Better Air Delivery Against Pressure
- Provide Quieter Operation Against Pressure
- Higher Air Velocity For Faster Cooling
- Air Flow Maintained With Dirty Filter
- Duct Connections Can Be Made If Desired

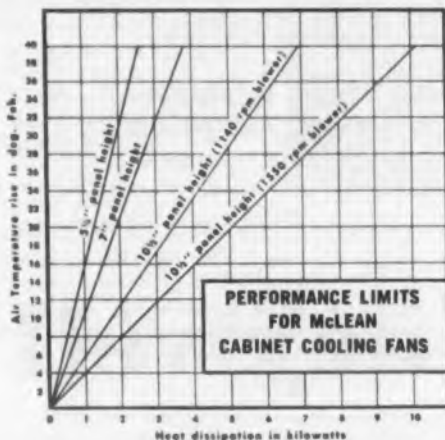
use McLEAN *Cabinet Cooling* FANS and BLOWERS*

RACK MOUNTED FOR EASY ASSEMBLY • FIT STANDARD 19" RACKS

THREE STANDARD MODULAR PANEL HEIGHTS COVER WIDE RANGE OF AIR DELIVERIES

Excessive or fluctuating temperatures in electronic racks make thousands of tubes die young . . . make crystals, transistors and sensitive electronic equipment perform erratically. System failure at critical times is disastrous . . . replacement costs are high. That is why leading manufacturers install McLean Fans and Blowers in Computers, Control Systems, Data Processing Systems,

etc. These small packaged units pressurize the cabinet with cool filtered air, keeping dust out. They are complete in one unit and ready for use. Standard RETMA notching allows mounting on rack . . . no cutting or fitting is necessary. All units contain an easily replaceable filter. Smart stainless steel grilles add beauty and eliminate the necessity of matching cabinet finishes.



SPECIFICATIONS

PANEL HEIGHT	MODEL	DEPTH	CFM	REMARKS	TYPE
5 1/4"	2A300	7 1/2"	80	Standard Rack Mounting For Trim Strip Racks Basic Model For Special Clearance Inside Height 7"	Blower Blower Blower Propeller Blower
	2E300	7 1/2"	80		
	2B300	7 1/2"	150		
	3E40	5 7/8"	190		
	2P408	11 1/8"	300		
7"	2E55	8 1/4"	250	Basic Model Basic Model No Projecting Outlets Vertical Discharge 400 cps Model	Propeller Blower Blower Blower Propeller
	2E408	10"	300		
	2A408	8 1/4"	300		
	2E408V	8 3/4"	300		
	2E55H	8 1/4"	310		
10 1/2"	2E80	8 1/8"	500	Basic Model Slow Speed Model 22" Rack Width Basic Model	Propeller Blower Blower Blower
	2B610	13 1/4"	550		
	2A610	13 1/4"	800		
	2E610	13 1/4"	800		

MODIFICATIONS OF ABOVE MODELS CAN BE MADE TO 24" OR SPECIAL WIDTH RACKS TO ORDER

FREE OUR NEW CONDENSED CATALOG! SEND FOR IT TODAY.

McLEAN ENGINEERING LABS. PRINCETON, NEW JERSEY PHONE: PRINCETON 1-4440

SAN FRANCISCO: WM. J. PURDY CO., 3127th St., San Francisco 3 • Underhill 3-4321
LOS ANGELES: RICHARD C. DUDEK, 407 No. Maple Dr., Beverly Hills • Bradshaw 2-8097

CIRCLE 168 ON READER-SERVICE CARD FOR MORE INFORMATION

Vernier-Potentiometer For Severe Environments



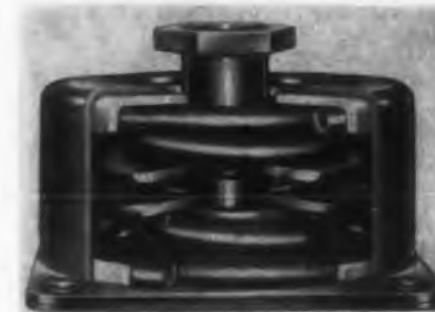
Designated RP04-0101, this vernier potentiometer combines flexibility in mounting provisions, mechanical travel and electrical characteristics with ability to withstand severe environments and to meet exacting and rigid operating conditions. Temperature range is -65 F to +275 F; vibration 10 g at 10 to 1500 cps, shock up to 60 g.

Travel distance is 4.13 in.; vernier scale reads to 0.010 in. increments, resolution is 0.001, life is 1,000,000 cycles. Power dissipation is 2 w, resistance, 30 k ohms ± 10 per cent, linearity ± 0.2 per cent. Weight is 2.5 oz.

Humphrey, Inc., Dept. ED, 2805 Canon St., San Diego 6, Calif.

CIRCLE 169 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Vibration Mount For All Flight Angles



The mechanical isolator pictured here is not limited in its action to horizontal positions or maximum inclinations of a few degrees, but affords continuing isolation through all positions in jets and missiles, during steep climbs, dives and maneuvers. The B-64 All-Angl Barrymount protects heavy electronic equipment against shock or vibration. Maximum load rating is 40 lb. The damping is effective in all directions, and keeps transmissibility at resonance below 3. Operating temperature range is -65 C to +120 C. Performance is unaffected by the salt spray, humidity, sand and dust environments of MIL-E-5272A. Still further improvement in structural stability of the mounted system under shock can be obtained by means of a wide-flange countersunk core, available with the mount, that permits seating its attachment screw in a dimpled base.

Barry Controls, Inc., Dept. ED, 875 Pleasant St., Watertown 72, Mass.

Radio Engineering Show, Booth 2534.

CIRCLE 170 ON READER-SERVICE CARD FOR MORE INFORMATION

△ **Transistor Curve Tracer**
Used With Oscilloscope



Used with any oscilloscope, the instrument here pictured provides a basic method of transistor inspection and evaluation. The scope presents either an eight-family curve or a single curve of the dynamic output of the transistor under inspection. Instant indication is afforded of its gain, breakdown, leakage current, linearity, saturation resistance, collector resistance and operational anomalies.

The evaluator itself is of transistorized design, and incorporates a digital type step generator that provides the base current drive. This drive is controlled by the panel base drive selector switch which affords selection of ranges of 5, 10, 50 and 100 μ amp, thus permitting low-power evaluation without danger of damage to the transistor to be tested. Setting the continuous base drive control at the right side of the panel on full, with the selector switch at 100 μ amp, then provides a maximum total drive of 700 μ amp. The output is in the form of either single or family curve presentation of collector voltage versus collector current.

Designated Model 504 transistor curve tracer, the instrument is small, light, self-powered and portable. Dimensions are 8-1/2 in. x 5 in. x 4-1/2 in.

Cubic Corp., Dept. ED, 5575 Kearney Villa Road, San Diego, Calif.

Radio Engineering Show, Booth 1723.

CIRCLE 171 ON READER-SERVICE CARD FOR MORE INFORMATION



△ **Synthetic Mica**

Low-Loss Factor

This synthetic mica has a heat factor of continuous usage at 1000 F as compared to 800 F of regular mined and glass bonded mica. The loss factor of Mykroy is 0.0009 per cent as compared with 0.0028 per cent in glass bonded mica. The synthetic mica is made in sheet form and in molded shapes.

Electronic Mechanics, Inc., Dept. ED, 101 Clifton Blvd., Clifton, N. J.

Radio Engineering Show, Booth 4239.

CIRCLE 172 ON READER-SERVICE CARD FOR MORE INFORMATION



LARGE WAVEGUIDE



Slotted line for waveguide size WR 2100. Covers range of 350-530 mc. Probes tunable over entire band. Inherent VSWR less than 1.02--slope less than 1.01. Features bolted and doweled aluminum construction.

LARGE WAVEGUIDE & COMPONENTS WR 770 to WR 2300 (1450 down to 320 mc)

To complement the waveguide presently being supplied for major military and commercial applications in radar and scatter communications systems, we now offer a complete line of components and test equipment.

Terminations. Aluminum construction. Engineered to absorb virtually all incident power. Load is adjustable with locking device to secure it in any position.

Attenuators. Vane type designed to provide 20 db of attenuation with a minimum of mismatch. Calibration curves available.

Directional couplers. Bolted and doweled aluminum construction. Power split to customer requirements.

Special components. Including waveguide switches, duplexers, diplexers, series and shunt tees, rotary joints, and special shapes.

All items are in production now and are available on short term delivery. For more information, write I-T-E Circuit Breaker Company, Dept. 35, Special Products Division, 601 East Erie Ave., Philadelphia 34, Pa.



VISIT THE I.R.E. SHOW, March 18-21
See this equipment displayed at Booth 1313-1315

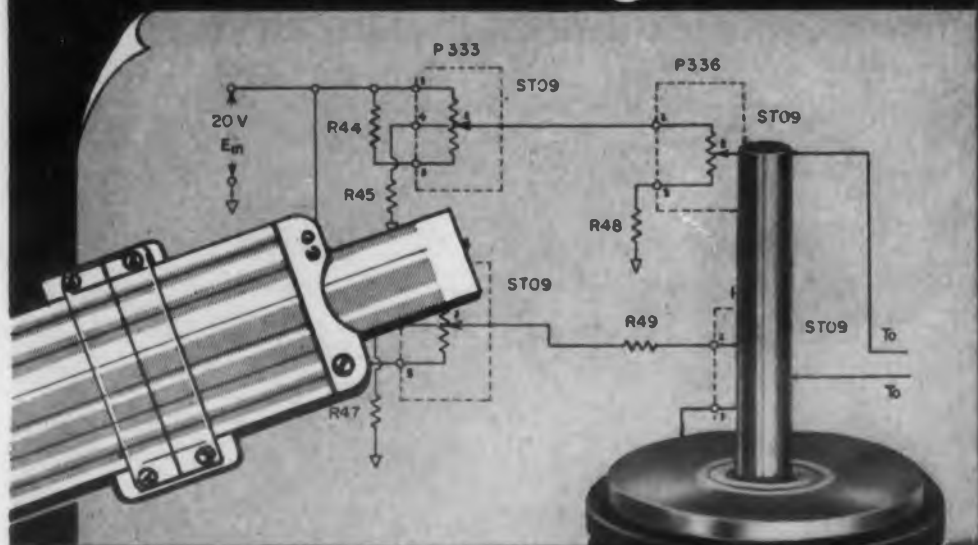
I-T-E CIRCUIT BREAKER COMPANY
Special Products Division

CIRCLE 173 ON READER-SERVICE CARD FOR MORE INFORMATION



Waveguide to coaxial transitions. High-strength, lightweight aluminum construction. Supplied as standard with 3 1/8 in. coaxial connector (for WR 770 size, 1 5/8 in.). Adapters to other sizes available. All transitions designed for high power handling capacity.

Where specs are tight...



SPECIFY SUPERIOR BALL-BEARING POTENTIOMETERS BY



Designed for those applications where less than the best means failure . . . by the world's first and leading manufacturer of precision single-turn wire-wound potentiometers. Advanced production and quality-control techniques by the pioneer in mass production of precision potentiometers offer unequalled delivery . . . of prototype and production quantities.

All models of the TIC Ball-Bearing Series are designed to the latest industrial dimensions. Servo mounting is AIA standard. Stainless-steel ball-bearing construction is used for low-friction . . . low-torque operation. Other precision mechanical features include precious-metal slider contacts . . . centerless-ground stainless-steel shaft . . . and one-piece stainless-steel clamp ring developed by TIC for simple, precise phasing of individual units of ganged assemblies.

Designed for precision applications in automatic control systems, the subminiature ST09, for example, features standard independent linearity of $\pm 1\%$ (0.3%, special) of the total resistance, and $\pm 5\%$ standard total resistance accuracy. High resolution . . . equivalent noise resistance less than 140 ohms . . . wide standard temperature range (-55°C to 80°C) increases application versatility. ST09 is available in standard resistances of 100, 200, 500, 1K, 2K, 5K, 10K, and 20K.

Full specification on the ST09 and other units of the TIC precision ball-bearing series available upon request.

TECHNOLOGY INSTRUMENT CORP.

555 Main Street, Acton, Mass., COlonial 3-7711
West Coast Mail Address, Box 3941, No. Hollywood, Calif., POplar 5-8620

CIRCLE 174 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Miniature Aluminum Connectors 75% Smaller Than AN



As small as only 25 per cent the size and weight of standard AN connectors, these Pygmy connectors free weight and space for other uses. Both military and commercial aircraft may reap distinct advantages. The Pygmy connectors come in a great variety of shell styles and insert arrangements. Shells incorporate from 1 to 55 contacts, and range in size from 3/8 in. i. d. to 1-3/8 in. i. d. Contacts are heavily gold plated, size 20. They can be supplied with quick disconnect coupling or positive, 3 point bayonet lock; and with varied provisions for grommet sealing, potting, conduit applications, etc.

Bendix Aviation Corp., Avnet Eastern Sales, Dept. ED, 36 N. Moore St., New York 13, N.Y.
Radio Engineering Show, Booth 2322-2425.

CIRCLE 175 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Silicon Waveguide Crystal 26.5 to 75 Kmc

Suited to mixer or low level video detector use in the range of 26.5 to 75 kmc, a silicon diode millimeter waveguide crystal has been made available for military and industrial applications. It measures 9/16 x 3/4 x 3/8 in., and is cased in silver plated brass. The case forms a section of ridged waveguide, with the crystal as an integral part. Tapered transition sections adapt the ridged waveguide crystal input for use with RG-96, RG-97 or RG-98/U waveguides. The MA-512 transition section is available for use with this crystal in RG-98/U waveguide over the 50-75 kmc band. Two important immediate applications will be in the field of high definition radar and in microwave spectroscopy. Designation is MA-412.

Microwave Associates, Inc., Dept. ED, 22 Cummington St., Boston 15, Mass.
Radio Engineering Show, Booth 3237-3239.

CIRCLE 176 ON READER-SERVICE CARD FOR MORE INFORMATION

NOW **2** INEXPENSIVE

MICRO-MICROAMMETERS

1 MODEL 411 for maximum stability
Meets or exceeds the zero stability of the most costly equipment; recommended for long-term control, alarm, and monitoring work, as in thickness gaging and reactor control. No transients created by switching from range to range.

- ★ **RANGES:** two per decade, from 10^{-3} to 10^{-11} ampere full scale.
- ★ **ZERO DRIFT:** less than 2% per week, with source voltages above 10 volts.
- ★ **TIME CONSTANT:** less than 4 seconds on the 10^{-11} range with 5000 mmf across input.



2 MODEL 410 for maximum sensitivity
The general purpose instrument for measurement and control of microcurrents. Typical uses: currents in ion gages, ion chambers, photocells, vacuum tube grids, back currents of silicon transistors.

- ★ **RANGES:** two per decade, from 10^{-3} to 3×10^{-13} ampere full scale.
- ★ **ZERO DRIFT:** less than 2% per day, with source voltages above 300 millivolts.
- ★ **TIME CONSTANT:** less than one second on the 10^{-11} range with 5000 mmf across input.

BOTH MODELS include a 250-volt tap for polarizing ion chambers, an output that drives 50-millivolt and 5-milliamperere recorders, input and output connections at both front and back. Suited to both bench and rack mounting, and available with a contact meter in place of standard meter.

DESCRIPTIVE LITERATURE is now available. A request on your company letterhead will bring your copy promptly.

KEITHLEY INSTRUMENTS, INC.

12415 Euclid Ave., Cleveland 6, Ohio

CIRCLE 177 ON READER-SERVICE CARD

NEW!

DC to DC and DC to AC
solid-state power converters
voltage regulated, frequency
controlled, for missiles,
telemetry, gyros, servos



Interelectronics Inverter solid-state thyra-tron-like elements and magnetic components convert DC to any number of voltage regulated or controlled frequency AC or filtered DC outputs from 1 to 1800 watts. Light weight, compact, 90% or better conversion efficiency.

Ultra-reliable in operation, no moving parts, unharmed by shorting output or reversing input polarity. Complies with MIL specs for shock, acceleration, vibration, temperature, RF noise.

Now in use in major missiles, powering telemetry transmitters, radar beacons, electronic equipment. Single and polyphase AC output units now power airborne and marine missile gyros, synchros, servos, magnetic amplifiers.

Interelectronics — first and most experienced in the DC input solid-state power supply field, produces its own solid-state gating elements, all magnetic components, has the most complete facilities and know-how—has designed and delivered more working KVA than any other firm!

For complete engineering data write Interelectronics today, or call LUDLOW 4-6200 in N. Y.

INTERELECTRONICS CORPORATION

2432 GR. CONCOURSE, N. Y. 58, N. Y.

CIRCLE 178 ON READER-SERVICE CARD

△ Valve Position Indicators For Aircraft and Missiles



Switches that signal the position, or the functioning, of a valve in a missile or aircraft or rocket engine, are made now in two lightweight models. The Capswitch model 65M41 is a spdt switch weighing 0.095 lb. Model 65M83 is a dpdt switch weighing 0.19 lb. Switching is accomplished by a sealed plunger, which is depressed by the valve stem. The switch is completely sealed in epoxy resin, and the entire mechanism encased in a steel shell. It is adapted to any type of control where repeatability within ± 0.001 in. is desired.

Robertshaw-Fulton Controls Co., Bridgeport Thermostat Div., Dept. ED, Milford, Conn.
Radio Engineering Show, Booth 2708.

CIRCLE 179 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Servo Accelerometer

Linearity ± 0.1
Per Cent

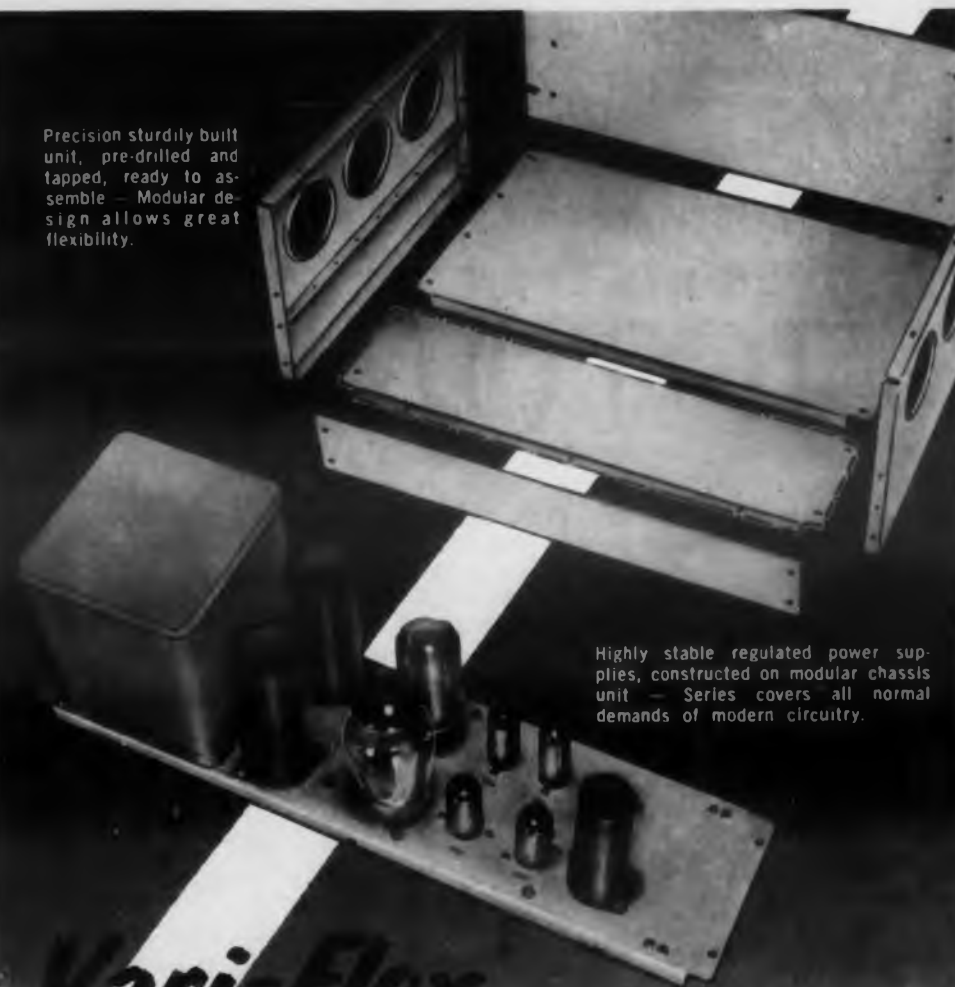
Incorporating a high-gain electromechanical amplifier in closed-loop operation, a servo accelerometer designated Model 4112 provides precise measurements of or control of linear acceleration under severe environmental conditions. It is especially suited to aircraft and missile applications where high accuracy and rugged construction are needed. Frequency range is 0 to 25 cps.

The Model 4112 provides resolution better than 0.001 per cent and linearity within ± 1 per cent at full range. It withstands hundreds of g's of shock. Compensation within 0.1 per cent of full scale over a temperature range of 100 C can be achieved. Available standard input ranges are from ± 0.1 g to ± 20 g. High output levels, requiring no further amplification, are available.

Donner Scientific Co., Dept. ED, Concord, Calif.
Radio Engineering Show, Booths 3616, 3618.

CIRCLE 180 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision sturdily built unit, pre-drilled and tapped, ready to assemble — Modular design allows great flexibility.



Highly stable regulated power supplies, constructed on modular chassis unit — Series covers all normal demands of modern circuitry.

Vari-Flex CHASSIS and POWER SUPPLIES

... Save You TIME and MONEY

- Combines ready-to-assemble chassis with high quality regulated power supplies — Saves time — Construction starts where it should with the circuit proper.
- Instantly demountable construction for circuit salvage or substitution.
- Two sizes of assembly — 9" and 13½" depth, utilizing three interchangeable chassis plates 4½", 9", and 6¾" deep.
- Standard RETMA overall size for convenient rack mounting. Panel size 8¾" x 19".
- Perforated metal shields available for top and bottom.
- Regulated Power Supplies — constructed on 4½" chassis plate — have extremely low ripple and excellent regulation and transient recovery characteristics.

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**Hamner Electronics
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P.O. Box 531, Princeton, N. J. • PENnington 7-1320



CIRCLE 181 ON READER-SERVICE CARD FOR MORE INFORMATION

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VICTOREEN

Components at Booth 2231

If tough specifications have you in a bind—check Victoreen first. For Victoreen is a major producer of prime quality electronic components. Many are off-the-shelf items we can ship immediately. If not, we can design and build them to exceed specification requirements . . . can generally beat delivery requirements, too.



Precision Encapsulated Deposited Carbon Resistors offering the ultimate in stability over thousands of operational hours; temperatures to 200°C; low temperature exposure; and moisture resistance.

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New Corona Type Voltage Regulators offering new, simplified, and more economical means of solving high-voltage power supply regulation. January 1957 reprints and technical design considerations available on request. The author of these articles, Don Ward, will be in attendance to help solve your problems.

Exclusive Export Agency: Terminal Radio International, Ltd.
135 Liberty Street, New York City

The **Victoreen Instrument Company**

Components Division

5806 Hough Avenue, Cleveland 3, Ohio

CIRCLE 182 ON READER-SERVICE CARD FOR MORE INFORMATION



△ 4 mm
Klystron
69.5-77.5 Kmc

Power output of this 4 mm klystron is 40 mw at band center, minimum of 10 mw. Heater power of only 4 w yields a beam current of 16 ma at a resonator voltage of 2400 v. Maximum repeller voltage is 400 negative with respect to cathode. A Philips "L" cathode furnishes the required beam current density of 2 amp per square centimeter.

Amperex Electronics, Dept. ED, 230 Duffy Ave., Hicksville, N.Y.

Radio Engineering Show, Booth 2522-2524.

CIRCLE 183 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Pulse Amplifier
320 Mc Bandwidth



With the Model 206 wide band amplifier fast-rise pulses can be reproduced by providing a stable 20 db gain over a 320 mc band. Nominal gain for this model is 20 db, sloping to 18 db at 300 mc and 14 db at 320 mc, but both flat and roll-off characteristics are available by means of plug-in accessories. Three output modes, linear, pulse and high pulse, are selectable by a front panel switch. There are nine possible combinations of three response characteristics and three output modes. Integral regulated power supply and rack mounting are also provided.

The bandwidth of this amplifier is 300 mc at the 3 db point; rise time is less than 0.002 μ sec. The output panel switch selects linear characteristic at 5 v rms, pulse at 30 v neg and high pulse at greater than 100 v neg, open circuit. Gain regulation is ± 0.5 db for line voltage between 105 and 125 v, and the gain control varies 6 db. Phase is linear to 300 mc. Impedance is 180 ohms input, 200 ohms output. Its size is 19 in. x 8-3/8 in. x 7 in., and it requires 115 v 60 cycle power.

Spencer-Kennedy Laboratories, Dept. ED, 1320 Soldiers Field Rd., Boston 35, Mass.
Radio Engineering Show, Booth 3502-3504.

CIRCLE 184 ON READER-SERVICE CARD FOR MORE INFORMATION

Flexibility for Designers



Adjust-A-Volt

500BU

VARIABLE AUTO-TRANSFORMER



2-GANG 500BU
(Also available in 3-gang)

Designed for back-of-panel mounting, the versatile 500BU Adjust-A-Volt variable auto-transformer offers the dependability and flexibility you have been looking for.

Shaft can be adjusted without disturbing rotor and commutator alignment. Terminal board connections allow for either clockwise or counter-clockwise rotation, as well as over-voltage or line-voltage operation.

Ganged units are available to provide increased current output, increased voltages, or for polyphase operation.

Specifications of the 500BU type—input voltage, 115 V; load rating, 1.0 KVA; output—0 to 135 V; output amps max. 7.5 A; driving torque in oz., 20-40. For more data, send for the catalog on the complete Adjust-A-Volt line.

STANDARD

ELECTRICAL PRODUCTS CO.

2240 E. THIRD ST., DAYTON, OHIO

CIRCLE 185 ON READER-SERVICE CARD



select
the right
pilot light
...fast!

**Johnson pilot lights
immediately available
for original equipment or
in-the-field replacement!**

Save valuable specification time by selecting your panel indicators from Johnson's "preferred" line. This group contains over 47 separate assemblies carefully selected from Johnson's standard line by many of the nation's top design and development personnel. Available in a wide variety of types, these "preferred" units are immediately available at parts distributors throughout the country, for original equipment or in-the-field replacement. Write for your free copy of Johnson's newest pilot light specification catalog—see how easy it is to select the *right* pilot light... fast!

free!

New pilot light catalog—contains complete specifications, prices and technical data... everything you need to select the proper unit for original equipment or in-the-field replacement.



Available types include: continuous indication neon types; models for high and low voltage incandescent bulbs; standard or wide angle glass and lucite jewels in clear, red, green, amber, blue or opal. Specials, including those meeting military specifications are also available in quantities.

E. F. Johnson Company

3413 Second Ave. S.W. • Waseca, Minnesota

CIRCLE 186 ON READER-SERVICE CARD

△ **Ruggedized Meter**
20 Microamp Movement



Sensitivities as low as 20 μ a are accomplished with a coil resistance of 3000 ohms in this core magnet meter movement. Shock mounted jewel assemblies incorporated in its construction ruggedize the instrument. The movement is available in a 2-1/2 in. round, clear plastic case, and in many attractive custom styles.

Phaotron Instrument and Electronic Co., Dept. ED, 151 Pasadena Ave., S. Pasadena, Calif.
Radio Engineering Show, Booth 3116.

CIRCLE 187 ON READER-SERVICE CARD FOR MORE INFORMATION

△ **Press-Fit Terminals**
Need No Hardware



Without nuts, washers, lockwashers or sealing, but with only a simple insertion tool and drill-press equipment, these miniaturized terminals, designated Press-Fit, are installed simply by pressing them into place. Labor requirement is minimum. The terminals are shock and vibration proof, essentially unbreakable, immune to ordinary high temperatures, and they resist corrosion and fungus. Despite diminutive size, permitting their use in compact equipment and tight spots, they withstand the service requirements of guided missiles, radar, electronic computers and communications equipment. They measure 0.093 in. dia, and range in overall height from 0.250 in. to 0.5 in., depending on whether they are stand-offs or feed-throughs.

Selectro Corp., Dept. ED, 610 Fayette Ave., Mamaroneck, N.Y.

Radio Engineering Show, Booth 3714.

CIRCLE 188 ON READER-SERVICE CARD FOR MORE INFORMATION



AT LAST a completely new kind of regulator!

**ACTUALLY THREE REGULATORS IN
ONE—PLUS MULTIPLE SENSING!**

The APR 1010 combines many new regulation and sensing systems in one versatile package. Here's flexibility of operation never before possible... saves space, eliminates instrument duplication, means greater economy in engineering operations.

- RMS VOLTAGE REGULATION
- AVERAGE REGULATION
- PEAK REGULATION
- FIVE PRINCIPAL SENSING ARRANGEMENTS

1. Internal
2. External
3. Remote
4. Constant Current
5. DC

ELECTRICAL CHARACTERISTICS:

Input	95-130 VAC, 1 ϕ (50 or 60 cps \pm 10%)
Output	115 VAC, adj. 110-120V
Regulation accuracy	\pm 0.1% against line \pm 0.1% against load
(RMS, average, or peak, switch selected)	
Distortion	3% max.
Load	0-1000VA
P.F. range	Unity to 0.7 lagging
Recovery time	0.1 sec.

WRITE FOR COMPLETE TECHNICAL DATA.

See the new
APR 1010
at Booths 2627-9
I.R.E. Show!

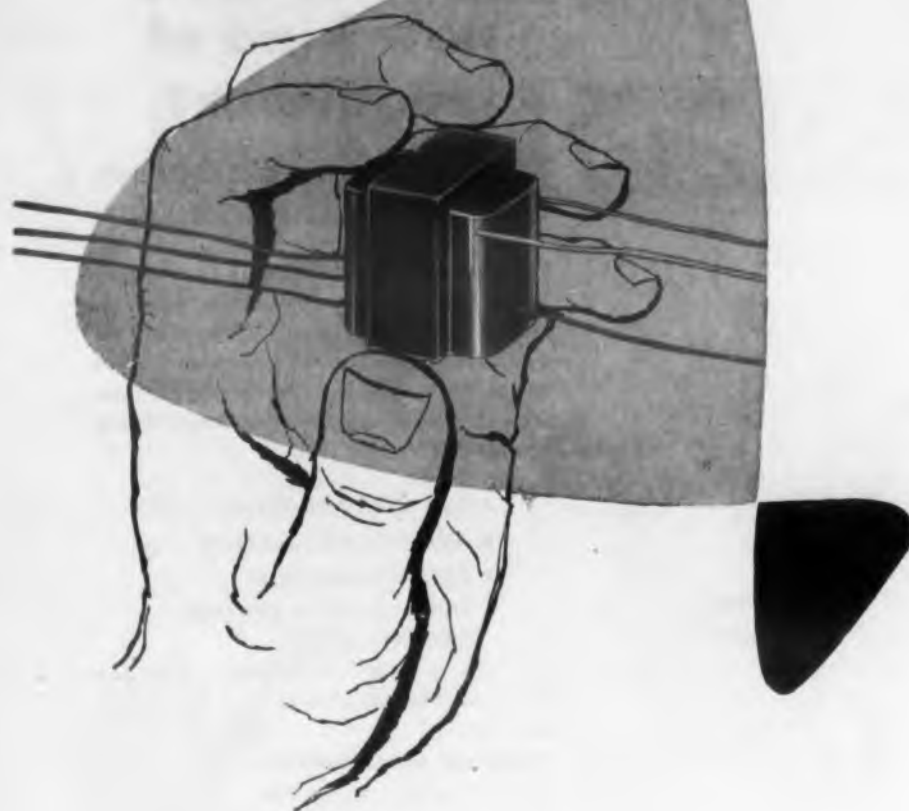


Sorensen

SORENSEN & COMPANY, INC. • STAMFORD, CONN.

CIRCLE 189 ON READER-SERVICE CARD FOR MORE INFORMATION

...know a good place to get EPOXYS?



Wheeler's new epoxy resin cast electronic components... including inductors, transformers, and subminiature assemblies of tuned circuit elements... offer the following specific advantages:

- Extremely wide ambient and internal temperature tolerance.
- Exceptional mechanical and physical stability... freedom from cracking, deformation, chemical or physical changes, and deterioration under service conditions.
- Exceptional electrical properties without tendency to deteriorate.
- High resistance to humidity, chemicals and other contaminants.
- Flexible leads and/or terminals.
- Elimination of hermetically sealed cans.
- Elimination, in many cases, of mountings.
- Further steps in miniaturization.

Wheeler's equipment for the casting of epoxys complements already very complete engineering and production facilities in the field of custom transformers, coils, amplifiers and electronic assemblies for military and civilian service. Here is your logical source for both development assistance and experienced production.

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INSULATED WIRE COMPANY, INC.
Division of Sperry Rand Corporation
1131 EAST AURORA STREET • WATERBURY 20, CONNECTICUT

3WH56R

CIRCLE 190 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Subminiature Pilot Light
Uses NE2D Neon Glow Lamp

Drawing as little as 0.00002 amp the NE2D glow lamp used in this pilot light consumes about 0.04 w of power, produces practically no heat and has an average life of 25,000 hr. The pilot light that houses it measures 3/4 in. x 1-1/4 in., and mounts from the front of the panel in a hole with 17/32 in. clearance. Its plastic, stovepipe-shaped cap provides 180 deg visibility and is available in clear and in any of six colors. The series of pilot lights housing the NE2D neon glow lamp is designated No. 137-7336-931. Metal parts are made of brass finished in black nickel, white nickel or chrome, as ordered. Terminals are perforated for wire and tinned for easy soldering. Insulation is phenolic material of mil-spec grade.

Dialight Corp., Dept. ED, 60 Stewart Ave., Brooklyn 37, N. Y.

Radio Engineering Show, Booth 2730-2732.

CIRCLE 191 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Switch Actuators
Leaf, Roller, Pushbutton

These leaf, roller and pushbutton actuators increase the utility of the basic switch and add considerably to its range of application. All provide additional overtravel. All are of stainless steel construction, with rugged positive stops and long-life torsional springs. The basic switch, which is designated KX4 series, has a capacity of 10 amps, resistive, 115 v ac/30 v dc, and is a snap action unit for use in aircraft, guided missiles, industrial controls and other applications that require immunity against environmental conditions. Switch and actuator have high shock and vibration resistance. Their combined weight is slightly over 1 oz.

Metals and Controls Corp., Spencer Thermostat Div., Dept. ED, Attleboro, Mass.

Radio Engineering Show, Booth 1226.

CIRCLE 192 ON READER-SERVICE CARD FOR MORE INFORMATION

Malco IS YOUR BEST SOURCE FOR SOLDERING LUGS TERMINALS PRINTED CIRCUIT HARDWARE



HERE'S WHY:

- Specialized high production techniques afford lowest possible unit cost.
- Precision tooling, rigid quality control assure tolerances to critical specifications.
- Ample stocks of over 1000 different parts permit prompt delivery.
- Malco specializes in a complete line of small stampings for Radio-TV, electrical/electronic and automotive industries.
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Let Malco show you how you can save on production time and costs. Contact us today.



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Magnet Wires
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SPECIALTY WIRES USING
TEFLON, GLASS AND SILICONE

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CIRCLE 194 ON READER-SERVICE CARD

**△ Slotted Lines
1.7 to 5.85 KMC**



For maximum flexibility and accuracy in standing wave measurements in the 1.7-5.85 kmc region the basic design of this universal carriage accepts interchangeable precision slotted sections in waveguide sizes RG-104/U, 112/U, 48/U, 49/U and WR-229. Additional slotted sections are soon to become available in the 0.750-0.985, 0.450-2.580 and 0.450-1.200 kmc ranges. Most standard probes can be used without alteration. Features include a stationary spinner knob for vernier control of probe position (which can be motor driven for remote operation by adding a suitable motor and limit stops), a push button probe release for faster operation, scale vernier and low residual VSWR.

Diamond Antenna and Microwave Corp., Dept. ED, 7 North Ave., Wakefield, Mass.
Radio Engineering Show, Booth 2733-2737.

CIRCLE 195 ON READER-SERVICE CARD FOR MORE INFORMATION



**△ Electronic Counter
Unitary or Binary**

Accepting numerical information either as unitary pulse trains or in parallel in binary coded form this electronic counter, designated Add-Tractor, adds and subtracts, and is applicable to many industrial and laboratory uses. It adds, sums and subtracts; controls servos, digital positions and ratios; weighs, measures frequency deviations, converts digital to analog data and does other things. It functions as an accumulating register, it can be operated as a right and left shift register. It converts to nine's complement for subtraction in ten microseconds.

Tube complement is four type 5963. Power requirement is 6.3 v ac at 1.2 amp; 300 v dc at 16 ma.

Victor Adding Machine Co., Dept. ED, 3900 N. Rockwell St., Chicago 18, Ill.

Radio Engineering Show, Booth 1320.

CIRCLE 196 ON READER-SERVICE CARD FOR MORE INFORMATION

BAIRD **B** ATOMIC

TRANSISTOR TESTING A PROBLEM?

LOOK TO

Baird - Atomic

FOR THE ANSWER

Complete, accurate testing requires test equipment especially designed for the job — not modifications of standard apparatus. B-A has developed a complete line of transistor test equipment. The features of some of B-A's Transistor Test Equipment are listed below:

TRANSISTOR TEST SET — 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.



Model GP4 — TRANSISTOR TEST SET

POWER TRANSISTOR TESTER — 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



Model KP1
POWER
TRANSISTOR
TESTER



Model KT1
BETA, h_{11} ,
 I_{co} TESTER

BETA, h_{11} , I_{co} TESTER — 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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BAIRD **B** ATOMIC

Baird - Atomic, Inc.

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CIRCLE 197 ON READER-SERVICE CARD FOR MORE INFORMATION



High "IR" Cold-punching Laminate INSUROK® XT-896

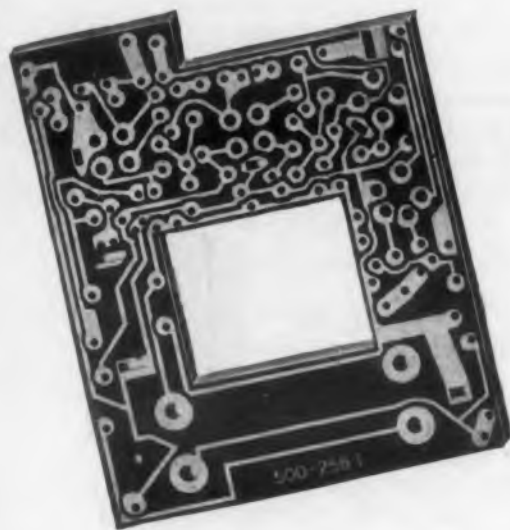
by Richardson

Here's an all-new Richardson product . . . that will cut your production costs in mechanical assembly and printed circuitry!

New Insurok XT-896 punches sharp and clean at average room temperatures. It is ideal for precision-punching of mechanical and electrical parts since it's not subject to dimensional changes that occur in materials which must be heated before processing.

This XXXP laminate has low moisture absorption, low dielectric loss and excellent insulation resistance. In copper clad form it maintains its bond strength throughout heat cycling and has good blister resistance.

For increased production of automatic assemblies . . . for greater precision in printed circuits . . . specify Insurok XT-896. Call on Richardson engineers to assist you in the application of NEMA, copper clad and special grades to meet your product requirements. A note on your letterhead to Dept. 18 will bring data and samples by return mail. Better still—phone today. Chicago telephone: MAnsfeld 6-8900.



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CIRCLE 198 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Missile Tape Recorder 250 Sec Recording Time



The Model 600 system consists of a remote-controlled, two-track magnetic tape recorder. The unit will record and play back typical IRIG FM/FM subcarrier signals from 200 to 100,000 cps on a 1/4 in. tape for a recording time of up to 250 seconds.

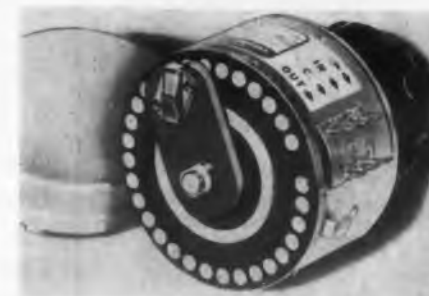
The recorder is completely contained in two cases, which are designed for missile mounting. Total weight of the two packages is 21.5 lb. The tape transport has a maximum flutter and wow content of 1 per cent, peak-to-peak. Signal to noise ratio is 30 db, with 2 per cent maximum harmonic distortion. The unit is designed to withstand 30 g shock, sinusoidal vibration of 10 g, 2 to 2000 cps, and white noise acceleration density of 0.2 g²/cps, 2 to 2000 cps.

Minneapolis-Honeywell Regulator Co., Davies Laboratories Division, Dept. ED, 10721 Hanna St., Beltsville, Md.

Radio Engineering Show, Booth 3118.

CIRCLE 199 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Unbalanced Ladder Networks Low Impedance Controls



Recommended for broadcast, public address recording systems, as mixer or master gain controls, these compact, unbalanced ladder networks offer 30 steps of attenuation in housings only 1-15/16 in. x 1-3/4 in. diam. Their extremely small size makes them particularly useful in recording equipment, or where panel space is at a premium. A large selection of various impedance combinations and decibel losses is available. Designation is LA-130.

Daven Company, Dept. ED, Livingston, N.J.
Radio Engineering Show, Booth 2717-2719.

CIRCLE 200 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 201 ON READER-SERVICE CARD ▶



△ **Miniature
Load Isolator**

**Length 1 in.,
Weight 9 Oz**

Operating over the frequency range 8.5 to 9.6 kmc this miniaturized ferrite microwave load isolator is for waveguide size RG-52/U, flanges UG-39/U. Designated Model X-125, it has a total length of only 1 in. and weighs 9 oz. Peak power is 100 kw, average power into 2:1 mismatch, 100 w. VSWR into matched load is 1.15. Isolation is 10.0 db over band; insertion loss 1.0 db.

Cascade Research Corp., Dept. ED, 53 Victory Lane, Los Gatos, Calif.
Radio Engineering Show, Booth 3607-3609.

CIRCLE 202 ON READER-SERVICE CARD FOR MORE INFORMATION

△ **Direct-Reading Phase Meter**
1 Cps to 500 Kc



A stable and convenient device for measuring phase angle between two voltages without either amplitude or frequency adjustment, the 405 Series phase meters display phase angle directly in degrees on an 8-in. rectangular-panel mirror-scale. The instrument is also capable of plotting phase-frequency curves on a recorder or oscilloscope. It is stable when measuring small fractions of one deg on all ranges including the 0-12 deg range.

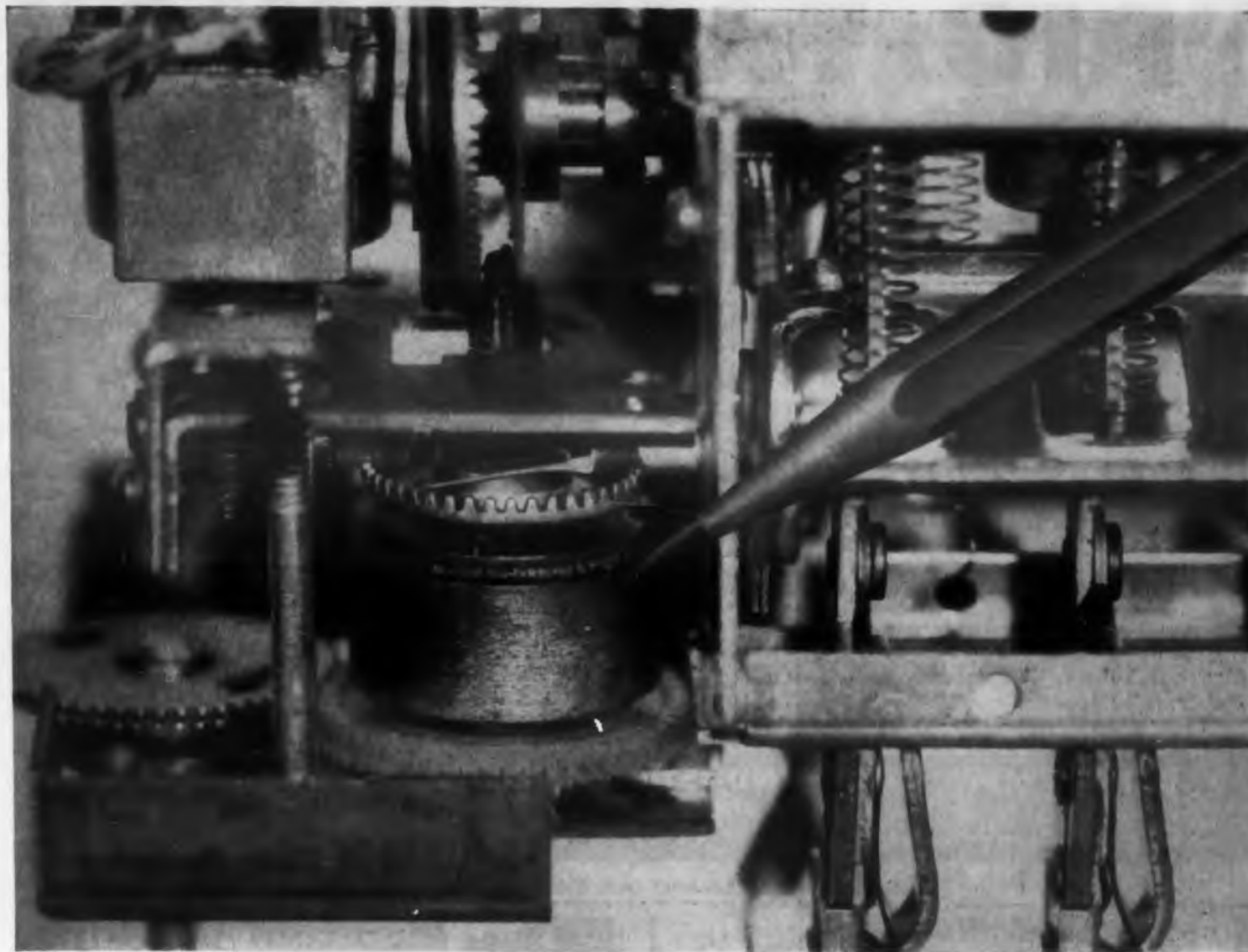
Consisting of a coincident slicer and cathode-coupled limiter stages with plate-to-plate degeneration, the meter features independence of the ratio of input signal amplitudes, equal accuracy for symmetrical wave-forms of any shape and identification of "lead" and "lag," self-calibration.

Relative accuracy is $\pm 1/4$ deg, absolute accuracy ± 1 deg (or 2 per cent) at any range. There are eight phase ranges, covering the entire span from 0 to 360 deg. Model 405L has a frequency range from 1 cps to 20 kc and an input voltage range from 0.3 v to 70 v. Type 405H has a frequency range 8 cps to 500 kc and an input voltage range from 2 v to 40 v. Both types have high impedance inputs.

Advance Electronics Lab, Inc., Dept. ED, 249 Terhune Ave., Passaic, N. J.
Radio Engineering Show, Booth 3412.

CIRCLE 203 ON READER-SERVICE CARD FOR MORE INFORMATION

◀ CIRCLE 201 ON READER-SERVICE CARD



New low cost magnetic clutches from 

Now you can get the same magnetic clutches used in today's finest signal seeking radio tuners. Originally designed by R/C for the rigid price-performance requirements of the automotive industry, they are finding new applications throughout electrical manufacturing. Designers are using them to replace cumbersome, complex assemblies . . . to save space and eliminate costly production steps. They show further promise in accomplishing jobs now being wastefully done with heavy duty and servo types at fifty to one hundred times the cost.

Two types of R/C magnetic clutch are in high volume production now. Designed for operation at from 11 to 16.2VDC, they are also available for 32V operation . . . and can be further modified to meet your special requirements.

We'll be happy to send you complete information on the two types shown, or if you wish, we'll have an R/C engineer at your desk ready to work with you to better fit R/C clutches to your needs.



**Operating Characteristics
Of New R/C Magnetic Clutches**

Voltage	11 to 16.2V 32V also available
Torque	8 in.-oz. minimum
Residual Torque	0.3 in.-oz. maximum
Operating Temperature	130F to -20F
Relative Humidity	tested to 95%
Life	successfully completed 120,000 operations with no sign of failure



RADIO CONDENSER CO.

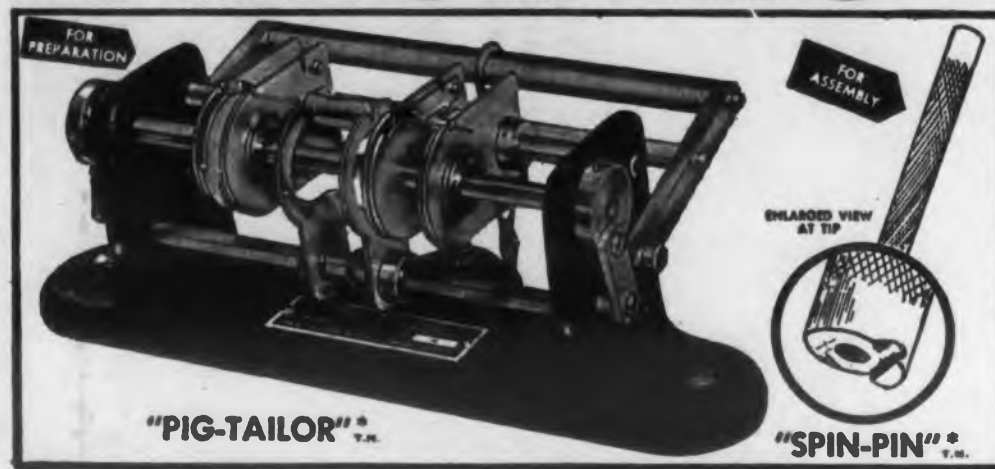
Davis & Copewood Streets • Camden 3, New Jersey
EXPORT: Radio Condenser Co., International Div., 15 Moore St., N.Y. 4, N.Y.
CABLE: MINTHORNE
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SEE US AT THE I.R.E. SHOW—BOOTH 2308

CIRCLE 204 ON READER-SERVICE CARD FOR MORE INFORMATION

"PIG-TAILORING"

... a revolutionary new mechanical process for higher production at lower costs. Fastest PREPARATION and ASSEMBLY of Resistors, Capacitors, Diodes and all other axial lead components for TERMINAL BOARDS, PRINTED CIRCUITS and MINIATURIZED ASSEMBLIES.



The "PIG-TAILOR" plus "SPIN-PIN" — Accurately Measures, Cuts, Bends, Ejects and Assembles both leads simultaneously to individual lengths and shapes — 3 minute set-up — No accessories — Foot operated — 1 hour training time.

PIG-TAILORING provides:

- | | |
|-------------------------------------|-------------------------------------|
| 1. Uniform component position. | 6. Individual cut and bend lengths. |
| 2. Uniform marking exposure. | 7. Better time/rate analysis. |
| 3. Miniaturization spacing control. | 8. Closer cost control. |
| 4. "S" leads for terminals. | 9. Invaluable labor saving. |
| 5. "U" leads for printed circuits. | 10. Immediate cost recovery. |

PIG-TAILORING eliminates:

- | | |
|--------------------------------|-----------------------------------|
| 1. Diagonal cutters. | 6. Broken leads. |
| 2. Long-nose pliers. | 7. Short circuits from clippings. |
| 3. Operator judgment. | 8. 65% chassis handling. |
| 4. 90% operator training time. | 9. Excessive lead tautness. |
| 5. Broken components. | 10. Haphazard assembly methods. |

* PATENT PENDING

Write for illustrated, descriptive text on "PIG-TAILORING" to ED-3P

BRUNO-NEW YORK INDUSTRIES CORPORATION

DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT

440 WEST 34th STREET

NEW YORK 1, N. Y.



CIRCLE 205 ON READER-SERVICE CARD FOR MORE INFORMATION

NEED A
Positive Action
LATCHING RELAY?



**specify
and get more for
your relay dollar!**

AEMCO

TYPE 48 — Here is a relay of unusual patented design — Ideal for unusual applications. Latching action is positive . . . trouble-free construction offers far greater dependability than ordinary cam or ratchet relays.

Available with contact combinations of SPST through DPDT rated at 10 amps., 115V-60C., inductive. Intermittent duty coils in voltages ranging from 6 VAC or DC to 230 VAC or DC. Dust covered or hermetically sealed enclosures.

AEMCO relays available in a wide variety of spring and coil combinations, operating potentials and contact ratings. Should one of the hundreds of AEMCO relay types fail to meet your exact requirements, we will be happy to design and build a unit to meet or exceed your specifications.

Write Today

Ask for free bulletin "H" covering the complete AEMCO relay line.



INCORPORATED

26 State Street • Mankato, Minnesota

CIRCLE 206 ON READER-SERVICE CARD FOR MORE INFORMATION

Industrial Counting and Control Instruments



COUNTING STRIP

- STANDARD COUNTERS — hundreds of models . . . preset counters and totalizers.
- SPECIALIZED COUNTERS — modular construction permits reasonable prices.
- PLUG-IN STRIPS — to use in your own applications. Low heat, long-life counting tubes and conservative design provide *Reliability in use* — over a year in constant operation without any servicing has been reported by satisfied industrial customers.

PRESET COUNTER



For information on various inputs, outputs, and counting units (up to 20,000 counts per second) . . . write for Industrial Bulletin — Edition II.

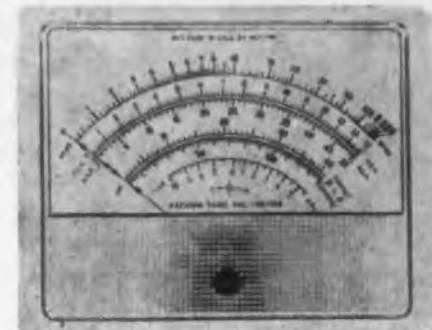
Sales Representatives in principal cities.



Baird-Atomic, Inc.

33 UNIVERSITY ROAD, CAMBRIDGE 38, MASSACHUSETTS
CIRCLE 207 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Long Scale Panel Meters Have Plastic Covers



Featuring long scales and plastic covers, a new line of Weston meters is offered in Models 1341 and 1346. Model 1341 can be supplied from 100 μ a maximum full scale sensitivity up to 5 amp, self-contained. Model 1346 is for applications requiring 50 μ a sensitivity. Used as d-c voltmeters, they can be supplied with sensitivities of 1000 ohm/v or greater. They can also be supplied as rectifier type a-c voltmeters in most standard ranges.

Being intended for panel mounting, these instruments are provided with shielded mechanisms that can be mounted on magnetic or non-magnetic panels with no special adjustment. They do not interfere magnetically with adjacent instruments and are not affected by adjacent instruments. The one-piece transparent cover admits light from many angles, improving visibility of the indication. Basic accuracy when used as d-c instruments is ± 2 per cent of full scale. When used as rectifier-type a-c instruments accuracy is ± 3 per cent of full scale when measuring a sine wave 60 cps input at 25 C.

Weston Electrical Instrument Corp., Dept. ED, Newark 5, N. J.

Radio Engineering Show, Booth 2907-2915.

CIRCLE 208 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Missile Power Supplies Multiple Output



Combining toroidal power transformers, toroidal filter chokes, high temperature capacitors and silicon rectifiers, these sealed units offer multiple output and low ripple, low stray field without internal shielding. Magnetic regulation where required.

Communication Accessories Co., Dept. ED, Lees Summit, Mo.

Radio Engineering Show, Booth 3908-3910.

CIRCLE 209 ON READER-SERVICE CARD FOR MORE INFORMATION

Whatever type of lacing cords and tapes you are now using...

consider the advantages of

NYLON and DACRON

HEMINWAY & BARTLETT

**NYLON FLAT BRAIDED TAPES
NYLON LACING CORDS
DACRON FLAT BRAIDED TAPES
COST MUCH LESS THAN YOU THINK!**

- Fungus-proof
- Stronger, abrasion-resistant
- Ties easier, faster, tighter
- Knots will not slip
- Higher heat resistance and stability.

GOVT. APPROVED!

Nylon tapes and cords meet new Govt. Spec. MIL-T-713A
Dacron tapes have Air Force approval

FREE! Write today for free samples of tapes and cords

The Heminway & Bartlett Mfg. Co., ELECTRONICS DIVISION, 500 5th Ave., N. Y. 36 Sales Offices: Chicago, Philadelphia, Boston, Cincinnati, San Francisco, Los Angeles, Detroit, Charlotte, N. C., Gloversville, N. Y., Lynchburg, Va. Foreign Agent: Turner, Halsey Co., Inc., 46 Wall St., N. Y.

SEE US AT THE I.R.E. SHOW — BOOTH #4105

CIRCLE 210 ON READER-SERVICE CARD FOR MORE INFORMATION



5 7/16"

Staggered starting of electric motors...

AGASTAT
Time / Delay / Relay

AGASTAT allows you to stagger the starting of three motors without imposing their load on the line at the same time.

- The AGASTAT is
- electrically actuated, pneumatically timed.
 - light, versatile, dependable.
 - instantaneous recycling.
 - 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.

Write our application engineers for help with your timing problem. Address Dept. A25-321.

AGA
DIVISION

Elastic Stop Nut Corporation of America

1027 Newark Avenue, Elizabeth, New Jersey
Pioneers in pneumatic timing.

CIRCLE 211 ON READER-SERVICE CARD FOR MORE INFORMATION

**△ Slotted Line for Waveguide
Size WR-2100**



Representing but one type of an entire line of waveguide and component equipment, this slotted line for waveguides features bolted and doweled aluminum construction. Probes are tunable over the entire frequency band. Inherent VSWR is less than 1.02 over the entire applicable band; slope less than 1.005 VSWR. Sizes range from WR-770 through WR-2300. The same manufacturer also produces directional couplers, waveguide loads, attenuators, plungers, waveguide-to-coax transitions, rotary joints, bends and other special configurations.

I-T-E Circuit Breaker Co., Special Products Div., Dept. ED, 601 E. Erie Ave., Philadelphia 34, Pa.
Radio Engineering Show, Booth 1313-1315.

CIRCLE 212 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Synchro Tester
Reads Synchro
Voltages $\pm 0.2\%$

An rms reading voltmeter is designed to read voltages of synchros and synchro systems rapidly and simply with a higher degree of accuracy than can be obtained by more conventional instruments. Designated Model 100 Transformation Ratio Meter, it reads directly in per cent of deviation of the transformation ratio from the ideal ratio. Model 100 consists of a precision voltage divider, input switching and an expanded scale voltmeter.

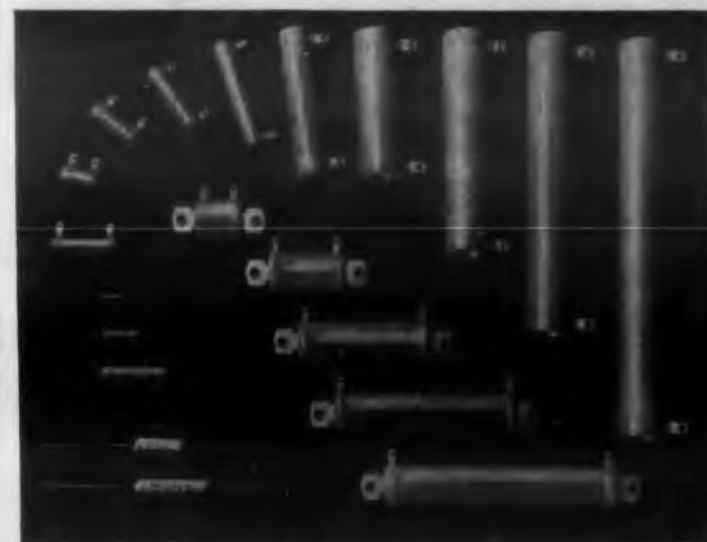
Nominal input voltages are 57.3, 78, 90, 105 and 115; frequency range 50-1000 cps; input impedance, 10,000 ohm/v; scale ± 3 per cent; smallest division, 0.1 per cent; accuracy ± 0.2 per cent.

Shasta Division, Beckman Instruments, Inc., Dept. ED, P. O. Box 296, Station A, Richmond, Calif.

Radio Engineering Show, Booth 3411-1728.

CIRCLE 213 ON READER-SERVICE CARD FOR MORE INFORMATION

NOW!
**Vitrohm MIL-R-26C
Resistors in all styles!**



Famous Ward Leonard Vitrohm® vitreous-enameled resistors are now available in every style to meet all requirements of Military Specification MIL-R-26C.

What's more, this line offers you *all* characteristics—G, V, and the exacting Y—and *all* specification sizes and resistance values—even the highest values using the finest wire (0.00175").

Tab-terminal, axial-lead and stack-mounting types are available in styles and characteristics shown in table below.

For complete data on these MIL-R-26C resistors, write us for Bulletin 12. (And incidentally, for Vitrohm resistors to *highest commercial and industrial standards*, get W/L Catalog 15.) Ward Leonard Electric Co., 77 South Street, Mount Vernon, N. Y. In Canada: Ward Leonard of Canada Ltd., Toronto.

7.10

ENGINEERING DATA

TYPE	STYLE	AVAILABLE IN CHARACTERISTICS	RESISTANCE RANGE
Stack Mtg.—Tab	RW20 thru 24	G	All values in Spec.
Tab terminal	RW29 thru 47	V, Y* and G	All values in Spec.
Axial lead	RW55 thru 59	V and G	All values in Spec.†

*Characteristic Y applies to styles RW30, 33, 37 and 47 only. Characteristic Y is similar to V but requires high insulation resistance at end of moisture-resistance tests.
†Maximum values for single-layer-wound resistors with 0.00175" diameter wire.

LIVE BETTER...Electrically

WARD LEONARD ELECTRIC CO.

Result-Engineered Controls Since 1892

RESISTORS • PRECISION RESISTORS • RELAYS • TRANSFORMERS • Meters



CIRCLE 214 ON READER-SERVICE CARD FOR MORE INFORMATION



Official U. S. Air Force photograph

Throws out electron tubes... keeps chopper

Today's aviation electronic standards are often tough to meet. Demands for extreme miniaturization are coming hard on the heels of new reliability and performance standards.

We've heard of one well-known manufacturer, for example, who has gradually eliminated all electron tubes and most other conventional electronic parts from his jet engine control system.

But it's significant that this manufacturer is still using the Bristol Syncroverter® Switch to convert servo signals from d-c to a-c.

The reason? There's no equivalent that comes up to the Syncroverter Switch's performance. Long life and Immunity to Severe Shock and Vibration are outstanding characteristics of the Syncroverter Chopper.

During vibration over the range of 5 cps to 2000 cps and up to 30G, the effect on output waveform is negligible.

Write today for data on this outstanding chopper for your critical signal conversion problems. The Bristol Company, 151 Bristol Road, Waterbury 20, Connecticut.



Bristol Syncroverter Switch.
Covered by patents.

6.73

TYPICAL OPERATION

Driving frequency range: 0-2000 cps (400 cps used for these characteristics)

Coil voltage:	6.3V sine, square, pulse wave
Coil current:	55 milliamperes
Coil resistance:	85 ohms
*Phase lag:	55° ± 10°
*Dissymmetry:	Less than 4%
*Switching time:	15° ± 5°
*Temperature:	-55°C to 100°C
Operating position:	Any
Mounting:	Flange or plug-in—fits 7-pin miniature socket

*These characteristics based on sine-wave excitation.

BRISTOL

FINE PRECISION INSTRUMENTS
FOR OVER 67 YEARS

CIRCLE 215 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Precision DC Supply Wide Range



This instrument, the Model 301C, is designed to produce an output voltage from 1.02 to 1012 v dc at 0 to 400 ma, positive, negative, or floating ground. The supply is chopper stabilized and referenced against a standard cell. Resolution is better than 0.5 mv at any output voltage. Calibration accuracy is greater than ±0.1 per cent. Regulation is 0.005 per cent for a 10 per cent line voltage change or 200 ma load current change, while long term stability is less than 0.01 per cent per day. This supply is equipped with a removable cabinet for bench or rack mounting.

John Fluke Mfg. Co. Inc., Dept. ED, 1111 W. Nickerson St., Seattle, Wash.
Radio Engineering Show, Booth 3047.

CIRCLE 216 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Servo Tachometer 60 or 400 CPS



Available for either 60 or 400 cps 115 v drive, this tachometer delivers an output of 6.0 v per 1000 rpm. Linearity is ± 0.5 per cent above 1000 rpm and ± 0.25 per cent between 1000 and 50 rpm. Total residual voltage is 5.0 mv. The tachometer can be supplied either separately, as shown, or mounted integrally in an a-c servomotor. It is not only a useful component in servo systems but also, because of its accurate linearity, it can be used as an integrator in computing applications.

Diehl Mfg. Co., Dept. ED, Somerville, N. J.
Radio Engineering Show, Booth 2237.

CIRCLE 217 ON READER-SERVICE CARD FOR MORE INFORMATION

1 STANDS OUT!

NEW TYPE 405 SERIES PRECISION PHASE METER



Direct Phase Reading With No Adjustment
From 1 cps to 500 kc

FEATURES

0.3 volt sensitivity, 1/4° relative accuracy. Measures a small fraction of 1° from 1 cps to 500 kc. Meter reading independent of signal amplitudes. No ambiguity at zero degree. Provision for self-calibration and self-adjustment. 6.5" long mirror scale on panel meter. New cathode-coupled limiter stages with plate-to-grid degeneration.

SPECIFICATIONS

Frequency Response: Type 405—10 cps to 100 kc; Type 405H—10 cps to 500 kc; Type 405L—1 cps to 20 kc. Phase Range: 0-12, 0-36, 0-90, 0-180 and 180-192, 180-216, 180-270, 180-360 degrees. Accuracy: 0.25° relative, 2% absolute. Input Voltage: 0.3 volt to 70 volts for Type 405 and 405L; 2 volts to 40 volts for Type 405H. Price: Type 405—\$485.00; Type 405H—\$524.00; Type 405L—\$546.00.

Visit our Booth No. 3412 at the Coliseum



ADVANCE Electronics Lab., Inc.
249-259 Terhune Ave., Passaic, N. J.

CIRCLE 218 ON READER-SERVICE CARD FOR MORE INFORMATION

Tubular's model 81 the Versatile riveter



- **AUTOMATICALLY** feeds and sets any style of TUBULAR's rivets up to 16/16" long x 9/64" diam. heavy setting or 3/16" diam. light setting.
- can permanently fasten **HUNDREDS** of different products.
- precision automatic setting to **SAVE** you hours of fastening **TIME** and **LABOR**.

- Motorized or pneumatic operation.
- Has 10" throat.
- Anvil Arm or Horn Adjustment of 19".
- Rivet-setting speed limited only by speed of operator.
- Single revolution clutch eliminates repeat settings, prevents damage to your products.
- Accessories include dial tables, loop anvils, etc. for more economical fastening.

Fastening "the Tubular Way" — with a Model 81 single head automatic riveter will equip your production line with the most versatile of riveting machines. Hundreds of products are permanently fastened every hour of the day with this versatile machine. There is no limit to its uses. The savings you can realize in labor and assembly time can be substantial. For further information on this Model 81 or Tubular's other automatic riveting machines, write direct or call your nearest Tubular Branch Office.



Tubular Rivet
A Sluis Company

Wollaston (Quincy) 70, Mass.

See your local classified directory for phone numbers

CIRCLE 219 ON READER-SERVICE CARD FOR MORE INFORMATION

Federal ONE STOP—SHORT RUN STAMPING SERVICE:



The next time you require parts of any shape or size up to 10" x 14" x 1/4" thick of any stampable material send your print, sketch or part for an . . .



CIRCLE 220 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Power Transient Analyzer Single-Step Technique



The Model TA-120 measures and records generator output voltage, frequency and KVA, providing this information simultaneously under both steady-state and transient conditions. Appropriate scales for metering voltage, frequency or KVA can be selected on dials, and accuracy is within 0.1 per cent for voltage and frequency and within 1 per cent for a constant phase to neutral voltage.

The voltage channel measures 120 to 416 v potentials across standard Y-connected circuits. Any one of four nominal voltages—120, 208, 240 or 416 v—can be selected. Step response of this channel is 15 milliseconds between the 10 per cent and 90 per cent point. The frequency channel measures frequencies from 46 to 54, 56 to 64 and from 375 to 425 cps. Three frequency scales—50, 60 and 400 cps—are available. Step response is 4 milliseconds between the 10 per cent and 90 per cent points.

American Machine & Foundry Co., Dept. ED, 1085 Commonwealth Ave., Boston 15, Mass. Radio Engineering Show, Booth 1506-1508.

CIRCLE 222 ON READER-SERVICE CARD FOR MORE INFORMATION



△ 100 Kv D-C Test Set

For Non-Destructive Tests

For non-destructive testing of insulation the unit here shown develops and reads 100 kv dc. It has sufficient capacity for rapid charging of full reels of cable. It conforms to the new IPCEA standards and to MIL, JAN and ASTM specs. Its features include automatic output shorting, external interlock provision, kv meter and ammeter for determining leakage resistance, and overcurrent trip-out to de-energize hv.

Peschel Electronics, Inc., Dept. ED, 19 Garden St., New Rochelle, N. Y. Radio Engineering Show, Booth 1921.

CIRCLE 223 ON READER-SERVICE CARD FOR MORE INFORMATION

DO YOU WANT TO...



GENERATE PULSES



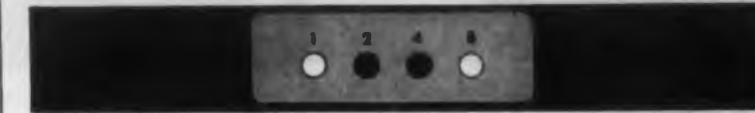
DELAY PULSES



WIDEN PULSES



REGISTER PULSES



COUNT PULSES



SUM PULSES



DO BINARY LOGIC



DRIVE TRANSISTOR CIRCUITS

You can do all of these functions with the new integrated line of NAVCOR transistorized pulse programming equipment . . . available in miniaturized building blocks.

Make a note . . . Booth 1909—I.R.E. Show



CIRCLE 224 ON READER-SERVICE CARD FOR MORE INFORMATION

New MINIATURE ELECTRICAL WAVE FILTERS

Volume as small as .5 Cubic inch!

- Miniature Low Pass Telemetry Filters Standard RDB channels.
- Miniature and Subminiature Filters of All Types Low Pass, High Pass, Band Pass, and Band Rejection.
- High Attenuation Low and High Pass Chebyshev Filters

Polyphase Miniature Electrical Wave Filters conform to Mil Specs, feature excellent temperature stability, good attenuation characteristics, low insertion loss. Units can be hermetically sealed, potted, or encapsulated.

PROMPT ENGINEERING DESIGN SERVICE ON SPECIAL FILTERS



Write for Bulletin 72-F See these new miniature filters at PIC Booth No. 2235, IRE Show.

Polyphase Instrument Company Bridgeport, Penna.

CIRCLE 221 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW

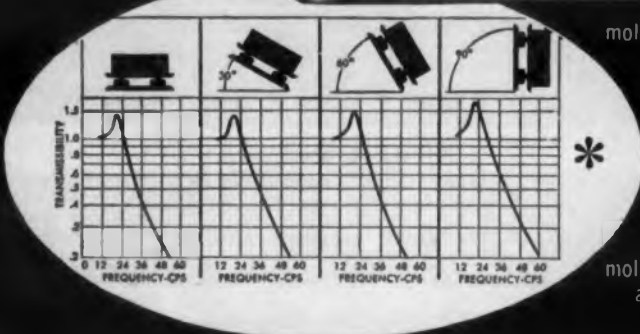
ALL-ANGL BARRY MOUNT

for Jets and Missiles



MIL SIZE 2

loads up to 40 lbs.
per mount



- 1 molded nylon spring seat and top snubber
- 2 stainless steel core
- 3 stainless steel cup
- 4 damper spring
- 5 phenolic damper
- 6 stainless steel load carrying springs
- 7 molded nylon spring seat and bottom snubber

NOW AVAILABLE in PRODUCTION QUANTITIES

Gives shock and vibration isolation where MIL-spec mounts won't work

- in every attitude of flight or launching
- under sustained high-g acceleration
- at high amplitudes of vibration input
- during severe shock conditions
- at high vibration frequencies

* These curves show why ALL-ANGL Barry Mounts really work through all attitudes. Data Sheet 57-02 gives detailed specifications. Write now for your copy.

ALL-ANGL BARRY MOUNTS are meeting the tougher requirements for shock and vibration isolation in such high-performance aircraft and missiles as North American Aviation's F-100 Super Sabre, Convair's supersonic F-102A, Martin's MATADOR, and in others still classified *top secret* — giving reliability protection where failure cannot be tolerated. "Only ALL-ANGL Barry Mounts gave effective isolation . . ." is the way their performance in one of today's hottest fighters is described.

When your problem is protection under the tough, complex requirements of jet and missile flight, your answer is ALL-ANGL Barry Mounts.

See All-Angl demonstration at Booth 2534, I.R.E. Show

Barry's new Western Division, in Burbank, California, offers fast, on-the-spot design and prototype service, and production of special systems.

BARRY
CONTROLS
INCORPORATED

BARRY B MOUNT

SALES REPRESENTATIVES
IN ALL PRINCIPAL CITIES

775 PLEASANT STREET, WATERTOWN 72, MASSACHUSETTS

CIRCLE 225 ON READER-SERVICE CARD FOR MORE INFORMATION



△ 2 Kw Klystron
7125-8500 Mc

Recommended for final amplifier in high-power microwave transmitters this klystron tube, designated VA-806, is of all-ceramic and metal construction. Its performance characteristics permit amplification of am, fm or phase-modulated signals with power gains of the order of 50 db. It supplies 2 kw of continuous power in the 7125-8500 mc range; is water-cooled and operates as a four-cavity cascade amplifier.

Varian Associates, Applications Engineering Dept., Dept. ED, Palo Alto, Calif.
Radio Engineering Show, Booth 2530-2532, 3514.

CIRCLE 227 ON READER-SERVICE CARD

△ Silicon Rectifiers In Twelve Types



Silicon rectifiers now available can be supplied in a choice of six 7/16 in. stud-mounted types or six wire-in types. The six wire-in types are designated CK840 through CK845, and the six stud types CK846 through CK851. The stud types have forward current of 1 amp at a case temperature of 150 C; and inverse voltage ratings in six steps from 100 to 600 v. The wire-in types have forward current ratings of 500 ma at 100 C ambient temperature; 250 ma at 150 C at ambient temperature.

Raytheon Mfg. Co., Dept. ED, 55 Chapel St., Newton 58, Mass.
Radio Engineering Show, Booth 2611-2614.

CIRCLE 228 ON READER-SERVICE CARD

NOW — WELD EVEN DIFFICULT METALS INSTANTLY with weldmatic precision stored-energy welders

Weld stainless steel, copper and other "problem" metals easily and in millisecond time. Weldmatic resistance welders readily join dissimilar metals and parts of widely varying thicknesses. Strong, uniform welds. You can even weld without removing insulation

on small wires with sandwich-weld technique. No discoloration or metallurgical change, no excessive deformation.



Weldmatic model 1015 illustrated — bench mounted. Accommodates special electrodes and handpieces.

APPROXIMATE WORK CAPACITY OF WELDMATIC WELDERS

MODEL NUMBER	LOW CONDUCTIVITY MATERIALS		HIGH CONDUCTIVITY MATERIALS	
	Sheet Thickness	Wire Diameter	Sheet Thickness	Wire Diameter
1012	.0005 to .010	.00015 to .030	.0003 to .005	.0001 to .015
1015	.0005 to .020	.0002 to .060	.0003 to .010	.0002 to .030
1016	.0005 to .015	.0001 to .045	.0003 to .008	.0001 to .020
1020	.0005 to .035	.001 to .095	.0003 to .020	.001 to .060

Write for descriptive literature and details of sample welding service.

WELDMATIC / a division of unitek corporation
260 NORTH HALSTEAD AVENUE, PASADENA, CALIFORNIA

Visit our Booths #4517 & 4519 at the I.R.E. Show

CIRCLE 226 ON READER-SERVICE CARD FOR MORE INFORMATION

△ **Vacuum Tube Voltmeter**
700 Mc Response



With a d-c voltage range from ± 1 to ± 1000 v and a-c from 1 to 300 v rms, the Type 810-A VTVM exhibits a frequency response of ± 1 db from 30 cps to 700 Mc. This meter is single scale calibrated from 0.2 to 500 ohms with 7 multipliers ranging from X1 to X1M. Its accuracy is rated at ± 2 per cent of full scale d-c, and ± 3 per cent of full scale a-c.

The input impedance of the unit is 100 megohms on all d-c ranges and 10 megohms in parallel with 2 μ f with probe nose cap removed, 3 μ f with cap in place on the a-c ranges.

Weighing 7-1/2 lbs, it measures 6-1/8 x 6-3/4 x 10-5/8 in. The a-c probe is 3/4 in. in diam.

Acton Labs, Inc., Dept. ED, 533 Main St., Acton, Mass.
Radio Engineering Show, Booth 1424.

CIRCLE 229 ON READER-SERVICE CARD

△ **UHF Attenuator Panels**
Laboratory Standard



These UHF Attenuator Panels, Model AT-106, consist of two or more variable step attenuator assemblies of up to six or twelve steps each. They are interconnected to provide a wide range of attenuation values. Increments as low as 0.1 db, and ranging in total attenuation to values up to 120 db may be obtained.

Empire Devices Products Corp., Dept. ED, 38-15 Bell Blvd., Bayside, N.Y.
Radio Engineering Show, Booth 3818-3820.

CIRCLE 230 ON READER-SERVICE CARD



Put the **PLUS** in your microwave systems
with **AIRTRON FERRITE** devices!

Airtron has stepped well beyond conventional designs through the use of remarkable non-reciprocal ferrite materials to give you microwave components with characteristics never before realized in the microwave design art!

Such vast improvements as isolating action, duplexing action, polarization diversity, electronic phase shift, remote attenuation and R.F. modulation are now possible with ferrite components.

These and Airtron's other great advancements are the *plus factors* that will minimize long line effects... provide rapid switching... improve AFC performance... permit rapid receiver recovery time... optimize magnetron operation... and eliminate mechanical mechanisms. Too, Airtron ferrite components will strengthen the reliability of your radar and microwave systems by increasing the operational life.

Airtron has successfully developed ferrite materials to a practical stage of application in a wide variety of designs, such as resonant absorption isolators, duplexers, switches, electrically variable attenuators and phase shifters, modulators, polarizers, beam switching antennas, single side band generators and similar devices that are unparalleled in comparison!

Add The Plus To Your Achievements with superior performing ferrite components by Airtron! For more detailed information and assistance in solving your specific microwave or ferrite component problems, contact Airtron immediately.

Airtron inc.

1121 W. Elizabeth Ave.,
Linden, N.J.

Engineers: Inquire about the unlimited career opportunities at our new ferrite center 317 Vassar St., Cambridge, Mass.

PERFECTION
in design

LONGER
life operation

UNPARALLELED
comparison

SUPERIOR
performance

Visit our Booth No. 3318 at the I.R.E. show.
CIRCLE 232 ON READER-SERVICE CARD FOR MORE INFORMATION

BOOTHS
2428-2521
IRE SHOW

**PRECIOUS METAL
WIRES**

Produced in Platinum, Gold, alloys and pure metals—small diameter... Platinum alloy resistance wires... Pure Iridium and Rhodium-Iridium alloy Thermo-couple Wire.

Metallurgists and Specialists
in **SMALL WIRE** for 56 Years

BASE METAL WIRES
Very small diameter—
for filaments, thermo-couples,
resistance units.

COATED WIRES

Comprising an extensive range of electroplated grid wires... Enamel insulated wires for precision resistors and potentiometers.

Since 1901



Write for List of Products



SIGMUND COHN CORP., 121 So. Columbus Avenue • Mount Vernon, N.Y.

CIRCLE 231 ON READER-SERVICE CARD FOR MORE INFORMATION

ACEPOT*
ACETRIM*

Sub-Miniature Potentiometers and Trimmers

1/2" size, precision wire-wound.
up to 250K. $\pm 3\%$ linearity

setting new standards
for dependability
in sub-miniaturization

Let the facts speak for themselves! ACE Sub-Miniature Precision Wire-Wound Potentiometers and Potentiometer Trimmers are the result of 4 years development and over a year of successful use by leading electronic equipment manufacturers. Users have conclusively proved that ACEPOTS and ACETRIMS meet requirements for space and weight saving compactness, while at the same time meeting MIL specs' most stringent qualifications for performance and dependability. Why invite trouble with untested components when you can protect your reputation with ACEPOT and ACETRIM . . . the subminiature potentiometers and trimmers proved in actual use.

Condensed Engineering Data

	ACEPOT (potentiometer)	ACETRIM (trimmer)
Resistance Range	200 \sim to 250K $\pm 2\%$	10 \sim to 150K $\pm 3\%$
Linearity	$\pm 3\%$	$\pm 3\%$
Resolution	extremely high	excellent
Ambient Temperature	-55° C to 125° C*	-55° C to 125° C
Torque	low or high	low or high

The above specifications are standard — other values on special order.

Available in threaded bushing, servo, flush tapped hole or flange mounting, and ganged units. All units sealed, moistureproofed, and anti-fungus treated. Meet applicable portions of JAN specs and MIL-E-5272A standards.

*New X-500 ACEPOT operates to a new high of 150° C.

Expedited delivery on prototypes; prompt servicing of production orders.
Send for Fact File and application data sheets.

*trademarks applied for

ACEPOT*
ACETRIM*

ACE ELECTRONICS ASSOCIATES

Dept. ED, 101 Dover St. • Somerville 44, Massachusetts

See the newest & latest at Booth 1807, the IRE Show

CIRCLE 233 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Illuminated Push-Switch Dual-Purpose Lock-Down



This dual-purpose switch functions as a conventional pushbutton when pushed straight down. When pushed and turned approximately 20 deg clockwise, the switch, Model 52PB7-T2 is held maintained in the operated position. When turned counter-clockwise from this position, the switch pops up to unoperated position.

A new subminiature bulb, independent of the switch circuit, illuminates the translucent button. Two subminiature basic switches are actuated by positive over-center snap-action. These switches are listed by

UL at 5 amp 125 or 250 v ac.

Micro Switch, Dept. ED, Div. Minneapolis-Honeywell Reg. Co., Freeport, Ill.

Radio Engineering Show, Booth 2202-2212.

CIRCLE 235 ON READER-SERVICE CARD

△ Speed Reducer Kit For Breadboards



These speed reducer kits are designed for reuse in breadboard applications, allowing assembly and disassembly to component hangers as desired with a complete range of ratios. All units come assembled in a felt-lined case with associated hardware, such as couplings, cleats, screws and tools.

The U4 kit has a 1-3/4 in. outside diam. and the U5 kit has a 1-1/16 in. outside diam.

PIC Design Corp., Dept. ED, 477 Atlantic Ave., E. Rockaway, N.Y.

Radio Engineering Show, Booth 3057.

CIRCLE 236 ON READER-SERVICE CARD

ATTENUATORS by TECH LABS

"Midget" model is especially designed for crowded apparatus or portable equipment.

STANDARD
TYPE
700



Manufacturers of
Precision Electrical Resistance Instruments

PALISADES PARK, NEW JERSEY

VISIT US AT BOOTH 3034—I.R.E. SHOW

CIRCLE 234 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Three-Position Controller

Fast Action



The unit corrects a signal to a specific point within a preset range. Two contact meter-relays are included in the circuit to provide limit control, but they are adjusted so that there is none of the delay inherent with periodic locking and unlocking of contacts while a signal is being sampled. Corrective action is steady rather than pulsing.

One of the meter-relays used in the control is a double contact model, adjusted for both high and low error. The other is a single contact model on which a control point is preset anywhere between the high and low limits of the first meter-relay. The control may be furnished with meter-relays in most standard ranges. The single contact

meter may be adjusted to coast the signal back to the control point.

Assembly Products, Inc., Dept. ED, Chesterland, Ohio.

Radio Engineering Show, Booth 3916-3918.

CIRCLE 237 ON READER-SERVICE CARD

△ Silicone Resistors

For Power Application



The Type R silicone coated miniature resistors with radial leads in 3, 5, 7 and 10 w powers, and the Type BT, a metal-clad subminiature resistor in 10 and 15 w powers, aluminum housed, are available in tolerances from ± 3 per cent to ± 0.05 per cent. They meet the requirements of MIL-R-26B.

Sage Electronics Corp., Dept. ED, 302 N. Goodman St., Rochester 7, N.Y.

Radio Engineering Show, Booth 3945.

CIRCLE 238 ON READER-SERVICE CARD



panacea

for ENGINEERS, INVENTORS,
RADIO AMATEURS, MODEL BUILDERS

for controlling toys, model boats, planes, cars,
garage doors, electric fences,
robot lawn mowers, iron-core politicians

In addition to a variety of rather specialized sensitive relays developed for particular applications, Sigma also makes several "basic" types, among them the five DC sensitive SPDT types shown here. The unenclosed styles (illustrated) allow contact observation, and readjustment or cleaning in case of accident. They are

also available in a variety of sensitivities, coil resistances, mounting styles and enclosures (open frame, dust cover or hermetically sealed; permanent or plug-in connections). One-at-a-time purchases can best be made from Sigma jobbers.

Complete catalog is available on request.

4F-8,000 S.

8,000 ohms, wt. — 2 1/4 oz. Price for one \$6.00. Operates on 1.6 ma., releases on 0.75 ma., withstands 11 ma. continuously without overheating. Silver contacts rated at 2.0 amp. Withstands 10 g vibration while operating.

Radio Control Modelers' long-time choice because it is fairly sensitive, highly reliable, easy to mount and adjust. Lately overshadowed by the "26".

5F-8,000 SS.

8,000 ohms, wt. — 4 1/2 oz. Price for one \$9.75. Operates on 0.35 ma., releases on 0.15 ma., withstands 15 ma. continuously without overheating. Palladium contacts rated at 0.25 amp. Too sensitive for applications where vibration will be encountered while operating. Other adjustments give secure contacts under 5, 10 or 15 g vibration.

Good for condenser time delay circuits and for holding during pulse trains.

41F-2,000 SK.

2,000 ohms, wt. — 2 1/2 oz. Price for one \$4.50. Operates on 4.0 ma., no specified release, withstands 22 ma. continuously without overheating. Tungsten contacts rated at 1.0 amp.

Keying relay giving clean, bounce-free pulses on normally open contact circuit at speeds up to 100 pulses per second. Coil should get at least 6 ma. signals from at least 150 volt supply. (Plate circuit, not cathode follower.)

11F-6,000 G.

6,000 ohms, wt. — 1 oz. Price for one \$1.70. Operates on 2.9 ma., no specified release, withstands 13 ma. continuously without overheating. Silver contacts rated at 1.0 amp. Withstands 10 g vibration while operating.

Within its ratings, a good combination of high quality and low cost.

26F-8,000 CDS.

8,000 ohms, wt. — 2 oz. Price for one \$8.50. Operates on 0.7 ma., releases on 0.4 ma., withstands 11 ma. continuously without overheating. Drop-out is held within 0.1 to 0.2 ma. of pull-on and within above limits. Palladium contacts rated at 0.5 amp. Withstands 5 g vibration while operating.

Designed especially for use in low power radio control circuits.

do you use time delay relays?

Do you require ADJUSTABILITY? No Problem!

Do you require HERMETIC SEALING? No Problem!

Do you require BOTH? NO PROBLEM for the

A. W. HAYDON Company

The A. W. Haydon Co. offers a complete line of ADJUSTABLE — HERMETICALLY SEALED TIME DELAY RELAYS for operation under adverse environmental conditions.

Write for Bulletin AWH TD401

Bulletin AWH TD401 Describes
6400 Series — DC units
11400 Series — AC units
24300 Series — 400 cycle units
Nominal Range of Adjustment: 8-1
Timers supplied with:
AN connector
Hermetic Adjusting Knob
Glass Window and Calibrated Dial

A. W. HAYDON COMPANY
227 NORTH ELM STREET
WATERBURY 20, CONNECTICUT
Design and Manufacture of Electro-Mechanical Timing Devices



Illustrated above are a few of the many environmental conditions which these compact timers are designed to withstand. More rigid requirements frequently can be met upon special consideration.

VISIT US AT THE
I.R.E. SHOW,
BOOTHS 2701 & 2703

CIRCLE 239 ON READER-SERVICE CARD FOR MORE INFORMATION

SIGMA

SIGMA INSTRUMENTS, INC.,

91 Pearl Street, So. Braintree, Boston 85, Massachusetts

CIRCLE 240 ON READER-SERVICE CARD FOR MORE INFORMATION

'I guess we're married to
the man from
PHILLIPS'



COIL CHARACTERISTICS:

Operating Voltage: up to 300 volts D.C.
Resistance: up to 21,000 ohms.
Single or double wound.
Operating Current: 0.002 Amps., minimum
Operating Time: 0.060 Secs., maximum
0.002 Secs., minimum

CONTACT ASSEMBLY:

All forms A thru E.
Single or double pileup
• #24 Twin Palladium contacts, standard
Other contacts available.

MOUNTING:

Two No. 6-32 Tapped holes, standard

VARIATIONS:

Plug-in mounting and terminals
Printed circuit terminals
Taper tab terminals
Metal enclosures
Hermetically sealed.

your relays

propose problems? Long life, compactness, high reliability and close adjustment! Are these all requirements for your electronic control, communication or data handling application? Then, the multi-contact telephone Type 8 relay is for you. To assure performance while retaining precision adjustment, Type 8 is fitted with a heavy duty bronze armature bearing. Standard twin contact springs insure maximum reliability with minimum contact resistance. Versatile, too, this relay is available with many variations in coils, contact assemblies, contact rating, adjustments, terminal arrangements and mountings — each combination for a specific application. Single or double-wound coils, for almost any voltage or current operation, may be equipped with slugs or sleeves for time delay on pick-up or drop-out.

Whatever your specifications, whatever your application—get in touch with the reliable "man from PHILLIPS." Write, wire or phone the Phillips office nearest you.

See us at our Booth No. 2714, I.R.E. Show

HERMETIC SEALS, MULTI-CONTACT, POWER, HERMETICALLY SEALED RELAYS, ACTUATORS

PHILLIPS

PHILLIPS CONTROL CORPORATION . . . JOLIET, ILLINOIS

AN ALLIED PAPER CORPORATION SUBSIDIARY

SALES OFFICES: NEW YORK - PHILADELPHIA - BOSTON - SAN FRANCISCO - DENVER - SANTA MONICA
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**△ Shock Mounted Crystal
16 Kc to 350 Kc**



These crystals have a frequency range of 16 kc through 350 kc, with lower frequencies possible in holders of different configuration. They have withstood shock tests of 100 g. Vibration per Mil-T-5422, Mil-E-5272 and Mil-E-5400 met with this unit without adverse results.

Storage temperatures over a range of -65 to +135 C can be coupled with an operation temperature range of -55 to +100 C. Excursions of frequency as low as ±0.015 per cent are available over this range. Ref-

erence Mil-C-3098B Types CR-37/U, CR-38/U, CR-42/U and CR-50/U.

Bulova Watch Co., Inc., Dept. ED, Electronics Div., 40-06 62nd St., Woodside 77, N.Y.

Radio Engineering Show, Booth 3930.

CIRCLE 243 ON READER-SERVICE CARD



**△ Power
Relay
For Aircraft**

The Type 57 power relay meets the applicable parts of MIL-R-5757C, MIL-R-25018, MIL-R-6106B and MS-25024. It has 4pdt contacts rated at 10 amp dc resistive load. Its temperature range is from -65 to +125 C, and operation vibration rating is 10 g at 10 to 500 cy per min. Operating shock is 25 g.

Phillips Control Corp., Dept. ED, Joliet, Ill.

Radio Engineering Show, Booth 2714.

CIRCLE 244 ON READER-SERVICE CARD

BE SURE TO SEE



**COAXIAL CABLE
CONNECTORS**

**famous DM series
standard UG series**

at the Dage exhibit
1957 I. R. E. National Convention
March 18-21
New York Coliseum, Booth 2633

DAGE ELECTRIC CO., INC.

67 N. Second St., Beech Grove, Indiana

CIRCLE 242 ON READER-SERVICE CARD

← CIRCLE 241 ON READER-SERVICE CARD

ELECTRONIC DESIGN • March 1, 1957

**△ TACAN Test Set
For In-Plane Testing**



This test set may be used with either military airborne TACAN (AN/ARN-21) or the new commercial version of airborne TACAN. The test set, designated as Type FTR 3156, provides testing of frequency, sensitivity, power output, range, bearing, and identity tone.

It weighs 17 lbs and measures 9 x 7 x 11-1/2 in. It has a handle for carrying and operates from standard aircraft power outlet (115 v 60 to 1000 cps, ac). No direct connection to the aircraft is needed. The unit is rainproof.

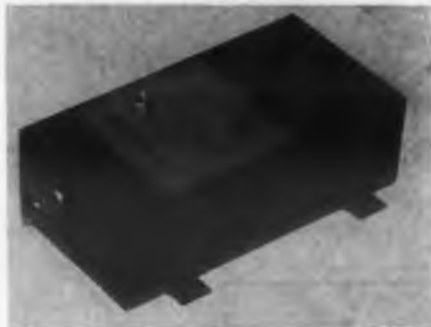
Federal Telephone and Radio Co., Dept.

ED, 100 Kingsland Rd., Clifton, N.J.
Radio Engineering Show, Booth 2510-2625.

CIRCLE 245 ON READER-SERVICE CARD

△ Fork Unit

For High Vibration Applications



The sensitivity to external vibrations of this unit is reduced at least one order of magnitude through a vibration range of 2 to 2000 cps. No shock mounts are used. Inherent stability is 0.001 per cent at ± 5 C or 0.00001 per cent with oven. Fork frequencies from 1000 to 4000 cps are available.

Times Facsimile Corp., Dept. ED, 540 W. 58th St., New York 19, N.Y.

Radio Engineering Show, Booth 1824.

CIRCLE 246 ON READER-SERVICE CARD



*A new sealed,
shaft-driven precision
AC voltage divider
for accurate positioning
and calibration.*

Gertsch Rotary RatioTran*

100-turn or 1000-turn models available, both in anodized aluminum cases, sealed against dirt and moisture. Ratio is controlled by a single ball-bearing mounted shaft. An internal mechanical counter provides easy readout. Printed silver switches assure long life and reliability.

- High accuracy... as good as .005% linearity
- High resolution... as good as .0005%
- Low phase shift... less than 1'
- High input impedance... approx. 50 henrys (200 henrys in 1000-turn model)
- Continuous transient-free output

*TRADEMARK

FOR COMPLETE DATA SHEET, CONTACT YOUR NEAREST
GERTSCH ENGINEERING REPRESENTATIVE OR

GERTSCH PRODUCTS, INC.

11846 MISSISSIPPI AVENUE
LOS ANGELES 25, CALIFORNIA

CIRCLE 247 ON READER-SERVICE CARD



**"I'm THE T&S customer*...
and I'm glad"**

Why am I glad I'm the Thomas & Skinner customer? Because T&S gives me service... it's as simple as that. Big orders, little orders or very special orders — I know I can depend upon T&S for all my magnetic material needs... whether for permanent magnets, wound cores, laminations or silicon iron magnetic tapes.

*Of course I'm not the only customer... T&S just makes me feel that way!

**SPECIALISTS IN
MAGNETIC MATERIALS**

Permanent Magnets  Magnetic Tapes 
Laminations  and Wound Cores 



Thomas & Skinner, Inc.

1157 E. 23rd Street, Indianapolis 7, Indiana

CIRCLE 248 ON READER-SERVICE CARD FOR MORE INFORMATION

MARCONI ACCURACY



Model
791C

NEW FM DEVIATION MONITOR

WIDER modulation frequency range is a feature of Marconi Deviation Monitor Model 791C, 50 cps to 35 kc.

HIGHER carrier frequencies are covered, 4 to 540 Mc in 6 ranges.

LONGER life is not claimed. No Marconi Deviation Monitor has yet worn out.

LOWER price, yet still Marconi precision.

Brief Specification

Frequency Range	4 to 540 Mc
Mod. Freq. Range	50 cps to 35 kc
Deviation Ranges	0 to ± 5 , ± 25 , ± 75 , ± 125 kc
Accuracy	3%, crystal standardized
Harmonic Distortion	Less than 0.2%
Tubes	6AK5, 6C4, 6CD6, 5718, 6AL5, OB2, 5Z4G

Price \$720.00

Delivery Immediate

The Marconi range of FM test instruments includes:

- Signal Generator Model 1066/1 10 to 470 Mc
- Signal Generator Model 995A/2 1.5 to 220 Mc
- Signal Generator Model 913 22 to 176 Mc
- Deviation Monitor Model 928 for Telemetering
- Ruggedized Deviation Monitor Model 934 2.5 to 500 Mc
- Eddystone Receiver Model 770R 19 to 165 Mc
- Eddystone Receiver Model 770U 150 to 500 Mc

I.R.E. SHOW, BOOTHS 3315-17



MARCONI instruments
44 NEW STREET • NEW YORK 4, N. Y.

CIRCLE 249 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Decade Counting Units

Use Low Power



Operating from a plate supply of 150 v dc at 7.5 ma from 0 to 100 kc, these decade counting units have direct read-out in decimal numerals, a counting rate of 100,000 pps, a pulse pair resolution of 5 μ sec. They require a negative pulse of 35 to 75 v peak with a rise time of 0.8 μ sec and a duration of 2 μ sec. The Model 100LA (pulse) output characteristics are a negative pulse, approximately 50 v peak, the Model 100LB (analog), a staircase and negative pulse of approximately 50 v peak, and the Model 100LC (binary) a 4-line 1-2-2-4 binary coded and pulse of approximately 50 v peak. These units are of modular plug-in construction and weigh 14 oz, with dimensions of 1-3/8 x 5-1/2 x 5-1/2 in., utilizing 4 type 5963 tubes.

Computer-Measurements Corp., Dept. ED, 5528 Vineland Ave., No. Hollywood, Calif.

Radio Engineering Show, Booth 1620-1622

CIRCLE 251 ON READER-SERVICE CARD

△ Precision Differentials

Use No Oil



All parts of the Models V10, V11, and V12 are stainless steel except the aluminum spider gear. The units are black anodized. Lost motion between any two end gears is not more than 30 min of arc. They feature a removable clamp ring for assembling end gears, and have 1/8, 3/16 and 1/4 in. shafts -72, 64 and 48 pitch.

PIC Design Corp., Dept. ED, 477 Atlantic Ave., E. Rockaway, N.Y.

Radio Engineering Show, Booth 3057.

CIRCLE 252 ON READER-SERVICE CARD

WHY NOT FIND OUT

ALL



BEFORE YOU BUY BLINDLY

Remember the benefits promised by Circuitry . . . savings in time, effort, and costs in your production. You will get them if your circuits are produced by economical mass production techniques. If they are uniform in quality. If they are delivered on schedule.

It makes sense to pick a supplier who promises these and more. **CRONAME DOES.** Mass production has tripled our production in one year. Our circuits are covered under Underwriters' Laboratories Recognition program for UL listed items. Specify **CRONAME** "printed circuitry processing" for your circuits.

CRONAME INCORPORATED

1767 GRACE STREET CHICAGO 13, ILL.

other Croname products - 53 years of leadership
Nameplates, dials, panels, escutcheons, mechanisms,
light assemblies, masks, bezels, cabinets, control
panels; decorated glass, CroRoto embossed.

CIRCLE 250 ON READER-SERVICE CARD FOR MORE INFORMATION



△ **Strain Analyzer**
Static and Dynamic



The Model PA-2A provides amplification and control for the measurement and oscilloscope display of static and dynamic strain. Sensitivity is provided by combining a 400 cy chopper and amplifier, with a resulting noise level of approximately 3 μ v. Amplifier frequency response is flat from 5 cps to 50 kc. Any resistive type strain gage may be used. Two strain measuring ranges of $\pm 5,000$ and $\pm 10,000$ microinches per in. read directly on a 10 turn dial permit peak to peak measurements of dynamic strain. This analyzer operates on ac.

Polyphase Instrument Co., Dept. ED,
Bridgeport, Pa.

Radio Engineering Show, Booth 2235.

CIRCLE 253 ON READER-SERVICE CARD

△ **Size 15 Servo**
Has High Torque For Size



A 60-cycle two phase servo with exceptionally high torque for its size and weight is now available. Coded Type 15-5156-03, it is a size 15 servo, weighing 7.6 oz, but delivering 1.45 in.-oz, minimum stall torque. Phase 1 is 115 v and phase 2 115/57.5 v. The unit comes housed in stainless steel. It can be built to conform to MIL-E-5272A. Speed is 3200 rpm at no load; at stall, current is 0.06 amp per phase and power 6.1 w per phase.

John Oster Mfg. Co., Avionic Div., Dept. ED, Racine, Wis.

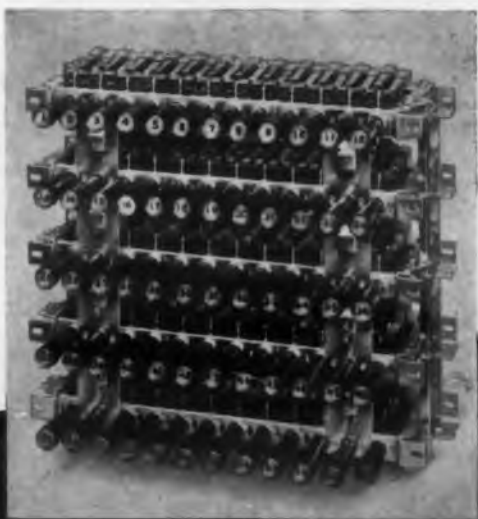
Radio Engineering Show, Booth 2129.

CIRCLE 254 ON READER-SERVICE CARD

NEED A
"Multi-Switch"?

Check with ...

SWITCHCRAFT
INC.



Can it be engineered?
How soon can we get delivery?
How much will it cost?

These are points to check with Switchcraft—one of the largest producers of Multi-Switches.

- Flexible tools make possible easy adaptation to your requirements.
- Functions to meet your needs.
- Single or multiple bank assemblies.
- Illuminated or non-illuminated push-button designs.

Proven for 36 months
in hundreds of different applications

SWITCHCRAFT
INC.

1312 N. Halsted St., Chicago 22, Ill.
Canadian Rep.: Atlas Radio Corp., Ltd.
50 Wingold Ave., Toronto, Canada

See this "Multi-Switch" and many other new
Components at the
Radio Engineering Show
March 18 to 21
NEW YORK COLISEUM • BOOTH 2228

CIRCLE 255 ON READER-SERVICE CARD FOR MORE INFORMATION

wherever

HIGH OPERATING TEMPERATURES
are a matter of fact

Then it's time to face the facts. Just any insulated wire or cable won't meet the test. But you can be sure that there's a Continental heat-resistant wire or cable that will. And when you meet high operating temperatures combined with moisture and corrosive vapor problems, the fact of the matter is ONE Continental wire that offers insulated advantages to meet your requirements all ways.

ELECTRONIC INSTRUMENT INSULATED WIRE

600-3000 volt service. Sizes: 32 AWG to 6 AWG inclusive.
CONSTRUCTION: stranded tinned copper, polyvinyl insulation with or without nylon jacket. Maximum operating temperature: 100°C.

CONFORMS TO: MIL-W-16878B

COLOR CODED: 1, 2, or 3 spiral stripes over polyvinyl insulation.



FACT-FILLED CATALOG

NEW, COMPLETE CATALOG OF CONTINENTAL INSULATED WIRE AND CABLE AVAILABLE ON REQUEST. WRITE TODAY.

Continental

WIRE CORPORATION

WALLINGFORD, CONNECTICUT • YORK, PENNSYLVANIA

CIRCLE 256 ON READER-SERVICE CARD FOR MORE INFORMATION

LOOK TO TOBE FOR PROGRESS

electronic interference filters



TOBE brings unequalled experience to the solving of your filtering problems. TOBE'S advanced design-techniques, and the technical data accumulated by TOBE filter specialists over the years, meet your problems with solutions that are quicker, more efficient, and more reliable. For all your filtering needs, look to TOBE DEUTSCHMANN, the oldest name in interference filters.

TOBE FILTERETTES, available in wide range of ratings, sizes and mounting styles, are engineered to operate under the most severe environmental conditions.

Tobe Exclusives:

Feed-thru capacitor construction in filterettes.

Miniaturization with maximum quality.

Guaranteed attenuation characteristics—under full-load operating conditions.

We invite inquiries on specific applications. The services of our engineers are always available. Write TOBE-DEUTSCHMANN Corporation, Norwood, Mass., the acknowledged authority on electronic interference—manufacturers of "FILTERETTES".



TOBE DEUTSCHMANN • CAPACITOR PIONEERS SINCE 1929

CIRCLE 257 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Digital Printer For Binary Code



Featuring rapid print-out, parallel entry, and up to 12 digit printing, this unit uses no stepping switches and can be connected to other electronic counting instruments. It will print, on standard adding machine tape, the total count accumulated by the basic instrument during each of its counting periods. The recycling rate may be increased several hundred per cent. The CMC Model 400A Digital Printer has been designed to operate from 4-line 1-2-3-4 binary code.

Specifications include: print-out capacity, 6 digits (up to 12 digits optional), accuracy, and counting period identical to characteristics of counting instrument, display time, 0.2 sec minimum controlled by counting instrument, dimensions: 14 in. width x 8 in. height x 10 in. diam.

Computer Measurements Corp., Dept. ED, 5528 Vineland Ave., No. Hollywood, Calif.
Radio Engineering Show, Booth 3501-3503

△ Push-On Connectors Subminiature



These push-on connectors are made in the following types: straight plug, angle plug, straight jack, and three types of panel jacks; 1/4 in. double D hole, 5/16 in. double D hole and 5/16 in. keyed hole. They are available in miniature and sub-miniature sizes up through 1/4 in. maximum O.D. The outside dimensions of each unit remain constant regardless of cable size used. Three types of receptacles are available for the above plug and a feed-through adapter.

Automatic Metal Products Corp., Dept. ED, 315 Berry St., Brooklyn 11, N.Y.
Radio Engineering Show, Booth 4426.



SEND FOR FUSED QUARTZ—FUSED SILICA DATA FILE



CENTER FOR HIGH-PURITY FUSED QUARTZ

The Amersil processes for producing and fabricating fused quartz and silicaware of critical purity, simplify your problems in securing the precise laboratory or industrial equipment required for your production.

Standard apparatus, crucibles, trays, cylindrical containers in a complete range of sizes and tubing (up to 25" diam.) are available for early delivery. Amersil engineers are available to assist in developing special equipment to individual requirements. Your inquiry is invited. ★ ★

- ROTOSIL
- OPTOSIL
- HOMOSIL
- ULTRASIL

AMERSIL
COMPANY, INC. FUSED SILICA
AND QUARTZ

685 RAMSEY AVE., HILLSIDE 5, NEW JERSEY

ENGELHARD INDUSTRIES

CIRCLE 258 ON READER-SERVICE CARD FOR MORE INFORMATION

△ **Tiny Test Point Jack**
Bulldog Grip



Designated Type SKT-10, this tiny test point jack has exceptional holding power. A four-leaf floating contact of heat-treated beryllium-copper provides maximum and lasting spring power. The metal insert is gold-over-silver plated. Insulation is Teflon. The jack meets MIL spec requirements. This SKT-10 test point jack is press-fitted into a chassis hole with a simple insertion tool, needing neither hardware nor sealing. It mounts even into thin aluminum stock, eliminating insulating panels, and is available in eight RETMA colors.

Sealectro Corp., Dept. ED, 610 Fayette Ave., Mamaroneck, N.Y.

Radio Engineering Show, Booth 3714.

CIRCLE 261 ON READER-SERVICE CARD

△ **Recording Oscillograph**
For Guided Missiles



Weighing 15 lbs, the Model 561 measures 5 x 6 x 9 in. and can withstand shock accelerations over 1500 g. It is designed to operate in an ambient of -65 to +160 F and at altitudes from 0 to 70,000 ft. Paper speeds are 1/2 to 80 in./sec. The magazine will hold 95 ft of DuPont Lino-Writ No. 4. This recording oscillograph handles up to 20 channels.

Midwestern Instruments, Dept. ED, P.O. Box 7186, Tulsa, Okla.

Radio Engineering Show, Booth 3103.

CIRCLE 262 ON READER-SERVICE CARD

from **DIT-MCO, Inc.**

... another startling new development in automatic electrical system testing!

New Model 850
MULTIPLIER SECTION

featuring ...

plugboard programming

new jumper-wire system simplifies test make-up and maintenance testing



Model 850 multiplier section mobile unit, with DIT-MCO model 200 Circuit Analyzer.



Now! In one operation at his desk, planner can design circuitry, layout matrix chart and jumper plugboard to conform to test sequence.



Now! Thorough, periodic maintenance tests can be made quickly and economically throughout the life of any airplane or missile.

Now! Test Modified Wiring Systems Without Altering Adapter Cables!

Do modified and improved electrical systems throw your testing section into a tailspin? Normally, it means existing test machinery (or the adapter cables, if DIT-MCO equipment is used) must be changed to conform to the circuit modifications. Here's how the new DIT-MCO plugboard system has solved that problem.

Circuitry can now be connected to the tester by the most convenient point-to-point method. Connecting wires (adapter cables) do not have to conform to any pattern. The testing sequence is programmed, quickly and easily, on the portable plugboards. Any subsequent circuit modifications are also handled on the plugboards... without changing existing adapter cables.

This is just one advantage offered by this new development. Write for full details on how DIT-MCO can help solve all your test problems.

Write today for complete information:

ENGINEERS:

DIT-MCO needs executive calibre sales and design engineers right now! Excellent opportunity with respected organization on the move. Work with key men in aircraft and missile industries. Write today!

DIT-MCO, INC.
Electronics Division

Box 03-20, 911 Broadway
Kansas City, Missouri

CIRCLE 264 ON READER-SERVICE CARD FOR MORE INFORMATION

Partial List of DIT-MCO Users:

Bell Aircraft Corporation, Texas Div. • Bendix Aviation Corporation, Sidney, New York • Boeing Airplane Company, Seattle, Washington and Wichita, Kansas • American Bosch Arma Corporation • Douglas Aircraft Company, Tulsa, Oklahoma • Fairchild Aircraft Division • Goodyear Aircraft Corporation • Martin, Baltimore • Naval Ordnance Laboratory, White Oaks, Maryland • Northrop Aircraft, Inc. • Motorola, Inc. • Temco Aircraft Corporation • Trans World Airlines • Convair • Chance Vought Aircraft • Servomechanisms, Inc. • Radio Corporation of America • Pacific Mercury Television Mfg. Corp.



KAY
Microwave Mega-Nodes

Calibrated Noise Sources at Microwave Frequencies

Designed for the measurement of noise figure, receiver gain, and to calibrate standard signal sources in radar and other systems, the Kay Microwave Mega-Nodes are available with either argon or fluorescent tubes. Argon tubes cover the ranges from 1200-1400 mc and 2600 to 26,000 mc; fluorescent tubes from 1120-12,400 mc.

SPECIFICATIONS

Noise Output, all sizes: Fluorescent, 15.8 db \pm 0.25 db; argon, 15.28 db \pm 0.1 db.
Temperature Correction Factor: Fluorescent, -0.05 db per degree C above 32 degrees C. Argon—no temp. coefficient
Power Supply: Input approx. 65 watts, 117 V (\pm 10%), 50-60 cps ac.
For Complete Information Regarding These, and Other Kay Instruments,

Write:

KAY ELECTRIC COMPANY

Dept. ED-3, 14 Maple Avenue, Pine Brook, N. J. Caldwell 6-4000

SEE US AT THE IRE SHOW
BOOTH #2608-09-10

CIRCLE 263 ON READER-SERVICE CARD FOR MORE INFORMATION

Prices*

Universal Power Supply \$100.
RG-49/U \$400.
RG-48/U 195.
RG-49/U 195.
RG-50/U 195.
RG-51/U 195.
RG-52/U 195.

*One power supply and any 3 of the following waveguides: RG-48/U, RG-49/U, RG-50/U, RG-51/U, RG-52/U, PRICE \$600. Additions of any of the above waveguides to the set of 3, \$167.

NEW . . . COMPACT . . .



For high loads at minimum deflection

The Energy Cartridge® fills the need for a spring with constant load deflection characteristics acting in compression. It is a one-piece unit of preassembled Belleville washers . . . stacked in varying sequence according to load and space requirement. For complete information about this versatile spring write for booklet "Energy Cartridge."

*Reg. U. S. Pat. Off.

**ASSOCIATED
SPRING
CORPORATION**



General Offices: Bristol, Connecticut © 1970 A.S.C.

CIRCLE 265 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW TEFLON SILICONE HERMETIC TERMINAL



For electronic components in the intermediate voltage range, 1500 V operating.

Lundey Series 399 Hermetic Terminals are rugged, simply constructed terminals, utilizing Teflon and silicone rubber for improved performance. Designed to meet MIL-T-27A specifications, they have an operating voltage of 1500, test voltage of 4000 and current rating of 10 amps. Assembly needs only simple tooling. Depending upon the electrode, assembly is accomplished by clinching in a press with rudimentary jiggling, or by drive fit with a press. As an added service, Lundey Associates will install terminals in customers' covers. The hermetic seal is completed by soldering the eyelet to the electrode at the time internal leads are soldered.

Available in three electrode styles: hollow electrode with lug, for minimum clearance; solid electrode with single turret; solid electrode with double turret.

Send for Lundey Bulletin #399.

LUNDEY ASSOCIATES

694 Main Street • Waltham 54, Massachusetts

CIRCLE 266 ON READER-SERVICE CARD FOR MORE INFORMATION



**Vacuum Cell
Senses Pressure Changes**

By means of a sealed metal bellows, which changes pressure on a load cell, a device with no moving parts, this vacuum cell senses changes in atmospheric pressure. With a power rating of 1 w, it operates directly into an ohm meter, or as a function of a circuit without amplification. The unit has a preloading adjustment, making initial resistance values to match a circuit parameter.

The size of the cell is 1/2 in. diameter by 1-1/2 in. overall, and has a total weight of 22 grams.

Clark Electronic Labs., Dept. ED, Box 165, Palm Springs, Calif.

CIRCLE 267 ON READER-SERVICE CARD FOR MORE INFORMATION

**△ Automatic Tube Tester
Uses Punched Cards**



In the Model 123 tube tester pre-selected voltages on screen, grid, plate or filament are tabulated on an automation card. The 0.22 v rms signal used on the grid permits testing of the newer sensitive tube types without distortion. A large number of controlled voltages are furnished for testing tubes used in special-purpose circuits. Cut-off point, zero bias current (up to 200 mils) and other specific controlled emission or gm tests at designated points can be made.

Regulated d-c voltages available from this unit are 12 to 160 v plate, and 12 to 160 v screen, with combined plate and screen currents up to 100 ma. Bias voltage varies from 0.1 to 100 v. Filament voltage is 0.1 to 119.9 v ac, and signal is 0.22 v.

The Hickok Electrical Instrument Co., Dept. ED, 10514 Dupont Ave., Cleveland 8, Ohio.
Radio Engineering Show, Booth 3516-3518.

CIRCLE 268 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, nonslip 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 Screw Division, STANDARD PRESSED STEEL CO., Jenkintown 12, Pa.

*TM Reg. U.S. Pat. Off., The Nylok Corporation

STANDARD PRESSED STEEL CO.



Unbrako Products are sold through Industrial Distributors



JENKINTOWN PENNSYLVANIA

CIRCLE 269 ON READER-SERVICE CARD FOR MORE INFORMATION

TRANSISTOR CLIP



Patent Pending

A silver-plated beryllium copper clip for holding G.E. and Texas Instrument oval silicon transistors under the rugged requirements of aircraft and missiles. This clip has been designed by a company* that knows these requirements at first hand.

See this NEW IDEA and many others for holding components under conditions of extreme heat, shock and vibration.

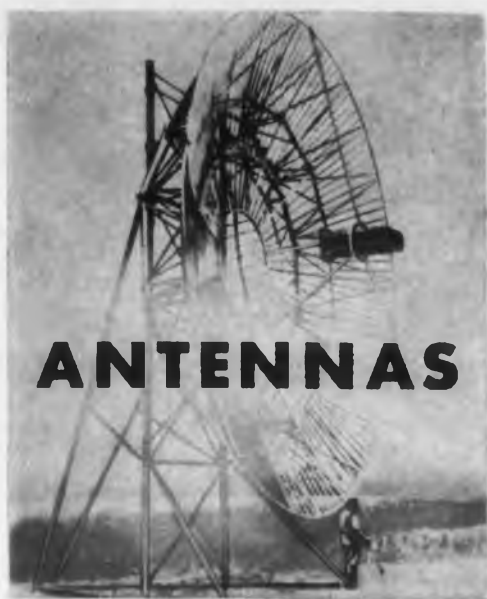
BOOTH 4235 — I. R. E. SHOW

*Manufactured and sold under exclusive license from Northrop Aircraft, Inc.

ATLAS E-E CORPORATION

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3757 Wilshire Blvd. • Los Angeles, California

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Antennas for every need: airborne, tele-
metering, point-to-point, glide path, and dishes
ranging from 4' to 60'. Design develop-
ment and manufacture of antennas is our
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**BOOTH 1428 AT
New York IRE Show**



CIRCLE 271 ON READER-SERVICE CARD FOR MORE INFORMATION



If it's HOT or DRY

USE 'DIAMOND H' SERIES R RELAYS



Where the temperature hits 200°C
... or drops to -65° ... where a
dry circuit is downright arid ... or

a power circuit employs 10 amperes (or even 20 amps for a
short life need) ... your best bet for reliability is a "Diamond
H" Series R miniature, hermetically sealed, aircraft type relay.
Their shock and vibration resistance you may take for granted.

Variations on the basic 4 PDT Series R relay perform out-
standingly over such a broad area that they are frequently used
to do many different types of jobs in a given application, with
resultant savings in spare part inventories. The range of possi-
ble characteristics covers:

Various brackets of vibration resistance from 10 to 2,000
cps, coil resistances from 1 to 50,000 ohms, operational shock
resistances of 30, 40, or over 50 "G"; mechanical shock
resistance to 1,000 "G"; contact capacities from 350 V., D.C., 400
MA, to 10 A., at 30 V., D.C., as well as signal circuits.

For complete information send for a copy of Bulletin R-250

THE HART MANUFACTURING COMPANY

210 Bartholomew Avenue, Hartford, Conn.

CIRCLE 272 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1, 1957

△ Pulse Generator

Provides Clock Pulses



A standardizer Pre-Amplifier Input is incorpo-
rated in the Model 100B. The unit generates stand-
ard 2.5 v system pulses and 25 v variable amplitude
pulses of both polarities, with digitized pulse in-
terval selection. The new Input Standardizer sec-
tion will trigger on any waveform with a positive
rise time of at least one μ sec, and ten v amplitude.

The unit is designed to operate as a general pur-
pose laboratory generator, or to provide accurately
timed clock pulses for logic units. Pulse intervals of
10 to 100 μ sec in decade one μ sec steps (plus or
minus 2 per cent accuracy) are complemented by an
extended range position to 150 Kc, a doubler for
low frequency extended range, and push-button
operation. Output impedance of the variable 25 v
pulse is 5 kv with pulse width of 1.5 μ sec and rise
and fall times of .25 μ sec.

The transformer coupled output stage of the
standard negative 2.5 v pulse has a constant voltage
characteristic which maintains an undeteriorated
pulse when loaded between 0 and 200 ma. output
current; or into resistive loads as low as 15 ohms.

A scope synchronizing pulse for a sweep lead of
.3 μ sec is also available from this unit.

The unit requires only -10 v and an average
current range of 20 ma at 100 kc.

Navigation Computer Corp., Dept. ED, 1621
Snyder Ave., Philadelphia 45, Pa.

Radio Engineering Show, Booth 1909.

CIRCLE 273 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Relay Antenna

7000 Mc



This relay antenna has 65 to 70 per cent gain
efficiency over a 5925 to 8100 mc frequency range.
The sidelobes are 24 db down and the VSWR is
1.15 over the band. Parabolic reflectors of 4, 6, 8,
and 10 ft are available.

The Gabriel Co., Dept. ED, Electronics Div.,
135 Crescent Rd., Needham Heights 94, Mass.

Radio Engineering Show, Booth 2917-2918.

CIRCLE 274 ON READER-SERVICE CARD FOR MORE INFORMATION

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FREE BOOK
TODAY!



ALL ABOUT ENVIRONMENTAL TEST EQUIPMENT

This 20 page digest of the
M & M line of environmental
test equipment gives you quick
facts on the application, per-
formance and economies of
Murphy & Miller equipment.
Illustrates and describes the
industry's most modern units—
provides tips on selection and
use of all types of environ-
mental test units. Write for
it today.



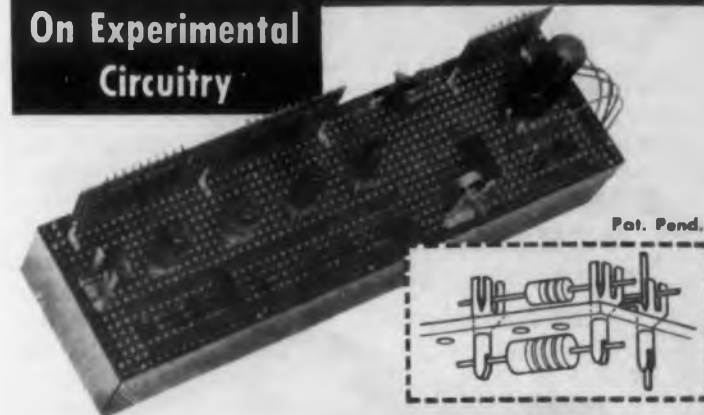
MURPHY & MILLER, INC.

1350 South Michigan Avenue
Chicago 5, Illinois

CIRCLE 275 ON READER-SERVICE CARD FOR MORE INFORMATION

Save Set-up Time
On Experimental
Circuitry

Vector
EXPERIMENTER'S CHASSIS



Featuring the unique PUSH-IN Terminal that springs snugly
into the holes of the board to provide quick set up of circuitry.
The serrated edges of the terminal forks firmly grip the leads of
resistors and capacitors for testing without soldering. Terminal
has through hole, two side connections and small fork for
transistor leads. Kit, sockets and brackets assemble with self-
tapping screws.

Write for
complete
information.

VECTOR ELECTRONIC COMPANY

3352 SAN FERNANDO ROAD
LOS ANGELES 65, CALIFORNIA
TELEPHONE CLinton 7-8237

CIRCLE 276 ON READER-SERVICE CARD FOR MORE INFORMATION

New **TRINSEEL** **TEFLON**[®]
sub-miniature terminals

for installation
SPEED **IN** and
in **4** Seconds
ready to solder

"Cork" into chassis...TEFLON insulation holds and seals PERMANENTLY.

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consistent
PERFORMANCE
60 cps — 30,000 MC

ALL TEMPERATURES... HIGH-HUMIDITY SHOCK conditions. Insulated with special "TSI" TEFLON developed by Tri-Point.

AVAILABLE in standard sub-miniature stand-off, feed-thru sizes, fixtures, variety of pin finishes... in test or production quantities.

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containing the complete
LOCKING Terminal line

SHAKEPROOF[®]
TERMINALS
incorporating built-in
lock washers

Shakeproof Terminals combine soldering lug and famous Shakeproof Lock Washer in one easy-to-handle unit. Assure positive electrical connections. Multiple locking teeth anchor terminal to base, prevent shifting, penetrate oxidized or painted surface. Plain terminals also available. Send for complete information.

SHAKEPROOF
"Fastening Headquarters"[®]

DIVISION OF ILLINOIS TOOL WORKS
St. Charles Road, Elgin, Illinois

CIRCLE 278 ON READER-SERVICE CARD FOR MORE INFORMATION

△ **Tube Tester**
Universal Type



With the Model RMP 400, sixteen different types of tube bases are acceptable through as many socket adaptors. A patented adaptor to cross rail busbar construction insures that any future type of tube—irrespective of base or internal connections can be tested. There are fourteen meters with an accuracy of ± 1.5 per cent full scale deflection. Meter protection is provided by relay devices. The unit uses rotary stacked selector switches.

In addition to testing tubes at rated characteristics complete families of curves can be plotted point by point. This applies not only to normal static characteristics but also to dynamic mutual conductance. Tubes can be tested for inter-electrode shorts and vacuum. Leakage can be detected. The mechanical structure is extremely rugged. A specially designed tubular carrier on caster wheels provides mounting and mobility. The weight including the carrier is four hundred pounds.

J. V. Kane & Co., Dept. ED, 1004 Cloverhill Rd., Wynnewood, Pa.

Radio Engineering Show, Booth 3014.

CIRCLE 279 ON READER-SERVICE CARD FOR MORE INFORMATION



△ **VTVM**
Laboratory Precision

The accuracy of the Model 1800-8 is better than ± 2 per cent on all ac and dc voltage ranges, and its shielded diode probe is designed for use into the uhf range. It has a high input impedance, dc polarity switch, illuminated meter scale with mirror and knife-edge pointer. All input terminals are insulated from the panel.

General Radio Co., Dept. ED, 275 Massachusetts Ave., Cambridge 39, Mass.

Radio Engineering Show, Booth 2319, 3302-3306.

CIRCLE 280 ON READER-SERVICE CARD FOR MORE INFORMATION



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Fast Service is the big "plus" you get at GEE-LAR—the House of Knobs. Hundreds of styles, sizes and types, including deluxe Gold Inlay Knobs, are stocked... quickly shipped to you in any quantity. Best of all, your costs are always moderate... there's no charge for tooling or molds.

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IMPEDANCE
COMPARATOR

MODEL
60

PRECISE,
RELIABLE,
AND RAPID
COMPARISON
OF ELECTRICAL
COMPONENTS



- Tests Resistors, Condensers, Inductors
- Percentage Deviation From Standard Read On Large Meter
- Rapid Response — No Buttons To Push
- Overall Regulation Assures High Accuracy
- No Zero Drift Adjustment Necessary

PRICE
\$17900
F.O.B.
NEW YORK

SPECIFICATIONS:

Component Test Voltage.....3 volts at 60 C.P.S.
Full Scale Ranges... $\pm 1\%$, $\pm 5\%$, $\pm 10\%$, $\pm 20\%$
Accuracy.....0.1% on 1% range
Impedance Range.....5 ohms - 5 megohms
Supply.....105 - 125 volts, 60 C.P.S., 25 watts

Representatives in Principal Cities

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you can obtain the SETKO

JEWEL CASE of SET SCREW IDEAS

without cost
or obligation

Contains over 30 different samples of the latest developments in set screws for you to examine—study—and try out. To have the Setko "Jewel Case" sent to you on loan, without cost or obligation, simply write your name and address in the margin, tear out this page and mail to us.

Set Screw & Mfg. Co.

265 Main St., Bartlett, Ill.
(Chicago Suburb)

We specialize in Solving Puzzling Set Screw Problems

CIRCLE 283 ON READER-SERVICE CARD FOR MORE INFORMATION

SIMPLYTROL AUTOMATIC PYROMETERS For Control of Temperature



10 standard ranges from -200° to $+3000^{\circ}$ F. Accuracy 2% (limit of calibration error). Sensitivity 4 ohms per millivolt.

Cat. No. 4535, size 10" x 6" x 7". Range 0/1000° F, 0/500°C. \$135.00

Thermocouple-type automatic pyrometer for controlling temperature in furnaces or ovens and manufacturing processes. Leads between Simplytrol and its thermocouple sensing element may be up to 100 feet or more depending on temperature range and lead wire resistance. Load relay, 5 amperes S.P.D.T. Optional heavy duty relays to 40 A.

Either AUTOMATIC control or LIMIT shutoff. An automatic Simplytrol turns heat on and off to hold required temperature. Proportioning effect can be increased or decreased by changing cam on the sensing cycle. With shorter cycles, control more nearly approaches straight line. A limit Simplytrol locks up when the trip point is reached and remains locked until reset. Use limit Simplytrols for monitoring and safety shutoff or alarm.



Cat. No. 4532-MFP, size 5" x 5 1/2" x 8" deep. Range 0/1500°F, 0/800°C. \$127.00

Cabinet model for wall mounting or portable shown at top. To the right is an MFP Simplytrol for flush mounting in a cabinet or control panel. Several other mountings are shown in Catalog 4-A. Send for your copy. Assembly Products, Inc., Chesterland 17, Ohio. Phone (Cleveland, O.) HAMILTON 3-4436. (West Coast: Box XX, Palm Springs, Cal. Phone DHS 4-3133.) Booth 232 Atomic Expo. Booth 3916 IRE Show

CIRCLE 284 ON READER-SERVICE CARD FOR MORE INFORMATION



△ RF Voltmeter
Has 400 μ v Sensitivity

The 91B rf voltmeter covers frequencies from 0.2 to 500 mc and is useful up to 1000 mc with reduced accuracy. The voltage calibration extends from 0.001 to 3 v, but detection of signal levels as low as 400 μ v is possible.

Two probes are supplied with the meter, one for general purpose high impedance work, the other a low VSWR 50 ohm probe for monitoring high frequency coaxial systems. Each probe contains a full wave diode detector with rms response at levels below 0.1 v.

Boonton Electronics Corp., Dept. ED, Morris Plains, N.J.
Radio Engineering Show, Booth 3121.

CIRCLE 285 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Adjustable DC Power Packs
Transistorized

These new models are designed for either 60 or 400 cy operation, 105 to 125 v a-c input and are available for output ranges of 5 to 10, 10 to 20, 20 to 30, 30 to 40, 40 to 50, 50 to 55 v dc in current ratings up to 200 ma. These adjustable models are also available for 100, 150, 200, and 300 v outputs at 100 ma ratings. Line regulation is better than 0.5 per cent; load regulation is better than 0.5 per cent. Ripple is less than 0.05 per cent.

Units are potted in transformer type housing but transistors are available for servicing and replacement. Voltage variation is made via screwdriver adjustment. Size of a typical 60 cy unit is 2-1/2 x 3 x 4 in. and the 400 cy equivalent is correspondingly smaller.

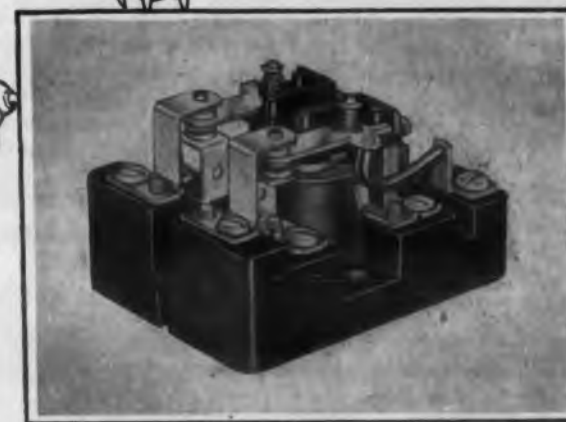
Electronic Research Assoc., Inc., Dept. ED, 67 E. Centre St., Nutley 10, N.J.
Radio Engineering Show, Booth 2705.

CIRCLE 286 ON READER-SERVICE CARD FOR MORE INFORMATION

G-r-r-r-Great!
The GUARDIAN
25 AMPERE
POWER RELAY



Interchangeable Coil Assemblies
Visit Booths 2502-2504
I.R.E. Show



DIMENSIONS—Length 3 3/4". Width 2 1/2". Height 2 3/4". WEIGHT—11 oz.

Interchangeable Coil Assemblies
provide innumerable operating variations
for experimentation—production—field servicing!

No solder connections necessary when changing coils. This relay that introduced 25 ampere power and interchangeable coil assemblies—the Guardian Series 2100-U Power Relay—has become the standard unit of control for a host of heavy duty applications, in less than six months. Standard unit has D.P.D.T. contacts rated at 25 amperes continuous duty A.C., with 75% power factor. Coil voltages available, 6 to 230 volts A.C., 6 to 220 volts D.C. Operating power requirement is 9.5 VA, coil drain approximately .080 amperes at 115 V., 60 cycles. Built to meet U/L specifications.

Now... The Standard Unit of Control for:



HEATERS • MOTORS
ELEVATORS • WELDING
TRAFFIC SIGNALS • AUTOMATION

Arrange for delivery of a production sample. Write for bulletin PR.

GUARDIAN ELECTRIC

1622-C W. WALNUT STREET

CHICAGO 12, ILLINOIS

"Everything Under Control"

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MODEL MS-4

MULTISCOPES MEET THE PROBLEM

By use of Tinker & Rasor Multiscopes it is now possible to rack mount oscilloscope indicating units more compactly than heretofore. Rack mounting achieves neatness, efficiency and greater convenience with oscilloscope tubes grouped for instant observation of trace variations. You may order Multiscopes indicating units (without sweep wave forms) in 1, 2 or 4 tube multiples compactly mounted in a standard 19-inch rack panel fully supported from the panel face. If you would like further information on Multiscopes and applications — Write for data sheets to —

Makers of electronic testing apparatus, indicating and signal recording equipment for field and laboratory



TINKER & RASOR
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What's
NEW
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SUPEREX!

*MICRO-MINIATURE CHOKE

- Smallest Ferrite-core choke in the world!
- Inductance up to 5 millihenries

*MINI-CHOKE

- Inductance up to 10 millihenries
- Higher Q . . . lower D-C resistance
- Superior to conventional RF chokes

* Now available encapsulated

EARPHONES

LOW
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. . . for the manufacturer

For kits, Geiger counters, tape recorders . . . ANY application where low cost earphones are required.

Write Dept. E for full line catalog.



SupereX successor to Grayburn
Radford Pl. Yonkers, N.Y.

PRINTED
CIRCUIT

variable and fixed
inductances

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AT THE
I.R.E.
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BOOTH
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CIRCLE 289 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Digital Comparator

Provides Servo Control



This digital comparator is designed for use in digital servo control systems. In conjunction with a 13-bit or 19-bit shaft position to the digital converter, the digital comparator can provide digital control through conventional servo amplifiers and motors. A 19-bit comparator allows control to one part in 524,288.

No relays or tubes are used. A built-in preamplifier provides adjustable gain up to 5 v maximum at 1000 ohms output impedance. The comparator has zero dead time. Voltage requirements are —40, —20 and +20 v dc and 115 v at carrier frequency.

Norden-Ketay Corp., Dept. ED, Commerce Rd., Stamford, Conn.

Radio Engineering Show, Booth 2401-2403.

CIRCLE 290 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Data Counters

Visual and Electrical Readout



Electrically or mechanically driven and provided with manual or electric reset, these counters show accumulated totals and automatically create specific control circuit contact closures for each number displayed. The electrically operated counter with electrical reset is illustrated. These instruments, with their five figure capacity, each provide 100,000 circuit arrangements. The counters are compatible with standard data processing equipment.

Veeder-Root, Inc., Dept. ED, Hartford 2, Conn.
Radio Engineering Show, Booth 1523.

CIRCLE 291 ON READER-SERVICE CARD FOR MORE INFORMATION

TELL YOUR PERSONNEL MANAGER ABOUT ELECTRONIC DESIGN'S "CAREER SECTION"

If your company is trying to attract skilled electronic design, development or research engineers, tell your Personnel Manager about ELECTRONIC DESIGN. Here is a concentrated audience of 25,000 engineers ready to read about the advantages offered by your plant.

Remember, more than 5,500 ELECTRONIC DESIGN readers inquire every issue—many of them will be interested in your opportunities.

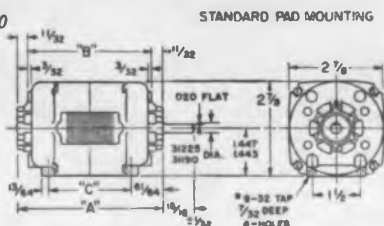
You can reach them in ELECTRONIC DESIGN'S "Career's Section," page 200 this issue.



NEW HOWARD MODEL 9200 INDUCTION MOTOR

Unusual Power in A Small Frame Size

HOWARD MODEL 9200
1/300 to 1/30 h.p.
Permanent Split Capacitor, Single Phase,
50/60 Cycle Induction,
Torque, Synchronous
Type—Also available in
two or three phase
designs.



Now available from Howard Industries, Inc. is an exclusive Miniaturized Induction motor with all the features of an ultra modern power motor for use in tape recorders, communication equipment, office machines, turn table, movie projectors, air craft, instruments, electronic devices and many more applications.

Howard's Model 9200 has been rated by experienced engineers as the finest small induction motor on the market. Performance ratings of these motors are outstanding, comparable to those of considerably larger frame sizes. For complete details, engineering drawings and samples, write, wire or phone HOWARD today.

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Other Howard motors: UNIVERSAL & D.C.
1/200 to 1/2 h.p. • SHADED POLE
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HOWARD INDUSTRIES, INC. 1725 State St., Racine, Wis.

Divisions: Electric Motor Corporation—Cyclohm Motor Corporation—Racine Electric Products

CIRCLE 294 ON READER-SERVICE CARD FOR MORE INFORMATION

SHORT . . .
in size
LONG . . .
in performance



NEW SODECO Type TCeBZ Electric Impulse Counters

The latest in the SODECO line, these new electric impulse counters offer designers a wonderful opportunity to squeeze a high-performance impulse counter into a very limited space.

Look at these features:

- AC or DC Models
- Counters measure as little as 1-3/8" wide x 2-1/16" high x 1-3/4" deep (designed for flush mounting)
- 4 or 5 digit models available
- Fast—can count up to 25 impulses/sec.
- Low power demand—as low as 1 W DC at 10 impulses to 6.5 W AC max. at top speed
- Instantaneous mechanical push-button reset

You'll want more information on these unique counters. Write to—

LANDIS & GYR, INC.
45 West 45th Street, New York 36, N. Y.

CIRCLE 295 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Single Turn Potentiometer

For Precision
Applications

The resistance element and terminal leads of this potentiometer are moulded into a single unit. Units may be ganged and each cup may be individually phased in the field. All models have ball-bearing mounted shafts.

The 910 Series Micropot has a power rating of 5 w at 40 C, and a resistance range of 50 to 10,000 ohms, (50,000 ohms, special), standard tolerance ± 5 per cent. Standard linearity accuracy is ± 0.5 per cent independent. Starting torque is 0.5 inch-ounce per section. Continuous mechanical rotation, 340 or less electrical rotation. Net weight is 4 oz per single unit, with 1 oz added for each additional unit. The length of a single unit is 1-3/64 in., width, 1-7/8 in.; the shaft is 5/8 in. long with special lengths available.

George W. Borg Corp., Borg Equipment Div., Dept. ED, Jamesville, Wisc.
Radio Engineering Show Booth 3840-3842.

CIRCLE 296 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Pulse Packages High Power or Trigger



The High power pulse package is built around the charging choke, pulse-forming network and pulse transformer of the line-type modulator, and is designed to provide an optimum required pulse shape.

The trigger-pulse package is designed to generate pulses of the required power and impedance to trigger any high-power hydrogen thyratron tube.

Filtron Co., Inc., Dept. ED, Flushing, L.I., N.Y.
Radio Engineering Show, Booth 2812.

CIRCLE 297 ON READER-SERVICE CARD FOR MORE INFORMATION

Designers—Engineers:

ADVAC TERMINALS

—will solve your toughest hermetic seal problem with a wide margin of safety!



OUTSTANDING
DESIGN
ADVANTAGES
INCLUDE —

- ▶ Immunity to Thermal Shock
- ▶ High Mechanical Strength
- ▶ Maximum Voltage 65,000 V.
- ▶ Adaptable for Brazing, Welding or Soft-soldering

Specify ADVAC for temperatures to 1400°F, pressures to 2000 P.S.I.

ADVAC Hermetic Seals are produced under an exclusive process that provides a superior seal capable of withstanding gruelling environmental conditions. Advac terminals feature a metallized high grade alumina construction that provides a super-strength seal. Performance-proven in critical commercial and military applications, ADVAC seals are available in standard types or custom designs for special requirements.

NEW BULLETIN — contains complete information on the ADVAC line. Address inquiries to Dept. DN.

ADVAC TERMINALS ARE PRODUCTS OF —

**ADVANCED
VACUUM
PRODUCTS • INC**

430 FAIRFIELD AVENUE, STAMFORD, CONN.

Telephone: DAVIS 4-2148

A DIVISION OF GENERAL CERAMICS CORPORATION

CIRCLE 298 ON READER-SERVICE CARD FOR MORE INFORMATION

See us
at the
I.R.E. Show!
Booth
1319

NEW ENGLAND

Junior Utility Ovens

- Low cost • Easy to operate
- Minimum maintenance

Junior Sized: 24" x 24" x 34"
Temp. range to 1000°F.

4 Models to choose from
at Booth #4133 I.R.E. Show

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:
Baking
Drying
Curing
Processing
Heat Treating
Product Control
Sample Testing

90 day Guarantee on workmanship and materials.

All 4 models have baked hammertone gray finish with an inside lining of Armo 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.
Representatives in most major cities.

NEW ENGLAND
OVEN & FURNACE COMPANY
INC
ORANGE, CONN.

CIRCLE 299 ON READER-SERVICE CARD FOR MORE INFORMATION



CPC PLASTIC CLAMPS

20 SIZES
1/8" to 3"

ALL SIZES, SHAPES and MATERIAL

- FASTER
- SAFER
- TOUGH
- SIMPLER
- MORE SECURE
- ENDURING

For wires, cables, conduits, tubing, light hose. Name the use and Commercial has a clamp... or will design one. Pioneering "know-how" and advanced production methods of CPC offer unmatched quality... and at a saving, too! Send for sample clamps and prices.



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COMMERCIAL PLASTICS Co.

CIRCLE 300 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Video Monitors Have DC Restorer

Designed for closed-circuit TV systems, these direct view monitors have eleven tubes and an aluminized picture tube. They are available in 14, 17 and 21 in. screen sizes. Total weight is 55 lbs for the 17 in. unit. The model DVM monitors which have a d-c restorer circuit have a video response within 1 db up to 10 mc. The input, either composite video or separate sync and video, handles a peak to peak voltage range from 0.25 to 5.0. Power requirement is 140 w from a standard 105 to 130 v 60 cy source. The operating temperature range extends from -10 C to 50 C.

Blonder-Tongue Labs. Inc., Dept. ED, 526-536 No. Ave., Westfield, N.J.

Radio Engineering Show, Booth 1210.

CIRCLE 301 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Network Switching Relay Handles High Voltages

The Model BL-148 is a high voltage, hermetically sealed, armature type relay. It consists of one set of SPST high voltage switch elements and two sets of low voltage SPST elements, simultaneously operated from a 26.5 v d-c source. The high voltage elements are rated to handle 7500 v and 90 peak amps, 3.0 amp rms; the low voltage elements are designed to handle 1000 v and 1.6 amp dc. The switching time is less than 0.1 sec. The switch portion is immersed in silicone oil during high voltage operation.

This unit weighs 3.6 oz and has over-all outline dimensions of 3 in. length and 1-1/16 in. diam.

Bomac Laboratories, Inc., Dept. ED, Salem Rd., Beverly, Mass.

Radio Engineering Show, Booth 3815-3817.

CIRCLE 302 ON READER-SERVICE CARD FOR MORE INFORMATION

new designs on the board?

GRC TINY MOLDED

NYLON PARTS

may be the difference between "problems" and profits!

Gries' unique single cavity molding facilities are flexible—provide the practical answer to countless problems of product design and improvement. No matter how tiny, or how intricate, GRC molds nylon parts to meet your exact specifications, with precise tolerances and uniform quality. And, because GRC methods are completely automatic, costs are surprisingly low—GRC tiny nylon parts are produced, completely trimmed and ready for use, in one high-speed, money-saving operation!

Send prints for quotation; write today for Bulletin and Samples.

GRC MOLDS ALL THERMOPLASTICS SWIFTLY, DEPENDABLY, ECONOMICALLY!

Automatic Continuous and Individual Inserts! Single Parts!

Quick deliveries on quantities of 25,000 to millions.

NO SIZE TOO SMALL!

MAXIMUM SIZE .03 oz.—1 1/4" long
LOW MOLD COSTS!



GRIES REPRODUCER CORP.

World's Foremost Producer of Small Die Castings
40 Second St., New Rochelle, N. Y. New Rochelle 3-8600

CIRCLE 303 ON READER-SERVICE CARD FOR MORE INFORMATION

connection is blind

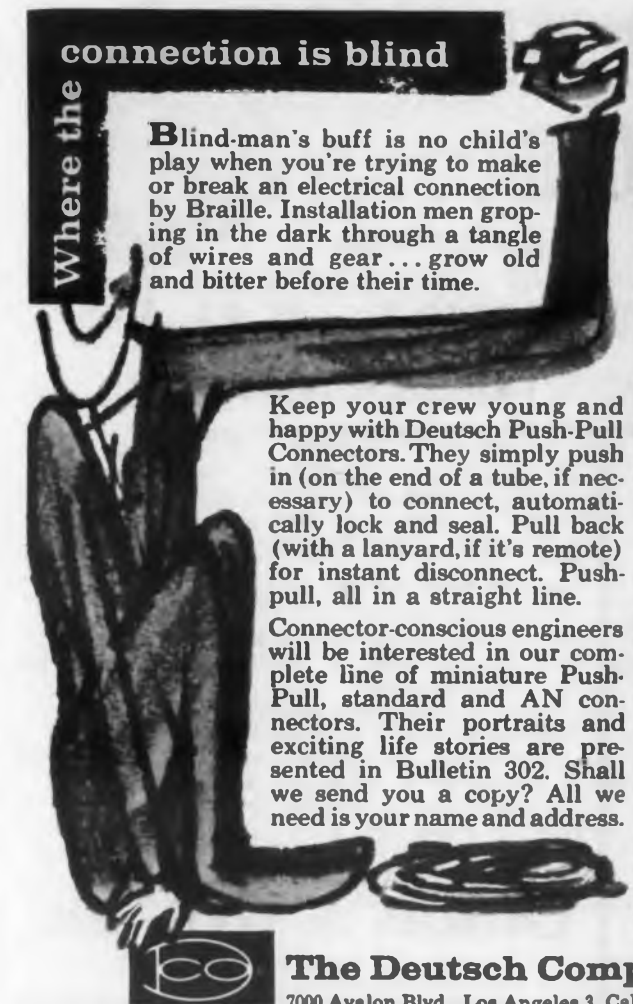
Where the

Blind-man's buff is no child's play when you're trying to make or break an electrical connection by Braille. Installation men groping in the dark through a tangle of wires and gear... grow old and bitter before their time.

Keep your crew young and happy with Deutsch Push-Pull Connectors. They simply push in (on the end of a tube, if necessary) to connect, automatically lock and seal. Pull back (with a lanyard, if it's remote) for instant disconnect. Push-pull, all in a straight line.

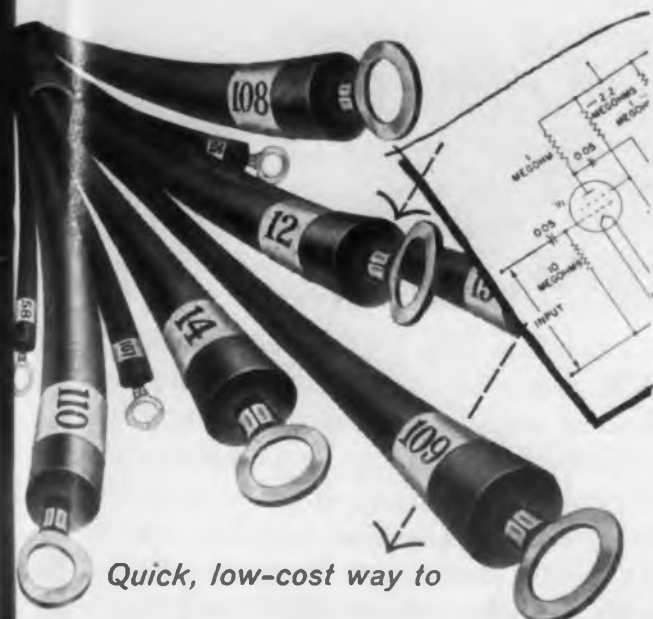
Connector-conscious engineers will be interested in our complete line of miniature Push-Pull, standard and AN connectors. Their portraits and exciting life stories are presented in Bulletin 302. Shall we send you a copy? All we need is your name and address.

Deutsch push-pull miniature connectors



The Deutsch Company
7000 Avalon Blvd., Los Angeles 3, California

CIRCLE 304 ON READER-SERVICE CARD FOR MORE INFORMATION



Quick, low-cost way to

Bring wiring diagrams to life

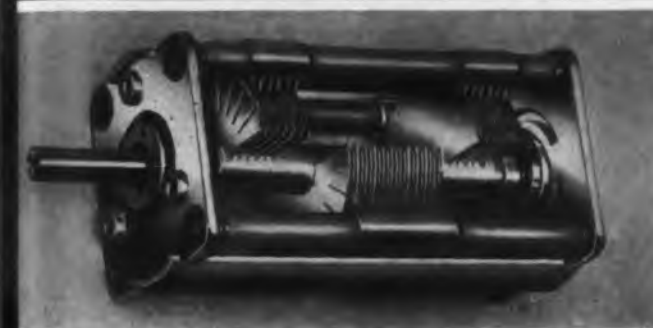
BRADY PERMA-CODE WIRE MARKERS

- For any wire, any temperature, any application.
- Tell which wire goes where—for less than 1/8¢ per lead.
- Self-sticking — go on fast.
- Insure proper installation of your electrical system.
- Reduce down-time for repair or trouble-shooting
- 1 1/2" and 3/4" lengths stocked by distributors in 160 cities.
- Over 2000 stock markers plus NEMA codes for immediate delivery.

Write for FREE SAMPLES you can use!

W.H. BRADY CO. 787 W. Glendale Ave., Milwaukee 9, Wis.
Established 1914

CIRCLE 305 ON READER-SERVICE CARD FOR MORE INFORMATION



Johanson Scanning Capacitor #1741 features rugged instrument quality

- Capacity variation SLC 7.5 mmf. to 128 mmf.
- Dynamically balanced rotor designed to operate at 1800 r.p.m. with no vibrational problem
- Pink alumina ceramic rods for rotor and stator insulation
- Split stators — no wiping contacts
- Rugged metal-frame construction — stainless steel ball bearings
- Silver plated for high Q
- Ideal for use in sweeping and scanning circuits.

Write for complete information

Johanson MANUFACTURING CORP.
16 Rockaway Valley Rd., Boonton, N. J.

CIRCLE 306 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Sine-Cosine Potentiometer Two Voltage Outputs



The model C-300, a three-inch enclosed sine-cosine function potentiometer, has two separate voltage outputs. Independent brush contacts are mounted on a common shaft 90 degrees apart to produce sine and cosine voltages. Function accuracies of 1 per cent are standard; function angle is 360 degrees. Either sleeve or ball bearings can be supplied in one piece machined aluminum housings. Mounting designs include servo, three hole with central pilot, or threaded bushing. Multiple ganged units are available with sections in simultaneous or other conformity.

DeJur-Amsco Corp., Dept. ED, 45-01 Northern Blvd., Long Island City 1, N.Y.

Radio Engineering Show, Booth 3911-3913.

CIRCLE 307 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Frequency Meters 0.1 per cent accuracy



The frequency meter assembly is composed of a 3 in. D'Arsonval movement and an accessory box, both components built to conform to applicable military specifications. It can be mounted on control or instrument panels. An accuracy of 0.1 per cent of input frequency is provided at a constant ambient temperature, with input voltages of 120 v \pm 35 per cent.

All PFM models are available with temperature control to operate in ambient temperatures of -55 C to +55 C. The dimensions of the accessory box for a 400 cycle unit are approximately 1-1/2 in. x 2 in. x 3 in. Power consumption is 1 w with intermittent values of 20 w in temperature controlled models.

American Machine & Foundry Co., Dept. ED, 1101 No. Royal St., Alexandria, Va.
Radio Engineering Show, Booth 1506-1508.

CIRCLE 308 ON READER-SERVICE CARD FOR MORE INFORMATION

HERMASEAL . . . Specialists in Glass-to-Metal Seals!

Hermaseal

CALL US ON STANDARD AND SPECIAL TERMINALS.

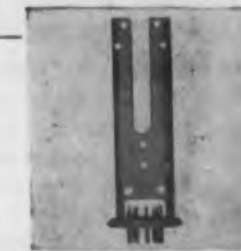
Hermaseal OCTAL Plug. ▶



Hermaseal

. . . A successful pioneer since 1943 in glass-to-metal seals, compression (cold rolled steel) and matched (Kovar), to meet your needs.

Hermaseal NOVAL Header and Bracket Assembly. ▶



Hermaseal

. . . with its expert engineering staff and the latest in production equipment is ready to serve you.

Hermaseal 10M Volt TERMINAL. ▶



For further information, phone 2-3773 or write.



THE HERMASEAL COMPANY, INC.
1010 N. Main, Elkhart, Indiana

CIRCLE 309 ON READER-SERVICE CARD FOR MORE INFORMATION

Terminal Connecting Strips For Faster, Better Wiring Of Multiple Connections To Terminal Blocks



Showing No. 650 Strip connected (but not wired) to our No. 600 Terminal Block

Made of laminated phenolic: Black XP and Natural XXXP
Lugs are of .031 thick brass. Hot-tinned for easy soldering.

Here is a practical device to simplify wiring work and to assure correct connections. Cable is attached at either end of strip with clamp. Each wire is soldered to terminal lug at raised nib. Pointed ends are clamped over insulation, holding wire fast. Work can be done at bench, or anywhere. Connect to matching terminal block by sliding spade-type lugs under binder screws and tightening. Lugs are double eyeletted and fit snugly between high barriers, so cannot shift. Uprturned ends of lugs act as extra 'lock'. Supplied flat, or with 90° angle (A), with cable mounting hole at left (L) or right (R) of strip.

For further information contact our Engineering Department

REQUEST CATALOG

KULKA ELECTRIC MFG. CO., Inc.

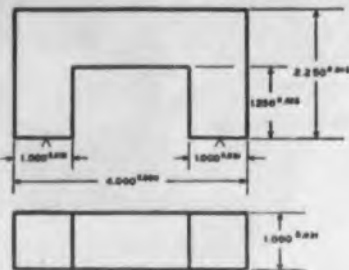
633 - 643 SOUTH FULTON AVENUE • MOUNT VERNON, N. Y.

Manufacturers of Electrical Wiring Devices

See Our Exhibit, 2nd Floor, I.R.E. Booth No. 2901

CIRCLE 113 ON READER-SERVICE CARD FOR MORE INFORMATION

HIGHER EFFICIENCY H-F POWER TRANSFORMERS



THIS IS A TYPICAL FERROXCUBE
MAGNETIC CORE DESIGN

Smaller, lighter and less costly H-F power transformers of outstanding efficiency are being designed around Ferroxcube magnetic cores. The unique advantages of Ferroxcube are particularly marked in transformers required to handle up to 2 kilowatts of power in the frequency range from 2 kilocycles to 2 megacycles.

Ferroxcube-cored transformers are being used successfully in ap-

plications as diverse as ultrasonic power generators and rectifier power packs operating from an aircraft's normal a-c supply. In the latter application, the low leakage field of Ferroxcube eliminates the need for external shielding — for further reduction in transformer size and weight.

Ferroxcube cores are designed and produced to specifications. Our engineering department offers a complete, prompt service to assist in the design of Ferroxcube cores for specific applications. Your inquiry will receive immediate attention. ★ ★ ★ ★ ★



FERROXCUBE CORPORATION OF AMERICA

• A Joint Affiliate of Sprague Electric Co. and Philips Industries, Managed by Sprague •

347 BRIDGE STREET • SAUGERTIES, NEW YORK

CIRCLE 310 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW Militarized Variac

350 to 1200 cycle
20 Ampere

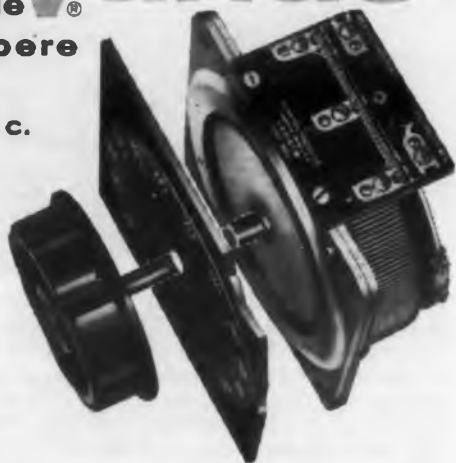
Input: 115 v.,
350-1200 c.

Load Rating:
3.0 kva

Output Voltage:
0-115 or
0-135

Rated Current:
20 a.

Maximum Current:
26 a.



Manufactured to conform with rigid military specifications for shock, vibration, salt spray and tropicalization.

Type **M20 VARIAC** (uncased): \$48.00

Available also in 2-gang and 3-gang uncased models for \$107.00 and \$155.

GENERAL RADIO Company

275 Massachusetts Avenue, Cambridge 39, Massachusetts, U.S.A.

Broad Avenue at Linden, Ridgefield, N. J. NEW YORK AREA 920 S. Michigan Ave. CHICAGO 8
8055 13th St. Silver Spring, Md. WASHINGTON, D. C. 1150 York Road, Abington, Pa. PHILADELPHIA
1000 R. Seward St. LOS ANGELES 38 1162 Los Altos Ave., Los Altos, Calif. SAN FRANCISCO

CIRCLE 311 ON READER-SERVICE CARD FOR MORE INFORMATION

A NEW DIMENSION IN DESIGN MATERIAL...

PRECISION BORE GLASS TUBING

Wilmad Offers Unheard-Of Accuracy and Low Cost

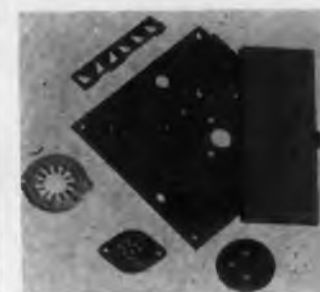
Design Engineers are constantly searching for new materials to reduce costs and improve performance. Wilmad has helped make glass a "new" material by producing precision bore tubing of uniform accuracy with amazing tolerance limits. Wilmad Precision Bore Tubing can be used in making product components, instrument assemblies or sub-assemblies, wave guide tubes, manometers, rotameters, viscosimeters, barometers, McLeod gauges, dilatometers, burettes, dash pots, capacitors, diodes . . . in virtually hundreds of precision applications in industry.

Learn how precision bore glass tubing can improve your product. Let our engineers help you determine how Wilmad Glass Tubing can solve your design problems.

Write for our new bulletin on Precision Bore Tubing.

WILMAD GLASS CO., INC.
Landsville, New Jersey

CIRCLE 312 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Printed Circuit
Laminate

Withstands Solvents

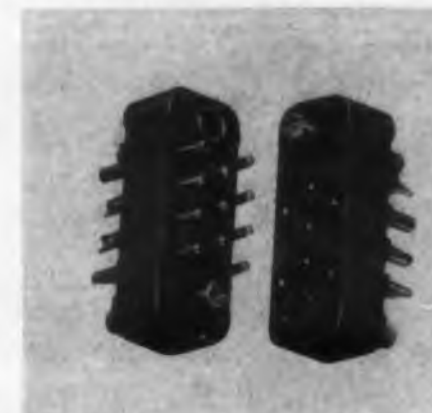
A new, low cost, paper-based laminate, Textolite 11572, is a printed-circuit laminate capable of withstanding common degreasing solvents. Exposure to trichloroethylene vapors for 15 minutes creates no deleterious effects on the laminate. It has an insulation resistance of 100,000 megohms after 96 hours at a relative humidity of 96 per cent. This material meets the standards for XXX-P and the property requirements of MIL-P-3115-PBE-P. 11572 can be cold-punched in thicknesses to 1/8 in.

General Electric Co., Dept. ED, Chemical & Metallurgical Div., Coshocton, Ohio.

Radio Engineering Show, Booth 2904-2932.

CIRCLE 313 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Miniature Connectors
Floating Contacts



The Series 22 precision Continental Connectors are suited for aircraft and instrumentation. The contact connector has an over-all length of 0.78 in. width, 0.27 in.; mounting dimensions center center on mounting studs, 0.532 in.

Polarization is positive with a reversed guide pin and guide socket made of stainless steel. Floating contacts insure positive self-alignment of each contact. Machined phosphor bronze contacts are gold plated over silver for low contact resistance and soldering ease.

Micro-Miniature Series 22 is available in 7, 11, 14, 20, 26, 29 and 34 contacts, with or without aluminum hoods.

DeJur-Amsco Corp., Dept. ED, Electronic Sales Div., 45-01 Northern Blvd., Long Island City 1, N.Y.
Radio Engineering Show, Booth 3911-3913.

CIRCLE 314 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Tube Shield Mount For Miniature Tubes

This heat-dissipating tube shield mount cools miniature tubes. It is available in all sizes of 7- and 9-pin electron tubes. The shield features a silver or copper wrap-around for glass bulb. A special beryllium-copper spring clip provides maximum retention; design of the right-angle mounting bracket assures proper alignment between tube and socket. A copper slug provides maximum contact and heat conductivity between shield, base and chassis. Tube life and reliability are increased accordingly. Electrostatic shielding is excellent. The right angle design permits the socket to be oriented to any of four positions, allowing greater flexibility in layout and design and a wider variety of solutions to problems of component crowding.

International Electronic Research Corp., Dept. ED, 145 W. Magnolia Rd., Burbank, Calif.

Radio Engineering Show, Booth 3704.

CIRCLE 315 ON READER-SERVICE CARD

Insulating Tapes Eight Colors

Using a special coloring technique developed in the Russell laboratories, these tapes are available in black, orange, blue, yellow, red, green, brown and white. Choice of colors makes it possible for user to select readily identifiable colors to simplify assembly and maintenance.

Woven of continuous filament glass fibers, these Rusco glass electrical insulating tapes have high tensile strength, dimensional stability and resistance to deterioration. They can be used as coil wrappers, protective coverings, conductor insulating and mechanical reinforcements.

Inorganic and fireproof, these glass insulating tapes are suited to applications where high ambient heat is developed or where high internal temperatures are encountered. In addition their stretch-proof and shrink-proof qualities insure permanent, tight wrappings which stay in place.

The Russell Mfg. Co., Dept. ED, 10 E. Main St., Middletown, Conn.

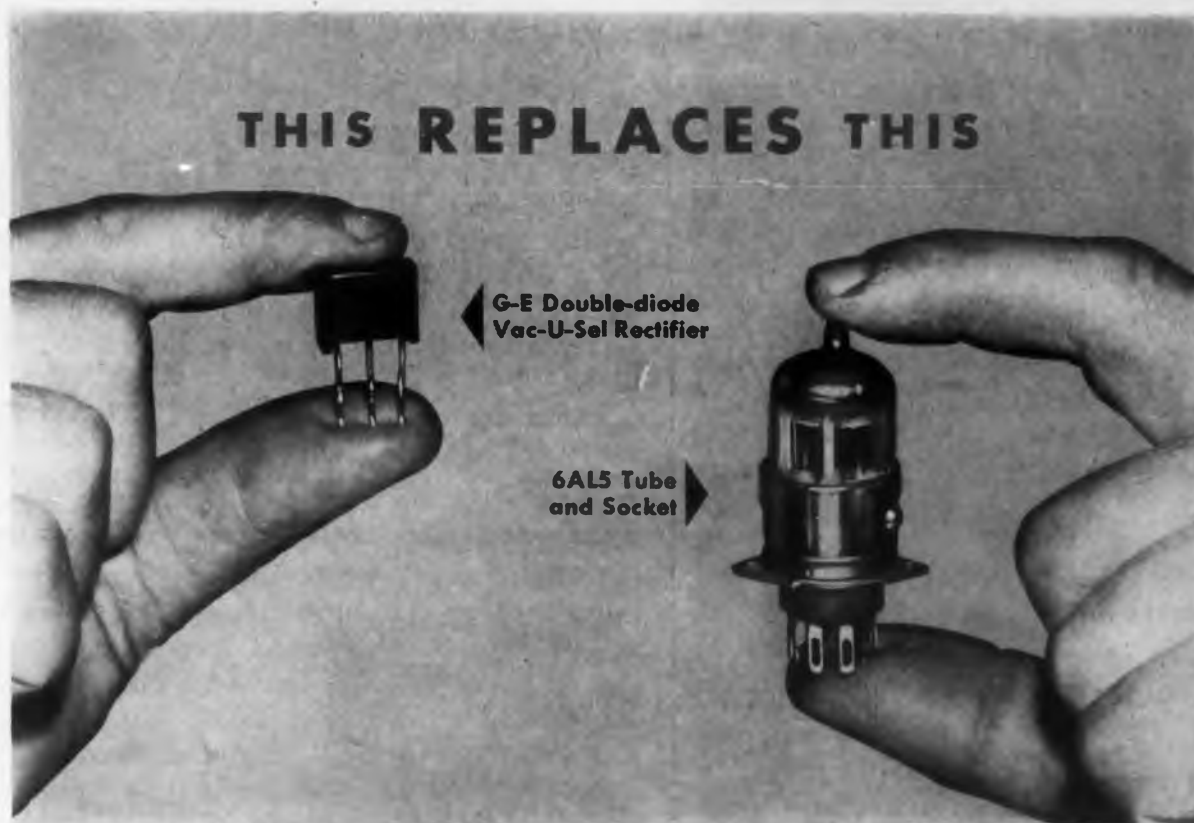
CIRCLE 316 ON READER-SERVICE CARD

NEW ...

General Electric Double-diode

Vac-U-Sel* Rectifier

Cuts Costs as Much as 35%



With a few minor modifications in most basic circuits General Electric's new double-diode Vac-U-Sel rectifier can replace the heavier, larger, 6AL5 tube and socket. Cost of the new Vac-U-Sel rectifier to you may be only about 65% that of a tube and socket.

Although designed for a wide range of uses, the new General Electric Vac-U-Sel double-diode rectifier is ideally suited for use as a TV horizontal-phase-detector diode. Other outstanding features include:

- longer life
- breakage-resistant
- low cell capacitance
- no filament power required

Sealed firmly in a durable, moisture-resistant housing the new General Electric Vac-U-Sel selenium rectifier is designed to be automatically assembled by machine. Longer leads are available for hand assembly in conventional chassis. Units consist of two single cells which may be either common cathode or plate-to-cathode connected.

SEE THIS GENERAL ELECTRIC VAC-U-SEL DOUBLE-DIODE RECTIFIER ... INSTALL IT ... OBSERVE FIRST HAND ITS HIGH PERFORMANCE ... WRITE TODAY FOR A FREE PRODUCT SAMPLE.

*Reg. trade-mark of the General Electric Co.

Progress Is Our Most Important Product

GENERAL ELECTRIC

CIRCLE 317 ON READER-SERVICE CARD FOR MORE INFORMATION

FREE RECTIFIER for trial installation

To:
General Electric Company
Section B461-45
Schenectady 5, N. Y.

Gentlemen:

Please send me free of charge one new General Electric Vac-U-Sel double-diode rectifier.

NAME _____
COMPANY _____
ADDRESS _____
CITY _____ STATE _____



HERE'S THE RELAY
THEY'RE TALKING ABOUT

ELGIN'S NEOMITE

Designers are excited about the unique advantages of Elgin's new **NEOMITE** Relay. It's the world's smallest, weighing just .09 ounces, and requires only 100 milliwatts of power to open and close electrical circuits. *There's nothing like it for size or performance . . . and now they're available from leading distributors.*



ACTUAL SIZE
only 0.392" x 0.195"
x 0.530" high

SPECIFICATIONS

Relay Type	NMIC 50	NMIC 200	NMIC 500	NMIC 1K	NMIC 2K
D. C. Coil Resistance ($\pm 10\%$ @ 20°C)	50 Ohms	200 Ohms	500 Ohms	1000 Ohms	2000 Ohms
Coil Voltage Pickup					
	3-5 V.D.C.	6-10 V.D.C.	9-15 V.D.C.	12-21 V.D.C.	18-30 V.D.C.
	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

Shock: Shock test: 50 G. without damage
Vibration: 10 G to 500 cps
Contact Arrangement: SPDT Form C
Ambient Temperature Range: -55°C to $+85^{\circ}\text{C}$
Life: 1,000,000 operations at rated load
Contact Resistance: .05 Ohms

YOU'LL FIND WHAT YOU WANT IN ELGIN'S ADVANCE RELAY LINE



. . . it's the most complete line of relays to meet almost every need. And they're available from stock at leading distributors all over the country. Write today for catalog information.



ELECTRONICS DIVISION
ELGIN NATIONAL WATCH COMPANY
Elgin, Illinois

CIRCLE 318 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Compact Magnetic Amplifier 2-36 V, 15 Amp



Designated Model MR532-15A, this tubeless unit, containing no moving parts, has a d-c output of 2 to 36 v, an a-c input of 105-125 v, 1 ph 60 cps, and a ripple content of 1 per cent, rms. Voltage regulation is ± 0.5 per cent between 5 and 32 v, ± 2 per cent between 2 and 5 and between 32 and 36 v. Response time ranges from 0.1 to 0.2 seconds, maximum. The amplifier weighs approximately 110 lb, mounted in its cabinet; and in rack panel construction measures 19 in. wide x 15 in. deep x 12-1/4 in. high.

Perkin Engineering Corp., Dept. ED, 345 Kansas St., El Segundo, Calif.

Radio Engineering Show, Booth 3711-3713.

CIRCLE 319 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Oscilloscope Enclosure

Mounts Large-Size
Scopes

Illustrating the versatility of modular construction and its lower costs, this "deep scope enclosure" is capable of housing many of the larger oscilloscopes now available. It consists of two major parts, the main element vertical frame, designated F31, and the turret, designated FT21. Combined, they provide a means of mounting many of the largest oscilloscopes for instrumentation work, and afford a variety of other enclosure possibilities. The complete enclosure measures 40 in. high, with a minimum depth of 25 in. at the top and a maximum depth of 32 in. at the bottom of the enclosure face. The turret panel opening is 21 in. high, with a slope of 20 deg.

Amco Engineering Co., Dept. ED, 733 West Ainslie St., Chicago 31, Ill.

Radio Engineering Show, Booth 4122.

CIRCLE 320 ON READER-SERVICE CARD FOR MORE INFORMATION



**LACING
TAPES**
lace
harnesses
securely,
permanently,
with no
slipping,
with no
gloves,
with no
trouble.

Gudebrod flat braided lacing tapes hold harness securely—no bite-through or slip, yet are easy on the hands. Some resist high temperature, some are color-coded . . . and they come wax-coated or wax-free . . . rubber-coated . . . or with special coating. Gudebrod makes many tapes for many purposes, including defense work. Send us your lacing problems or your specifications . . . we can supply the answer to both.

**GUDELACE • GUDE-NYLACE
GUDELACE H • TEFLACE**

GUDEBROD BROS. SILK CO., INC.
ELECTRONICS DIVISION
225 W. 34th St., New York 1, N. Y.

EXECUTIVE OFFICES
12 South 12th St., Philadelphia 7, Pa.
Visit Gudebrod Booth No. 4025
on the 4th Floor
at the I.R.E. Show

CIRCLE 321 ON READER-SERVICE CARD

NEW

AT BOOTH 1424 IRE SHOW
ALI VTVM TYPE 810



Featuring:

- Balanced amplifier for high stability
- 700 mc high frequency probe — smallest in the industry
- Voltage regulator provides stable dc for ohmmeter, minimizing line voltage effects
- High loop gain in the amplifier and total feedback assure long-time accuracy and nullify tube parameter variations
- Balancing diode used to match characteristics of probe, adding further stability

This VTVM, a new presentation from Acton Laboratories, provides circuit improvements and techniques which combine to give stable characteristics and long-time accuracy. The mechanical design provides an instrument of convenient size, and a miniature thermionic diode probe. Color coded meter scales, properly grouped, provides exceptional readability on all ranges.

SPECIFICATIONS

Voltage Ranges:

DC — Full scale ranges 1-3-10-30-100-300-1000 Volts (Plus and Minus)

AC — Full scale ranges 1-3-10-30-100-300 Volts (RMS)

Resistance Ranges:

0.2 — 500 ohms scale; multipliers, X1, X10, X100, X1K, X10K, X100K, X1M

Accuracy:

DC: $\pm 2\%$ AC: $\pm 3\%$

Frequency Response:

± 1 db; 10 cps to 700 mc

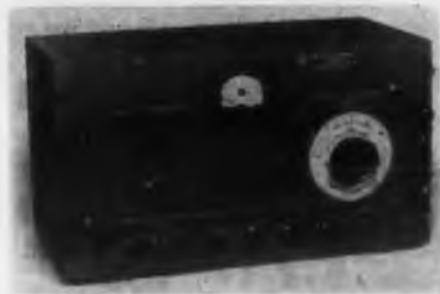
Write ALI for complete technical information — published in Laboratory Report, Vol. II, No. 1.

This instrument, and other ALI products, can be seen at the IRE Show, Booth 1424

Acton Laboratories, Inc.
553 MAIN STREET, ACTON, MASS.

CIRCLE 323 ON READER-SERVICE CARD

△ Precision Phase Detector
To 1% or 0.1 Degree



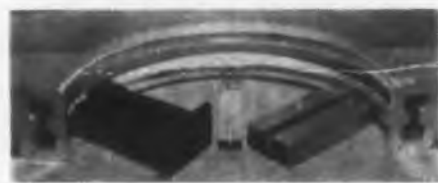
This instrument measures time delay or phase angle at high frequencies with error of less than 1 per cent or 0.1 degree. It is recommended for high frequency precision work, as for example with color TV circuits. Designated Type 205A, the instrument consists essentially of two amplifier stages, two step-variable delay lines, a continuously variable delay line, a differential tuned amplifier, a balanced phase detector, and a sensitive output indicator. The continuously variable delay line and the step-variable delay lines are used to delay input signals until the reading on the output phase indicator shows zero or minimum.

Specifications are: resolution time, 8×10^{-11} or smaller; smallest readable phase angle approximately equal to $8 \times 10^{-11} \times 360 \times$ frequency in cps; frequency range 100 kc to 15 mc. Time delay of the continuously variable delay line is from 0 to 0.1 microsecond; the step-variable delay lines have a total time delay of 11 microseconds in steps of 0.1 microsecond each. Indicator sensitivity is approximately 0.01 v full scale maximum without probe; 0.1 v with probe.

Advance Electronics Lab, Inc., Dept. ED, 249 Terhune Ave., Passaic, N. J.
Radio Engineering Show, Booth 3412.

CIRCLE 324 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Double Ridge Waveguide
2 to 5 KMC



A double ridge waveguide, designated D-37, this unit has a maximum loss of only 0.04 db/ft. It is available, with components for the 2 to 5 kmc range, in both rigid and flexible models. Components include rigid bends and twists, and waveguide-to-coax adapters, which can be used with Type N, Type C or Type LC coax connectors. The photo shows a 4.75 to 11 kmc double ridged guide.

Technicraft Laboratories, Dept. ED, Thomaston-Waterbury Road, Thomaston, Conn.
Radio Engineering Show, Booth 3810.

CIRCLE 325 ON READER-SERVICE CARD FOR MORE INFORMATION



RAYONIC CATHODE RAY TUBES

By The Pioneer of Compact Oscilloscopes

High Performance in Small Space

Waterman's demand for peak performance in its wide range of oscilloscopes has resulted in design of the RAYONIC Cathode Ray Tubes to meet new high standards of efficiency and reliability. Modern air-conditioned laboratories and assembly lines permit rigid quality controls which assure, consistently, the finest tubes obtainable—now available to you!

Listed below in tabular form are the tubes normally maintained in stock by Waterman. Included in the chart are the characteristics which most concern the design engineer. All of these tubes are available in P1, P2, P7 and P11 phosphors. Further detailed information will be supplied on your request. Waterman Products Company is a JAN approved source for 3JP1, 3JP2, 3JP7, 3RP1, 3SP1 and 3XP1 tubes. The Waterman experience and facilities which have solved many complex problems related to cathode ray tubes are always available to meet new challenges. Send us yours!

TUBE	PHYSICAL DATA		STATIC VOLTAGE		DEFLECTION*		LIGHT OUTPUT**
	FACE	LENGTH	A3	A1	VERT	HOB	
3JP1	3"	10"	3000	1500	151	120	40
3MP1	3"	8"		750	99	104	4
3RP1	3"	9.12"		1000	61	66	5
3SP1	1.5x3"	9.12"		1000	61	66	5
3XP1	1.5x3"	8.875"		2000	33	60	22

*Deflection in units per inch
**Light output of a line in millifoot lamberts per millimeter of line width not to exceed .45mm

BOOTH NOS. 1902-1904

WATERMAN PRODUCTS CO., INC.
PHILADELPHIA 25, PA. CABLE ADDRESS: POKETSCOPE

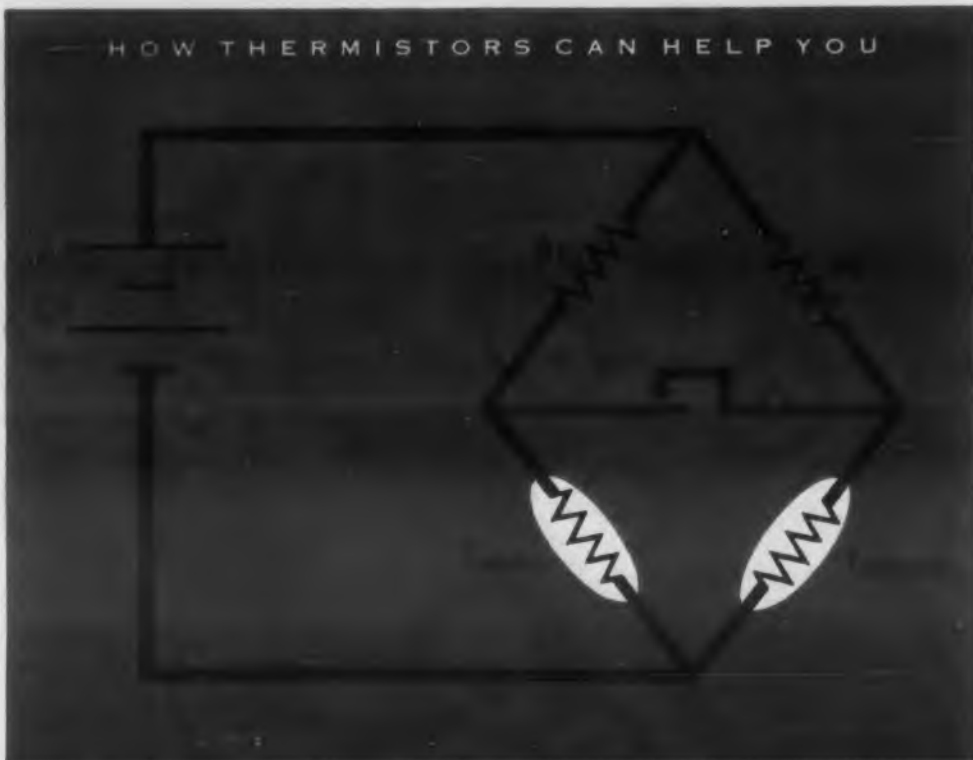
MANUFACTURERS OF

PANELSCOPE*
PANELPACK*
POCKETSCOPE*
PULSESCOPE*
RAKSCOPE*

... And Other Associated Equipment
*Registered Trade Marks



CIRCLE 326 ON READER-SERVICE CARD FOR MORE INFORMATION



BEAD THERMISTOR
35 TIMES ACTUAL SIZE

detecting liquid levels with GLENNITE® thermistors

Engineers have discovered that versatile thermistors offer a unique, trouble-free method of determining liquid levels for many fluids. Accurate, instantaneous and dependable readings are obtained with only simple associated equipment.

GLENNITE Self-Heated Bead Thermistors, $T_{sensing}$ and $T_{reference}$ are used to regulate the balance in the bridge shown in the schematic above. When surrounding medium of the $T_{sensing}$ Thermistor is changed, its resistance is changed and the subsequent bridge imbalance activates a relay whose resultant signal can be transmitted to a readout or feedback device.

Liquid level detection is only one of many applications possible for GLENNITE Thermistors. To learn about others, send for your copy of the reprint, "How to Use Thermistors." It contains valuable technical information.

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GULSTON INDUSTRIES, INC.

CONT

Small Hole Gage Set Measures Diameters



A complete set of three of these gages measures hole diameters from 0.025 in. to 0.380 in., with an accuracy of 0.0005 in. Diameter is read directly with the help of the 2-1/2 x magnifying lens. In addition to the magnified scale, the gage consists essentially of a clutch mechanism and a tapered, retractable needle. The needle is inserted in the hole to be measured, the barrel is pushed down flush with the piece being measured, and the gage removed and read. The complete set of three Kwik-Chek gages is supplied in a velvet-lined case.

Hamilton Watch Co., Allied Products Div., Dept. ED, Lancaster, Pa.

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Teflon Terminals Subminiature Size



These Teflon-insulated subminiature stand-off and feed-thru terminals have capacitances ranging from 0.35 to 0.75 μ fd with "flash-over" points of better than 500 v ac. Service ratings include 60 cps to 30,000 Mc frequencies, temperature range of -450 to +500 F. Sizes range from 0.148 to 0.218 in. diam, with 0.040 in. diam pins.

Tri-Point Plastics, Inc., Dept. ED, Electronics Div., 175-177 I. U. Willets Rd., Albertson, N.Y.

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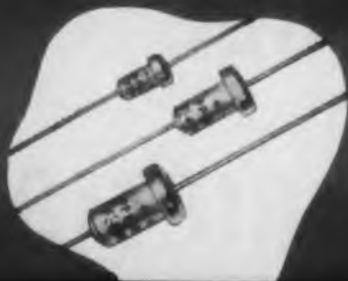
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Plug-In Relays
Ten-Amp Silver Contacts

Utilizing the standard octal plug, these relays are housed in dust-proof enclosures measuring 3-1/4 in. x 1-7/8 in. x 2 in. Coils can be supplied in all standard ac and dc voltages. Contact arrangements are available up to dpdt. Contacts are silver, rated at 10 amps 115 v ac, non-inductive. The enclosure of the LR relays carry a clearly-printed relay wiring diagram.

Line Electric Co., Dept. ED, 1407 McCarter Highway, Newark 4, N.J.

CIRCLE 334 ON READER-SERVICE CARD FOR MORE INFORMATION

Broadband D-C Amplifier
For Floating Input



Designed for use with grounded transducers, such as thermocouples and strain gages, this model 111AF d-c amplifier contains its own power supply. Frequency response is flat within 0.3 db from dc to 10 kc, down 3 db at 40 kc. Resistance between amplifier chassis and signal ground leads is greater than 100 megohms; input impedance is 100,000 ohms and output impedance less than one ohm; 10 gain settings afford choice of gain from 20 to 1000 within 1 per cent accuracy. Output drift and 60 cps noise are exceptionally low. The unit is available in single-amplifier cabinets or six-amplifier modules which fit standard 19-in. racks. By slight modification of the input circuit, the amplifier may be adapted to non-floating, normal, inputs.

Kay Lab, Dept. ED, 5725 Kearny Villa Rd., San Diego 11, Calif.

CIRCLE 335 ON READER-SERVICE CARD FOR MORE INFORMATION

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CIRCLE 338 ON READER-SERVICE CARD



**Water Bath Stirrer
And Temperature Control**

This laboratory water bath apparatus can control the temperature of an uninsulated 4-gallon water bath while simultaneously circulating 1 liter per minute to external instruments such as viscosimeters or refractometers. Its temperature control system is sensitive within ± 0.05 C. The 1-kw immersion heater is wound in the shape of a helix; the stirrer rotates inside the heating coil so that heat is effectively dissipated. The water bath is heated from room temperature to set point without excessive overshoot.

The Tempunit can be attached to a container by a rubber cushioned clamp. It weighs only 5-1/2 lb. Case dimensions are 5-1/2 in. x 4-1/2 in. x 3-1/2 in.; overall length, 10 in.

Arthur S. LaPine & Co., Dept. ED, 6001 S. Knox Ave., Chicago 29, Ill.

CIRCLE 339 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supply

For Precision Measurements



A power supply for precision laboratory measurements, the D1-100B provides two output voltages of 1 to 100 v dc each. Both are linear throughout the entire range. Output voltage is set by means of a 10-turn Multipot on which each turn is equivalent to 10 v of the outer scale. The inner dial is scaled for setting of 0.1 v increments. Current is 0 to 100 ma, with no derating necessary. Voltage regulation is 20 mv throughout the entire range. Outputs may be pulsed with square wave load without affecting normal regulation. Ripple under worst conditions is below 1.5 mv rms. The unit is of standard 7 x 19 in. relay rack construction, with a 13 in. depth.

Dressen-Barnes Corp., Dept. ED, 250 N. Vinedo Ave., Pasadena, Calif.

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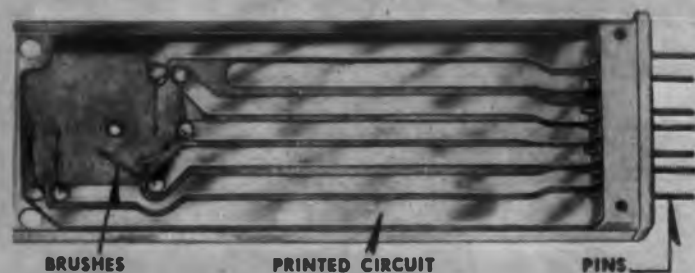
CIRCLE 341 ON READER-SERVICE CARD FOR MORE INFORMATION



New UNION

Digital Indicator

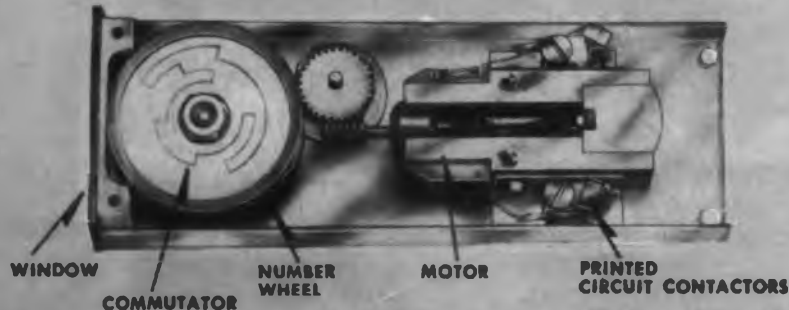
combines data readout
and storage facilities



BRUSHES

PRINTED CIRCUIT

PINS



WINDOW

COMMUTATOR

NUMBER WHEEL

MOTOR

PRINTED CIRCUIT CONTACTORS

Physical characteristics: Over-all length... $5\frac{1}{8}$ "", width... $\frac{3}{4}$ "", height... $1\frac{3}{4}$ "", weight... .7 oz., operating time at 24 volts... .0.8 sec., life expectancy... 1,000,000 operations. Character size... $\frac{3}{16}$ " x $\frac{1}{4}$ ".

The new UNION Digital Indicator will satisfy most requirements for data display, either local or remote. It is a companion product to our Alpha-Numerical Data Display Indicator, but occupies only one-half the volume and requires under three watts power.

The ability of the indicator to operate as a storage facility, a readout device, and its inherent non-dissipating storage give it characteristics not to be found in any other indicator of this type.

The indicator is motor-driven and operates on a direct wire basis in response to binary code. The coded

decimal notation was chosen for prototype to demonstrate more familiar uses, but other notations can be used.

A typical application in a pipeline remote control system works like this: Telemetered digital data on temperature and pressure is received at a central station and entered into an intermediate storage. From there it is routed to the appropriate digital indicators for visual display and electrical storage for time programmed input to a telelog printer. Each indicator can store four binary bits and eliminates the use of relays for this purpose. Write for our new Bulletin 1011.

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CIRCLE 343 ON READER-SERVICE CARD FOR MORE INFORMATION

△ High Temperature Capacitors Operate at 200 C



Resistance of 10^{13} ohms at 25 C highlights the characteristics of these capacitors. They have low leakage up to 200 C. Others of important practical interest are tolerances up to 0.1 per cent, dielectric absorption of 0.01 per cent, dissipation factor 0.02 per cent; capacitance drift of less than 0.1 per cent per year and temperature coefficient smaller than 100 ppm/deg C. The units are metal-cased and truly hermetically sealed with glass-to-metal terminals. They come in standard or special configurations, and are immediately available.

San Fernando Electric Mfg. Co., Dept. ED, 1509 First St., San Fernando, Calif.
Radio Engineering Show, Booth 2710.

CIRCLE 344 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Miniature Switch 360 Degree Rotation



Hermetically sealed, this switch, designated No. 9135, has a 360 deg rotary action with 180 deg pre-travel and 180 deg over-travel. It is available in two models, with potted leads or with pin connectors, and can either be mounted flat with four fasteners or vertically behind a retainer. Case is heavy nickel silver, qualified to withstand great shock and extreme environments. The switch operates at either 28 v dc or 110 v ac, with a 10-amp resistive, 4 amp inductive, rating. Rated life is 100,000 cycles. Dimensions are 2 in. x 1 in. x 1-3/4 in.

Haydon Switch, Inc., Dept. ED, Waterbury 20, Conn.

Radio Engineering Show, Booth 3922.

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△ **Digital Voltmeter**
Portable, Miniaturized



Operation of this instrument, which has been designated Mark IV, is completely fool-proof, needing no manual adjustments or manipulations. Measurements are made automatically. Readings are accurate to 0.05 per cent absolute, with linearity better than 0.01 per cent from a millivolt to 1000 v, dc. Balance logic positions the decimal point. Unitized packaging facilitates servicing. Readings are presented in 1-in. high numerals which can be read at distances as great as 30 feet. Dimensions are 7 in. x 10 in. x 13 in. The instrument provides a precision, general-purpose, digital voltmeter for a wide variety of laboratory and field applications.

Electro Instruments, Inc., Dept. ED, 3794 Rosecrans, San Diego, Calif.
Radio Engineering Show, Booth 3614.

CIRCLE 349 ON READER-SERVICE CARD FOR MORE INFORMATION

△ **Low-Voltage Supply**
Mag-Amp Regulated



A light weight magnetic amplifier regulated 2 to 36 v at 15 amp power supply is a tubeless unit. It has a voltage range available between 2 and 36 v and between 5 and 32 v. The Model MR532-15A has a dc output, an ac input of 105 to 125 v, 1 phase, 60 cy, Ripple is 1 percent rms. Voltage regulation is $\pm 1/2$ percent over the range of 5 to 32 v, ± 2 per cent from 2 to 5 v and 32 to 36 v. Response time is 0.1 to 0.2 sec maximum. Weight is approximately 110 lbs in cabinet.

Perkin Engineering Corp., Dept. ED, 345 Kansas St., El Segundo, Calif.
Radio Engineering Show, Booth 3711-3713.

CIRCLE 350 ON READER-SERVICE CARD FOR MORE INFORMATION

Bourns **NEW** *TRIMPOT JR.**

- micro-miniature size
- high power rating
- humidity proof

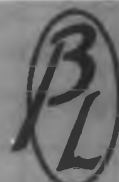
*Trade Mark



This micro-miniature potentiometer is designed for use with printed circuit boards and modular-type assemblies, and is derived from Bourns' original *TRIMPOT*.[®] The new TRIMPOT JR. is only $3/16$ " x $5/16$ " x 1" in size. Seventeen units can be mounted in one square inch of panel space. Power rating is 2 watts, and maximum operating temperature is 175°C.

The TRIMPOT JR. is built to meet or exceed government specifications for humidity, salt spray, vibration, acceleration, and shock. This potentiometer features a 15-turn screwdriver adjustment and $1\frac{1}{2}$ ", 0.016" diameter leads. The shaft-clutch assembly idles when the mechanical limits are reached, thus preventing possible damage from forcing of adjustments. The TRIMPOT JR. is mounted with 2-56 screws through stainless steel eyelets on $3/4$ " centers.

Deliveries from stock. Send for complete data: Bulletin JR.



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CIRCLE 351 ON READER-SERVICE CARD FOR MORE INFORMATION

Amplifier-Discriminator Non-Overloading



This fast discriminator circuit generates a pulse whenever the built-in amplifier produces a signal which exceeds the preset discriminator bias. The discriminator bias is set manually by means of a ten-turn potentiometer calibrated directly in volts. The discriminator output is a positive pulse of 0.35 microseconds base width, 15 v amplitude.

The amplifier, which is excited by an input of either positive or negative polarity, has a gain of 9000. Its output consists of positive pulses of 100 v maximum amplitude, RC-shaped, with a base width that can be varied between 0.2 to 200 microseconds, and a rise time less than 0.2 microsecond.

The Model 155 amplifier-discriminator is recommended for high counting rate applications that require gain stability, linearity and non-overloading properties. The output from the discriminator may, for example, be fed to scintillation and proportional counters, or to coincidence circuits.

The panel, finished in gunmetal hammertone, measures 5-1/4 x 19 in. Shipping weight is 65 lb.

Beva Laboratory, Dept. ED, P. O. Box 478, Trenton 8, N. J.

CIRCLE 353 ON READER-SERVICE CARD FOR MORE INFORMATION



**Variable
Composition
Control
Has Radial
Element**

The Model R variable control uses a molded composition resistance track and employs a radial resistance element which fills the entire inner perimeter of the resistor barrel. With this design current is spread over a larger area and external cooling surface is greater. The Model R offers a 3 w standard rating; 2 w under RV4 style. This new control has a rotational life of 100,000 cycles. After MIL moisture resistance testing it will exceed the "Y" environmental characteristic, with an average change of 2 per cent. Linear, clockwise and counter clockwise tapers are available.

Reon Resistor Corp., Dept. ED, 117 Stanley Ave., Yonkers, N. Y.

CIRCLE 354 ON READER-SERVICE CARD FOR MORE INFORMATION

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To evaluate thermistor circuit applications for:

1. Temperature compensation.
2. Time delay.
3. Temperature sensing and control.

Global THERMISTORS

Test Kit No.	Type	Body Size		R at 25° C ± 20%	Nom. Temp. Coeff. "B" Constant	Max. Watt Loading at 40° C	Price
		Length	Dia.				
T-1	997F	1/4"	3/4"	40 ohms	1500	0.25	\$3.95
T-2	997F	1/4"	3/4"	220 ohms	1750	0.25	3.95
T-3	997F	1/4"	3/4"	10000 ohms	1950	0.25	3.95
T-4	763F	3/8"	1/2"	5 ohms	1200	0.5	3.70
T-5	763F	3/8"	1/2"	10 ohms	1400	0.5	3.70
T-6	763F	3/8"	1/2"	15 ohms	1500	0.5	3.70
T-7	763F	3/8"	1/2"	20 ohms	1500	0.5	3.70
T-8	763F	3/8"	1/2"	120 ohms	1700	0.5	3.70
T-9	763F	3/8"	1/2"	1000 ohms	1800	0.5	3.70
T-10	763F	3/8"	1/2"	10000 ohms	2100	0.5	3.70
T-11	763F	3/8"	1/2"	120000 ohms	2150	0.5	3.70
T-12	763F	3/8"	1/2"	330000 ohms	2150	0.5	3.70
T-13	416H	1/8"	3/8"	1200 ohms	3800	0.5	3.95
T-14	479H	1/8"	1/2"	1000 ohms	3800	1.5	3.95
T-15	373H Metallized Faces Only	1/8"	3/4" o.d. 1/4" i.d.	10 ohms	2700	3.5	4.55
T-16	373H Metallized Faces Only	1/8"	3/4" o.d. 1/4" i.d.	40 ohms	2700	3.5	4.55
T-17	343H	1/8"	3/4" o.d. 1/4" i.d.	5.5 ohms	2700	3.5	4.85
T-18	343H	1/8"	3/4" o.d. 1/4" i.d.	20 ohms	2700	3.5	4.85
T-19	549H	3/4"	3/4"	5000 ohms	3200	0.75	3.95
T-20	588H	1"	3/4"	11000 ohms	3200	1.	4.25
T-21	763H	3/8"	1/2"	500000 ohms	4600	0.5	3.95

Global THERMISTORS

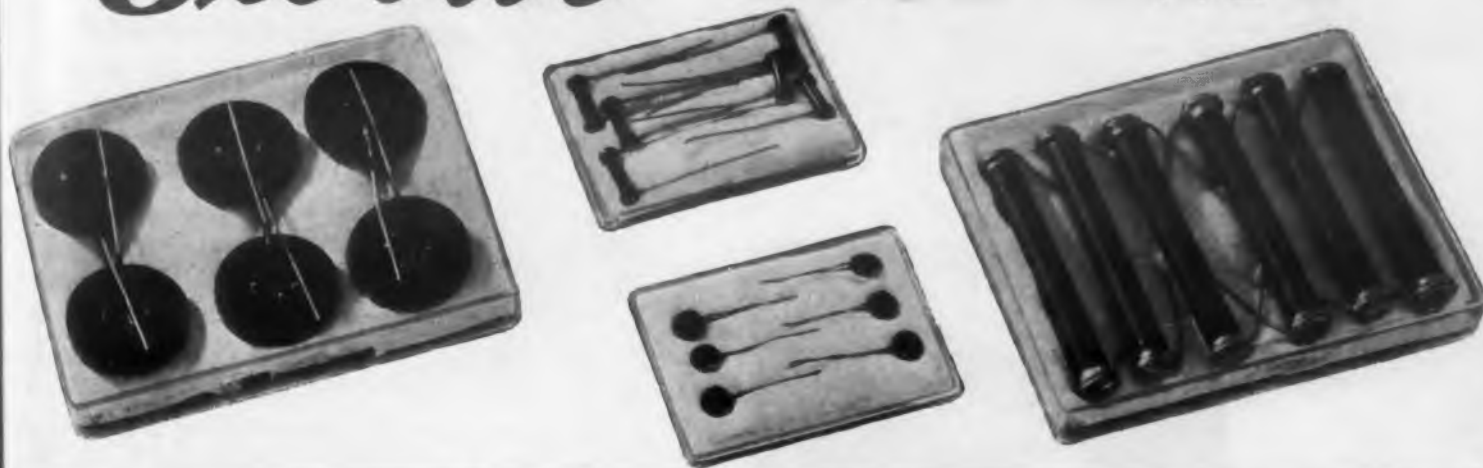
For evaluation of surge current suppression in series filament and pilot light circuits in radio and television receivers.

Test Kit No.	Type	Body Size		R at 25° C ± 30%	Nominal R at 45° C and Rated Current	Price
		Length	Dia.			
T-22	763F	3/8"	1/2"	145 ohms	40 ohms at 150 m.a.	\$3.70
T-23	759F	3/4"	1/4"	500 ohms	85 ohms at 135 m.a.	3.95
T-24	441F	1 1/8"	3/8"	880 ohms	100 ohms at 150 m.a.	4.25
T-25	341F	3/4"	3/8"	375 ohms	40 ohms at 300 m.a.	4.55
T-26	525F	1 1/8"	1/2"	250 ohms	20 ohms at 600 m.a.	4.55
T-27	327F	3 3/8"	1/2"	460 ohms	35 ohms at 600 m.a.	4.85
T-28	421F	3 3/8"	1" x 1/8" Wafer Type	125 ohms	43 ohms at 600 m.a.	5.15
T-14	479H	1/8"	1/2"	1000 ohms	50 ohms at 150 m.a.	3.95
T-17	343H	1/8"	3/4" o.d. 1/4" i.d.	5.5 ohms	.31 ohms at 3.0 amps.	4.85

selective basis...

THERMISTOR AND VARISTOR

Globar[®] TEST KITS



To evaluate varistor circuit applications for:

1. Reduction of surge voltage peaks.
2. Reduction of relay contact arcing.
3. Voltage stabilization.
4. Generation of harmonics.

Globar VARISTORS Type BNR

Test Kit No.	Type	Body Size		R ± 20% at D.C. Calibration Voltage	Max. Watt Loading at 40° C	Price
		Length	Dia.			
V-1	432BNR	1/8"	1/2"	1000 ohms at 10.5V	0.25	\$3.70
V-2	432BNR	1/8"	1/2"	25000 ohms at 10V	0.25	3.70
V-3	432BNR	1/8"	1/2"	100000 ohms at 10V	0.25	3.70
V-4	432BNR	1/8"	1/2"	1 megohm at 10V	0.25	3.70
V-5	479BNR	1/8"	1/2"	100000 ohms at 100V	0.3	3.75
V-6	328BNR	1/8"	3/4"	10000 ohms at 40V	0.5	3.85
V-7	463BNR	1/8"	1"	24000 ohms at 40V	1.	3.95
V-8	524BNR	3/8"	1 1/4"	24000 ohms at 100V	1.5	4.25
V-9	430BNR	1/4"	1 1/2"	17500 ohms at 175V	2.7	4.55

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Niagara Falls, New York

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High Power Rectifiers
For Aircraft

Available in capacities up to 1000 amps, and in dc ranges from 6 to 40 v, this line of high power rectifiers is offered as particularly suited to ground support equipment and missile testing, and in aircraft, electronic and industrial fields. The rectifying units are silicon diodes, hermetically sealed against humidity, fungus, salt spray, sand and dust. Operating temperatures are -55 C to +65 C. Response is 0.1 second, ripple 1 per cent rms, dc regulation ±0.5 per cent.

Christie Electric Corp., Dept. ED-S22, 8410 W. 67th St., Los Angeles 43, Calif.

CIRCLE 357 ON READER-SERVICE CARD FOR MORE INFORMATION

AC Millivoltmeter
Transistorized



Transistorized, this ac millivoltmeter has an input impedance of 22 megohms. Twelve full range scales provide coverage between 0.001 and 300 v ac, and between -80 to +52 dbm. Usable frequency coverage is from 1 cycle to 5 megacycles. Between 5 cycles and 1 megacycle the accuracy is ±3 per cent. Use of transistors eliminates instability resulting from temperature rise. Battery operation permits ready measurement of floating voltages and eliminates beating between line voltage fluctuations and 60 cps. The battery provides 400 hours of continuous operation. Accurate ac measurements can be made with it to 50 μv.

Fisher Research Laboratory, Inc., Dept. ED, 1961 University Ave., Palo Alto, Calif.

CIRCLE 358 ON READER-SERVICE CARD FOR MORE INFORMATION

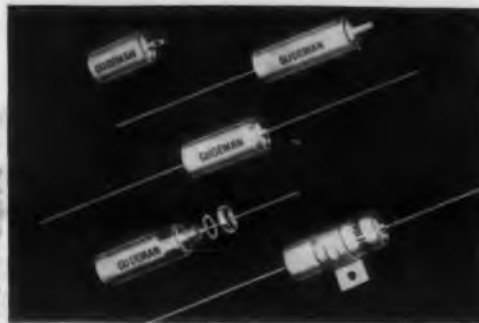
◀ CIRCLE 356 ON READER-SERVICE CARD

GUDEMAN Capacitors



Bathtub Type Military Capacitors

MIL-C-26 Types
CP53, CP54, CP55 Case Styles
Temperature Ranges:
-55°C to +85°C
-55°C to +125°C



"XC" Plastic Film Dielectric Capacitors

The development of the Gudeman "XC" capacitors provides high temperature capacitors that have exceptionally high insulation resistance, low power factor and low dielectric absorption. No voltage derating is required when used within a temperature range from -65°C to +165°C. Bathtub and rectangular case styles also are available.



Miniature Feed-Through Capacitors

The Gudeman Feed-Thru Capacitor, Types 271 and 272 is a three-terminal component designed to be used for R. F. Interference suppression in a manner similar to a low pass filter. The typical insertion loss characteristics for these Feed-Thru Capacitors when measured in a 50 ohm line are in accordance with MIL-Standard 220.



Silicon Diode Demodulator

Ruggedly Built

The Atlas electronic demodulator furnishes a dc voltage which is directly proportional to the phase and amplitude difference between an ac input voltage and an ac reference voltage. It consists of silicon diodes and miniaturized transformers enclosed in a small, hermetically sealed unit of rugged construction. Two models are available, designated ED-551 and ED-551-L. The former plugs into a standard octal socket and the latter into a 7-pin miniature socket. Both models supply a maximum dc of 10 v. Output is linear over a range of applied ac input voltage from 0 to 15 v rms. Reference voltage limits are from 0 to 25 v rms. Frequency response is flat from 60 cycles to 80 kc.

Atlas Electro-Mechanical Laboratories, Inc., Dept. ED, 14734 Arminta St., Panorama City, Calif.

CIRCLE 363 ON READER-SERVICE CARD FOR MORE INFORMATION



Military Capacitors

MIL-C-26 Types
CP70 Case Styles
Temperature Ranges:
-55°C to +85°C
-55°C to +125°C



Tubular Laminated Cardboard Capacitors

The 633 series gives extra protection in extremely high humidity applications.
Paper Dielectric: Wax or Oil Impregnated Resin End Seals
Temperature Range: -40°C to +85°C



Dry Electrolytic Capacitors

ME and Printed Circuit Types
High Purity (99.99%) Aluminum Foil
Low Leakage
Temperature Range:
-30°C to +85°C



Free Gyro Caging is Solenoid-Powered

The Model FG01-0203-1 free gyro weighs 2-1/2 lbs and measures 5-1/2 in. in length, 3 in. in diameter. It has cage indicating switches, precision potentiometers on both gimbals, and may be used with 400 cy 115 v (three-phase or single-phase), or 28 v d-c motors.

Humphrey Inc., Dept. ED, 2805 Canon St., San Diego 6, Calif.

CIRCLE 364 ON READER-SERVICE CARD FOR MORE INFORMATION

See these and other new products Booth #2227, New York Colliseum, March 18-21

Write for latest technical data

THE GUDEMAN COMPANY

Main Plant & General Offices
340 West Huron St., Chicago 10, Illinois, Dept. H 256
Mfg. Branches: Chelsea, Mich.; Sunnyvale and Monrovia, Calif.; Terryville, Conn.
Manufacturers of Electronic Components for Military and Commercial Applications.

CIRCLE 362 ON READER-SERVICE CARD FOR MORE INFORMATION

△ High Voltage Transformers

High-Temperature Operation

These miniaturized high-voltage transformers using evaporative cooling techniques include pulse, magnetron filament, plate and audio transformers. They comply with military specifications and are capable of operating in ambients from -50 to +125 deg C. Cooling is effected by high-voltage electric fluorochemical liquid which vaporizes in contact with the hot windings and then condenses on the outer surface of the transformer case. Condensation takes place in the space normally provided for the expansion of insulating liquids or gasses.

Raytheon Mfg. Co., Dept. ED, Equip. Marketing Dept., Waltham 54, Mass.

Radio Engineering Show, Booth 2611-2614.

CIRCLE 76 ON READER-SERVICE CARD

△ Synchro Data Switch Replaces Relays

This potted unit, Model DS-3, performs fine-coarse synchro switching and is suitable for all common synchro ratios and sensitivities. It measures 3/16 in. in diameter and is 29/32 in. high. This non-linear network sums fine and coarse synchro signals in such a way that the coarse signal is locked for small errors, yet overrides the fine signal for large errors to prevent false nulls.

Feedback Controls, Inc., Dept. ED, 99 Main St., Waltham 54, Mass.

Radio Engineering Show, Booth 3013.

CIRCLE 77 ON READER-SERVICE CARD

Long Lived Test Point Jack One-piece Beryllium-Copper

Utilizing fatigue-resistant beryllium-copper, a new test point jack for the standard 0.080 in. test prod has an indefinitely long life. A solid beryllium-copper rod is machined into a one-piece metal insert with a four-leaf contact at one end and terminal lug at the other. This is heat-treated, gold-plated, and inserted into a teflon insulator body. The jack thus formed, holds firmly against a 2 oz pull any insertion having a diameter between 0.077 in. and 0.083 in. Insertion and withdrawal characteristics are very smooth. Type SKT-10 conforms to MIL-S-28A. For eye appeal or color-coding, it is available in any of the eight RETMA colors.

Sealectro Corp., Dept. ED, 610 Fayette Ave., Mamaroneck, N.Y.

I.R.E. Show, Booths 3806-3808

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International Rectifier

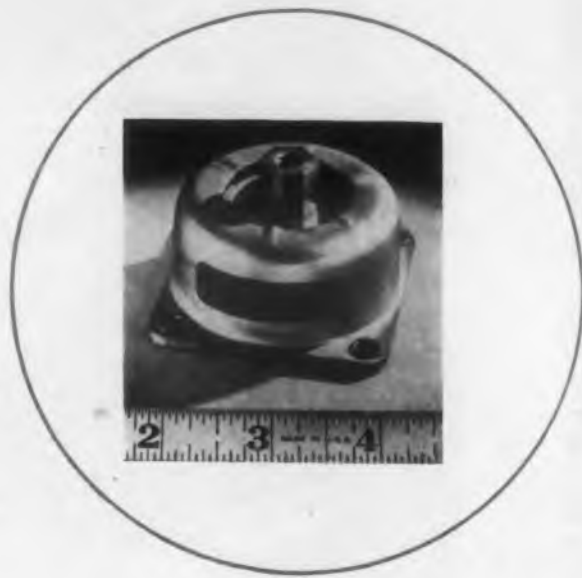
C O R P O R A T I O N

EXECUTIVE OFFICES: EL SEGUNDO, CALIFORNIA • PHONE OREGON 8-6281

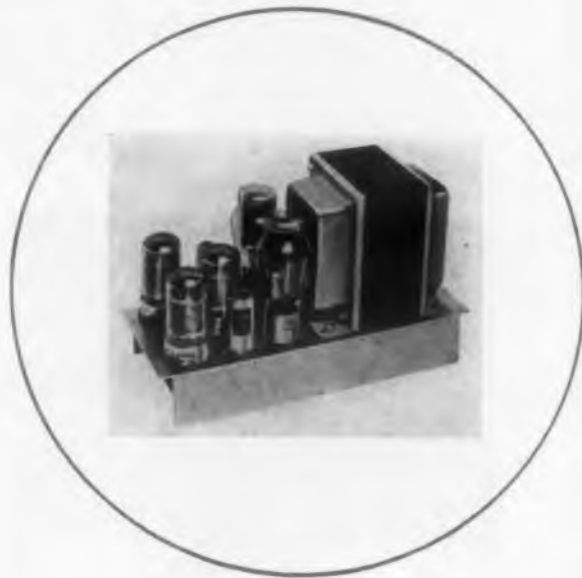
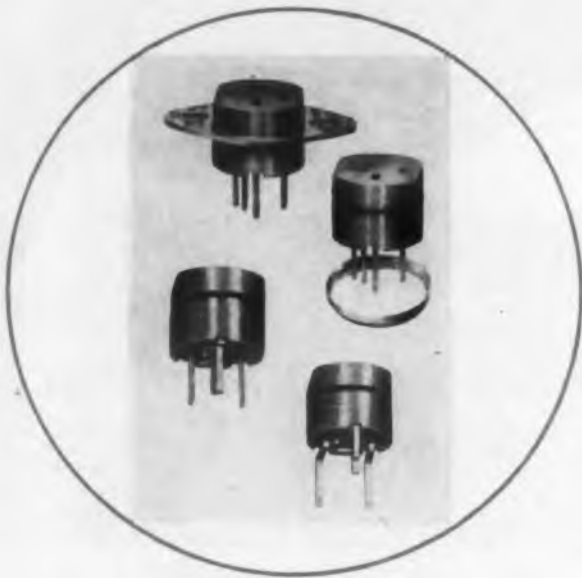
NEW YORK: 132 E. 70TH ST., TRAFALGAR 9-3330 • CHICAGO, 206 W. WACKER DR., FRANKLIN 2-3689

IN CANADA: ATLAS RADIO CORP., LTD., 80 WINGOLD AVE. W., TORONTO, ONTARIO, RU 1-6174

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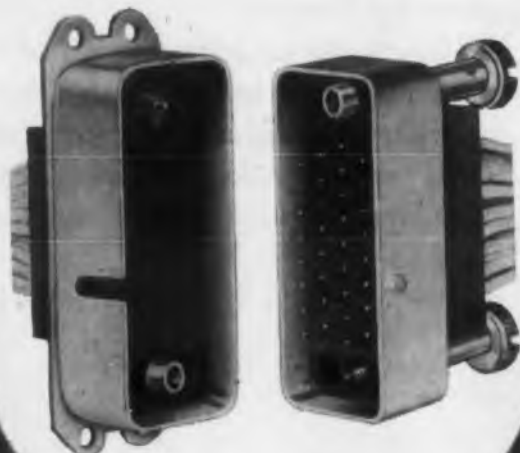
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CIRCLE 371 ON READER-SERVICE CARD FOR MORE INFORMATION

Reference Voltage Supply

Stability 0.2 Per Cent



Supplied as a plug-in unit mounted on a standard 8-pin octal socket, this voltage supply unit is operated by 60-400 cps 115 v ac, and delivers a d-c reference level adjustable from 0 to approximately 87 v. With any load not exceeding 1 ma, with line voltage changes between 90 to 135 v, and through the temperature range -50°C to $+40^{\circ}\text{C}$, the output stability is better than 0.2 per cent. Design is simple and construction encapsulated. Uses include supplying reference potential for d-c motor and servo systems, replacement of standard wet or dry cells, and replacement of more extensive electronic regulatory systems.

Servo-Tek Products Co., Dept. ED, 1086 Goffle Rd., Hawthorne, N. J.

CIRCLE 372 ON READER-SERVICE CARD FOR MORE INFORMATION

Fractional HP Motors

6v to 220 v AC or DC



Available with universal, shunt or permanent magnet fields a group of 1/30th hp motors constitute the latest addition to Rae Motor Corp.'s line. The permanent magnet motor is designated M-100; the wire-wound fields are in motors designated M-20. The latter can be supplied for voltages from 6 to 220, ac or dc. All of these newly-announced motors are supplied either ventilated or enclosed, and with either ball or sleeve bearings, as desired. All have a maximum hp rating of 1/30th, shaft diameter of 5/16 in., and weigh approximately 2 lb. The same manufacturer's G-11A gear reducer was designed specifically for these motors.

Rae Motor Corp., Dept. ED, 2009 Kewanee St., Racine, Wis.

CIRCLE 373 ON READER-SERVICE CARD FOR MORE INFORMATION

An Engineer
Speaks Out...

Announcing the New 0.005 to 100.0 cps Model F Servoscope®



Now the complete Servoscope line meets almost all frequency requirements for evaluating servosystems and components with the

addition of the new Model F. The convenience of wide frequency coverage is featured in one Servoscope Servosystem Analyzer. The frequency range of 0.005-100.0 cps is covered in four bands: 0.005-0.1 cps; 0.05-1 cps; 0.5-10 cps; and 5-100.0 cps. The built-in electronic sweep covers the entire frequency range.

Servoscope provides a *direct* method for measuring gain and phase shifts of low frequency networks by combining a multiple signal generator, an electronic sweep generator, and calibrated phase shifter in one instrument.

This Servosystem Analyzer is easy to use. As continuously variable output signals of Servoscope are fed into the system under test, the resulting quantitative changes in phase are obtained by simply turning the direct-reading phase dial. Signal amplitude is read directly from the associated indicator.

Used in the laboratory, on the production line, and for field measurements, Servoscope is an extremely versatile test instrument. Some of its proven applications include: missile testing; automatic flight and ship control design; computer response; etc.

Theo. Westover
Chief Control Systems Engineer



Send for the full story on Servoscope Servosystem Analyzer. Just address your request on your company letterhead to Dept. WTA.



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HIGH PERFORMANCE



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**Custom-Built
 Antenna Horns**

1000 to
 40,000 Mc

Beam width antenna gain can be provided to individual specifications in a complete line of custom-built antenna horns, available in bandwidths from 1 to 40 kmc. The small horn pictured here measures 0.28 in. x 0.14 in. and is intended for short range communication, laboratory use or as a field testing device for radar.

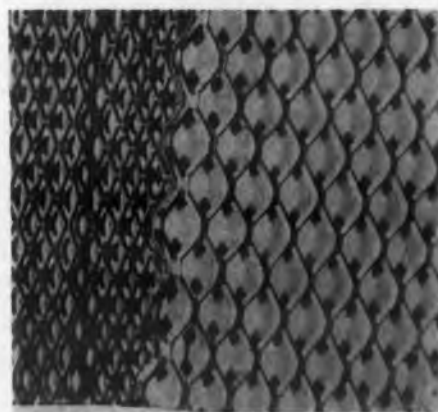
All horns can be supplied with quick disconnect for ease of installation and interchangeability. Silver brazed assembly provides high mechanical strength. Silver and rhodium are used for all electrical working surfaces to provide maximum resistance to corrosion.

J.V.M. Engineering Co., Dept. ED, 4633 Lawn-dale Ave., Lyons, Ill.

CIRCLE 377 ON READER-SERVICE CARD FOR MORE INFORMATION

Expanded Metals

Ultra Small



Aluminum, stainless steel, monel, copper, brass and other standard sheet materials can be used in forming these expanded metal sheets. The aluminum, moreover, can be supplied in any color. Among the many uses of these expanded metals are antenna dishes, electronic cabinet panels, radio or TV grilles and housings, machine guards, and the like. Openings may be as small as 1/16th in. and up to 2-1/2 in. Designations are Micromesh and Duromesh, the latter being for heavier duty. Both can be supplied either standard or flattened, as required.

Designers Metal Corp., Dept. ED, 456 E. 159 St., Harvey, Ill.

CIRCLE 378 ON READER-SERVICE CARD FOR MORE INFORMATION

From LFE's Special Products Division—
 the **ONLY OSCILLOSCOPE** with
 x-axis
 diversification
 plus
**DC to 10 mc
 bandwidth
 0.035 μ s
 rise time
 20 mv
 sensitivity**



Look how versatile! Six plug-in adapters give you all these important features:

- any sweep delay between 1 μ sec and 0.1 sec by the flip of a switch
- triggering from 0.5 to 5,000 cps
- two-signal display on separate sweeps
- markers 0.1, 1, 10, 100, 1,000, 10,000 μ sec apart spaced to 1% time accuracy . . . also functions as width gate
- triggering on composite TV video signal . . . permits triggering on any part of leading or trailing edge of any signal
- sweep speeds down to 5 s/cm

Direct-reading, continuously-variable sweep speeds, 0.1 μ s/cm to 0.1 s/cm, 5% accuracy. Timing measurement accuracy 1% with gated marker generator plug-in.

Simple operation . . . direct-reading, functionally grouped controls throughout.

Clean, brilliant trace and DC amplifier stability.

Direct-reading, continuously-variable square-wave calibrating voltage from 0.1 to 100 volts, 5% accuracy.

Versatile triggering facilities — external, internal signal, internal recurrent 500 to 5,000 cps or line voltage — trigger on leading or trailing edge of signal.

Internal trigger and sweep gate outputs, Z-Axis input for intensity modulation.

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Boston, Massachusetts

manufacturers of oscilloscopes, digital test instruments, decade scalars, delay lines, transformers, radar sets, business machines and other types of complex electronic equipment.

CIRCLE 379 ON READER-SERVICE CARD FOR MORE INFORMATION

**NEW 411A with 1401 adaptor
 Model 1400 Extended Range
 Trigger Generator not shown**

Model
 1401
 Delay
 Sweep
 Generator



Model
 1402
 Video
 Switch



Model
 1403
 Gated
 Marker
 Generator

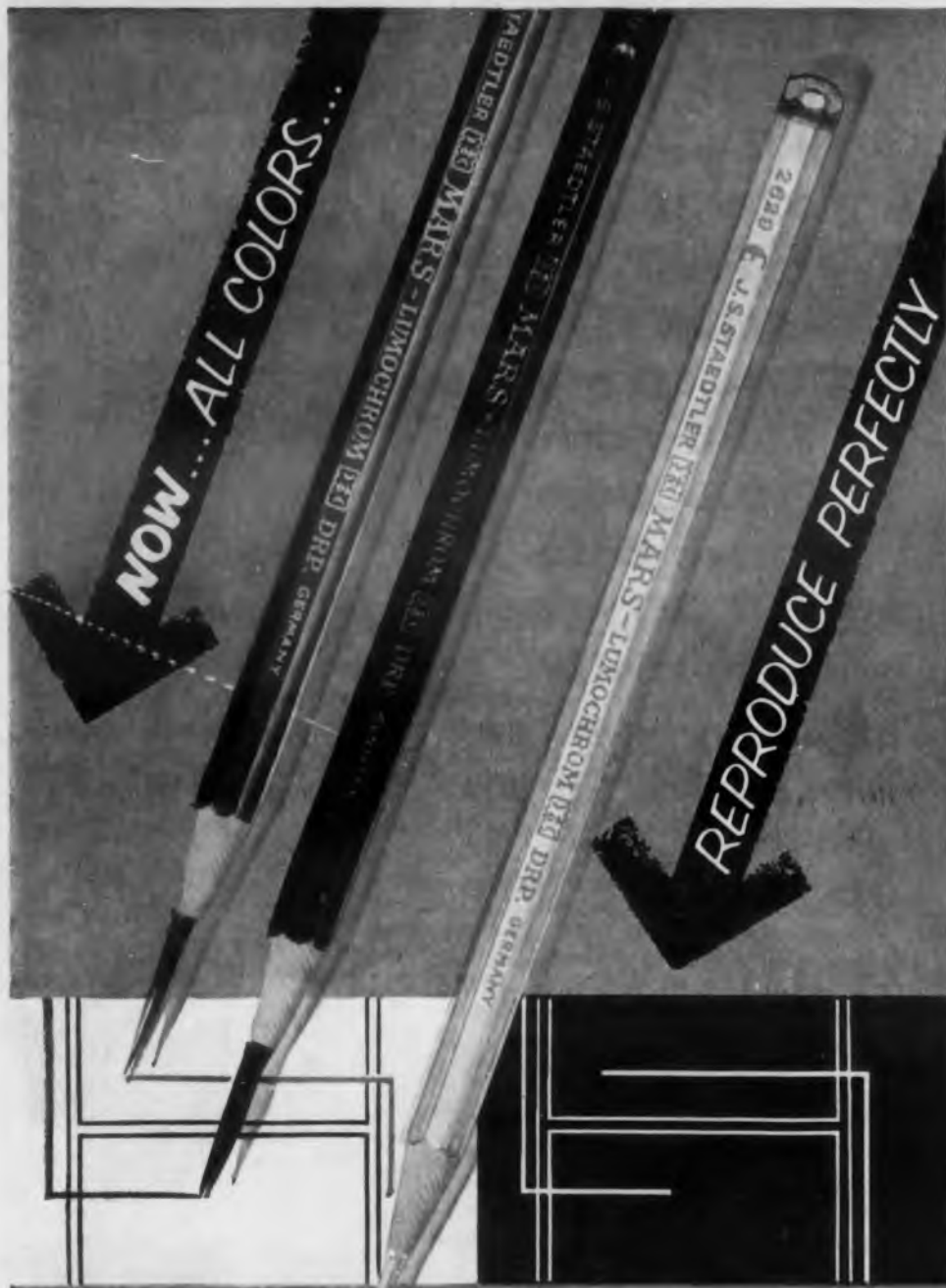


Model
 1404
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Model
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 Generator





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makes possible an important new drafting technique. It's not just a colored pencil; it's a color-drafting pencil. Twenty-four colors — and every one reproduces perfectly. Lets you draft with as many colors as you need. Saves time, prevents mistakes.

- won't fade • won't smear • really waterproof
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Send for free sample

Other new Mars products include: the Mars-Pocket-Technico for field use, the Mars "Draftsman's" Pencil Sharpener with the adjustable point-length feature, and the efficient, clean Mars lead sharpener. All available — along with the established standards: Mars-Lumograph black graphite drafting pencils, Mars-Technico lead holder and leads, and Tradition-Aquarell painting pencils — at all leading engineering and drafting supply dealers.

J.S. **S**TAEDTLER, INC. HACKENSACK, NEW JERSEY

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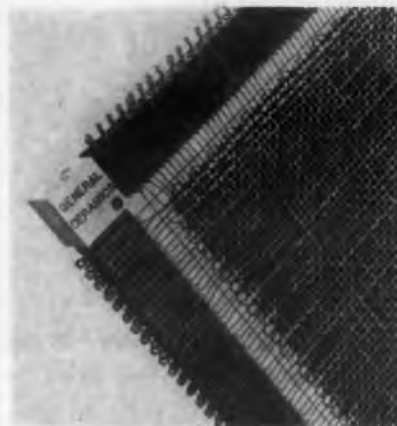


△ Plug-In Output Strip
For Counting, Read-Outs

This decade counting, 10-wire output strip is useful in computers, punch card systems and in multiple sequence pre-set counters for data processing, recording and production control. It carries the designation Model 189B. Functional construction facilitates combination with other strips to meet a great variety of instrumentation requirements. Model 189B utilizes a Dekatron cold-cathode glow transfer counting tube and associated conservatively-designed drive circuits. Maximum counting speed is 4 kc, minimum in-out requirement a 15 v positive pulse of at least 100 microseconds width. Output signal is a 30 v positive pulse; output impedance is 100 k. Power requirements are 0.5 ma at +400 v dc, 0.5 ma at +125 v dc, 0.5 ma at -125 v dc, 0.1 ma at -133 v dc, 0.6 amp at 6.3 v ac (gnd) and 0.6 amp at 6.3 v ac (-125 v dc); all ± 10 per cent.

Baird-Atomic, Inc., Dept. ED, Cambridge, Mass.
Radio Engineering Show, Booth 3219, 21.

CIRCLE 382 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Magnetic
Memory Planes
Stack Construction

These magnetic memory planes, available in any frame size up to and including 10 in. x 10 in., are made in stacks which eliminate the need for molds. The planes have greater frame strength and rigidity, and spacers are not required for the vertical assembly of planes, since the four corners have a greater cross-sectional height than the remainder of the frame.

General Ceramics Corp., Dept. ED, Crows Mill Rd., Keasby, N. J.

Radio Engineering Show, Booth 1629.

CIRCLE 383 ON READER-SERVICE CARD FOR MORE INFORMATION

for MICROWAVE SIGNAL ANALYSIS

of radar communications
equipment and components



VECTRON SA30 SERIES MICROWAVE SPECTRUM ANALYZER

Clearly and accurately displays:
Frequency of carrier and side bands
Undesired frequencies generated
Relative power of all signals
Details of intermittent signals.

SA30WR-1 2,000 to 12,000 mc/s
Direct Reading Dial

Recommended for laboratory or production use where wide frequency coverage is needed and moderate frequency accuracy (0.5%) is required.

SA30X5 8,500 to 9,660 mc/s
Direct Reading Dial

Frequency Accuracy 0.05% or better
Ideal for use in design, production and maintenance facilities where major requirements are fast, accurate readings within its frequency range.

THE SA30 SERIES IS LIGHTER: — uses all aluminum construction in a portable 80 lb. bench-top unit or as two rack-mountable assemblies.

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Electronic and Electro-Mechanical Equipment
1583 Trapelo Road • Waltham 54, Mass.



VECTRON'S MINIATURIZED SPHERE RESOLVER requires less than 5 in/oz input for 1 to 2 in/oz from the sine and cosine output shafts. This precision mechanical resolver is 1 1/2" square with a body block over 2 1/8" long.

This product of Vectron design and manufacture is another example of the electro-mechanical problems which Vectron can help you solve.

CIRCLE 384 ON READER-SERVICE CARD

Glide Slope Receiver

Transistor Powered



Utilizing an all-electronic means of converting aircraft battery current to ac, instead of the usual dynamotor or vibrator, this glide slope receiver weighs only 6-3/4 lb. Two transistors, operating as a multivibrator circuit, provide all the ac required. The receiver, designated Model DGS-20, has up to 10 crystal channels in the 329.3 to 335.0 mc band, and is supplied with 10 additional crystals for future requirements. Crystals are selected by a rotary solenoid controlled by a panel switch. Vacuum tubes are ruggedized; modular design has been featured to simplify servicing. The entire unit conforms to the electrical performance requirements of RTCA paper DO-58.

Dare, Inc., Dept. ED, Troy, Ohio.

CIRCLE 386 ON READER-SERVICE CARD FOR MORE INFORMATION

Remote Positioner

Small Input Torque



The Model 11 Torsynator is a low cost remote positioning device. It has small input torque and high output torque. Accuracy within $\pm 1/2$ degree. Input volts are 28 v dc, starting time is 20 milliseconds, idle current is 0.1 amp, starting current is 0.4 amp, and output is 7 in. oz. Gear reduction is 400-1 and temperature range is -40 to $+80$ C. Maximum vibration is 10 g. Weight of receiver is 6 oz, weight of transmitter is 2 oz, and weight of relay box is 11 oz. Max. follow-up speed is 60 degrees per second.

Air-Marine Motors, Inc., Dept. ED, 369 Bayview Ave., Amityville, N.Y.

Radio Engineering Show, Booth 2315.

CIRCLE 387 ON READER-SERVICE CARD FOR MORE INFORMATION

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ELECTRONIC DESIGN • March 1, 1957



(Actual Size)
K3-SERIES

TRIPLE-POLE SWITCH

OPERATING CHARACTERISTICS

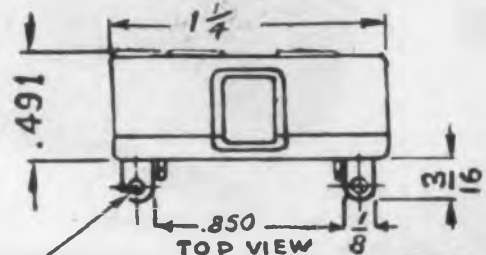
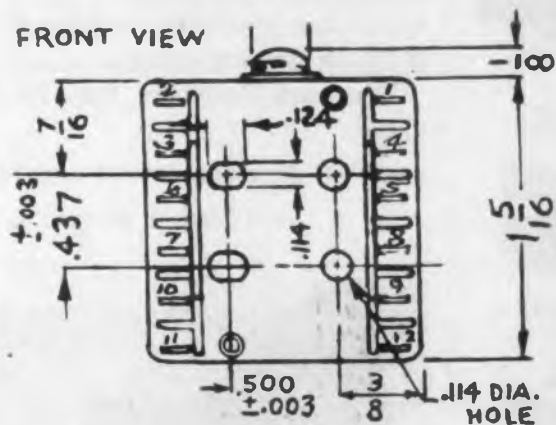
CONTACT ARRANGEMENTS:

K3-4—TRIPLE-POLE, DOUBLE THROW
K3-2—TRIPLE-POLE, NORMALLY OPEN
K3-1—TRIPLE-POLE, NORMALLY CLOSED

ELECTRICAL RATING:

15 AMP 125/250 V.A.C.
15 AMP 30 V.D.C. RESISTIVE
10 AMP 30 V.D.C. INDUCTIVE

PROBABLE MECH. LIFE.....1,000,000 OPS
PROBABLE ELEC. LIFE.....500,000 OPS
AMBIENT TEMP. RANGE..... -100° TO $+275^{\circ}$ F.*
*(-100° to $+375^{\circ}$ F. available)



(6.075 DIA WIRE HOLES



MODERN DESIGN
IN A COMPLETE LINE
OF SWITCHES



CIRCLE 388 ON READER-SERVICE CARD FOR MORE INFORMATION

New **ELECTRO-SNAP**

SIMULTANEOUS

TRIPLE-POLE SWITCH

for interrupting 3-phase,
110 V, 400 cycle AC circuits

6-CIRCUIT CONTROL — in a small package.

Makes possible a wide variety of circuit combinations.

SIMULTANEOUS "MAKE & BREAK" ACTION

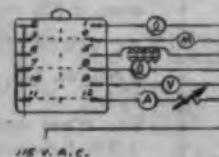
Permits unusual applications, reduces arcing, prolongs switch life and increases electrical capacity.

This completely new Electro-Snap triple-pole switch simultaneously reverses current flow through three windings of a 3-phase motor up to 1 H.P. and interrupts other types of multi-switching installations. Instantaneous snap-action of the three poles is independent of the speed of actuation — even extremely slow moving cams can be used.

The K3-Series offers designers a wide variety of 3-phase circuit hookups for servo-controls, to limit movement of machine members and as a start-and-stop switch which formerly were possible only with complicated relays or a number of separate switches. A large selection of standard actuators is available.

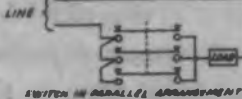
LOOK WHAT YOU CAN DO WITH IT!

Control Six Circuits
with ONE Snap



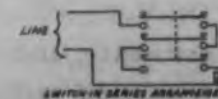
Used in motor control device switch, when actuated, turns on the red light on No. 1, the solenoid on No. 5, the voltmeter on No. 9 and turns off the motor on No. 4, the green light on No. 8 and the furnace and ammeter on No. 12.

Wire Movable Poles in Series for High Voltage
or in Parallel for High Current



With the switch wired in parallel arrangement, the current is divided into 3 paths through the switch. This permits the switch to be used with a load rated up to 3 times the ampere rating of the switch.

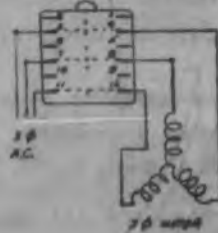
With the switch wired in



series arrangement, the current has only 1 path through the switch. The multiple breaks in the current path permits the switch to be used where the line voltage is rated up to 3 times the voltage rating of the switch; ampere rating not affected.

Start and Stop
Three-Phase Motors

Completely disconnect all current supplied to a 3-phase motor by interrupting 3 phases simultaneously with one snap.



ELECTRO-SNAP
SWITCH AND MFG. CO.

4216 West Lake Street • Chicago 24, Illinois

RCA INSTRUMENTS OF
LABORATORY PRECISION

Excellent
stability
characterizes
this new
vacuum tube
voltmeter
by RCA



RCA VACUUM TUBE
VOLTMETER
Type LV-10, Price \$250*
Also ask about Null Voltmeters.

THIS VACUUM TUBE VOLTMETER is extremely versatile, combining in one instrument an AC Voltmeter—covering a range from audio to UHF frequencies, a DC Voltmeter—with 100 megohms input resistance, and an ohmmeter capable of measuring resistance from zero to 1000 megohms. Ideal for use wherever highly precise measurements are essential. Maximum stability and low current consumption are outstanding features. Balanced indicating movement makes this exceptional instrument suitable for use lying flat, standing vertically or inclined.

For complete information on the above and other instruments in the RCA line, write to RCA, Dept. P-292, Building 15-1, Camden, N.J.

*Price in U.S.A., f.o.b. Camden, N.J. Subject to change without notice.

- DC VOLTS
- 7 ranges: 1, 3, 10, 30, 100, 300, 1,000.
- Accuracy: $\pm 3\%$ full scale deflection.
- Input resistance: 100 megohms $\pm 2\%$ on all ranges.
- AC VOLTS
- 6 ranges: 1, 3, 10, 30, 100, 300.
- Sine Wave Accuracy: $\pm 3\%$ full scale deflection.
- Input impedance: Less than 2 mmf in parallel with 15 megohms.
- Frequency Response: ± 1.0 db, 18 cps to 700 MC.
- Relative Measurements: possible to 1,000 MC.
- RESISTANCE: 0 to 1,000 megohms in 7 ranges.
- Accuracy: $\pm 5\%$ between divisions 10 and 100 on scale.
- DB Range: -10 to $+52$ dbm in 6 ranges.
- Zero dbm = 1 mw in 600 ohms.



RADIO CORPORATION
OF AMERICA
COMMERCIAL ELECTRONIC PRODUCTS
CAMDEN, N. J.

In Canada—RCA VICTOR Company Ltd., Montreal

Instrument
Engineering
Representatives in
Principal Cities

CIRCLE 390 ON READER-SERVICE CARD FOR MORE INFORMATION

Nylon Fasteners

Also Insulate



Self-locking, self-retaining fastening devices, made of nylon, create vibration-proof and shock-resistant assemblages in which metal parts may be physically joined but electrically insulated. The Grippit fastener is an unthreaded nylon nut. It has self-retaining features, so it can be inserted during production runs without danger of being dislodged during handling. A self-tapping screw, such as type "Z", is driven into the Grippit by either hand or power screwdriver. The screw impresses its own thread on the nylon inner wall. As the screw is tightened the Grippit is drawn up and forms a collar, as shown in the illustration, thus constituting a secure and rigid lock washer. Grippits are particularly recommended for assembling enameled parts without risk of the chipping or crazing sometimes caused by metal to metal contacts. The fasteners are presently available to take sizes #8 and #10 self-tapping screws.

Tru-Lock Fasteners, Inc., Dept. ED, Woodbury, Conn.

CIRCLE 391 ON READER-SERVICE CARD FOR MORE INFORMATION



Wide Angle
Lens

165 Degrees

Equipped with iris ring adjustment from f/1.5 to f/8.0, this compact, 3.45 mm lens covers an area of 165 deg both horizontally and vertically. It is designated Triad 720 and is available in either a gun camera (GSAP) mount or a "C" mount. With the gun camera mount it protrudes 4-1/2 in. from the front plate of the camera and measures 4 in. in dia at its widest point. The Triad 720 is primarily intended for use in instrumentation.

Triad Corp., Dept. ED, 17136 Ventura Blvd., Encino, Calif.

CIRCLE 392 ON READER-SERVICE CARD FOR MORE INFORMATION



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DO YOU NEED

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RUGGED*
COMPACT
SENSITIVE
LIGHT-BEAM
GALVANOMETER



*Will take
25 G's!

this is it...

There 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.

SPECIFICATIONS:

Sensitivity to .105 microamperes per millimeter resistances: 20, 100, 500 and 1000 ohms. Short period; high speed response. SIZE: ONLY 2.6" x 3.62" x 3.615" Sealed construction.

For full information
please write or wire



HOWELL INSTRUMENT Company
1101 Trinity St • Fort Worth 7, Texas

CIRCLE 395 ON READER-SERVICE CARD

Rectangular Indicator Lamps

Flat or Prism Lens



These rectangular indicator lamps are supplied in two sizes: 1-13/32 in. x 31/32 in., and 31/32 in. x 11/16 in. Lamp bulbs are serviced from the front of the panel. Designations can be engraved directly on the lens. Lenses may be flat, or prismatic for wider visibility. The lamps are single-hole mounted in a circular opening. Multiple application in annunciator assemblies is simple and can be made either by the user, or the manufacturer will assemble the lamps into multiple units meeting the user's requirements.

For low voltage applications T3-1/4 single-contact miniature bayonet lamp bulbs are recommended; and they may also be used for 120/220 v service with a 10-w resistor externally bracketed and secured by the lamp unit. A NE-51 neon lamp bulb may be used for 120/220 v applications with the prism lens, and the required resistor incorporated in the socket assembly.

H. R. Kirkland Co., Dept. ED, 8 King St., Morristown, N. J.

CIRCLE 396 ON READER-SERVICE CARD FOR MORE INFORMATION

Teflon Tubing In New Sizes

From AWG 0 to AWG 30



Teflon ("spaghetti") tubing, formerly supplied by its maker only in AWG sizes 8 through 26, has now been made available also in sizes 1, 2, 3, 4, 5, 6, 7, 28 and 30. Polypenco thin-wall tubing has a minimum dielectric strength of 750 volts/mil, dielectric constant of 2.0, surface resistivity above 10 to the 12 ohms per sq cm, zero water absorption, and a temperature service range from -320 to +555 F. The material resists soldering temperatures completely. Every size is available in ten colors for circuit identification.

Polymer Corp. of Pa., Dept. ED, 2140 Fairmont Ave., Reading, Pa.

CIRCLE 397 ON READER-SERVICE CARD FOR MORE INFORMATION

TECHNICRAFT



Technicraft advanced design engineering and manufacturing facilities are available to serve your needs from the face of the Magnetron through to the antenna.

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Assemblies and Components

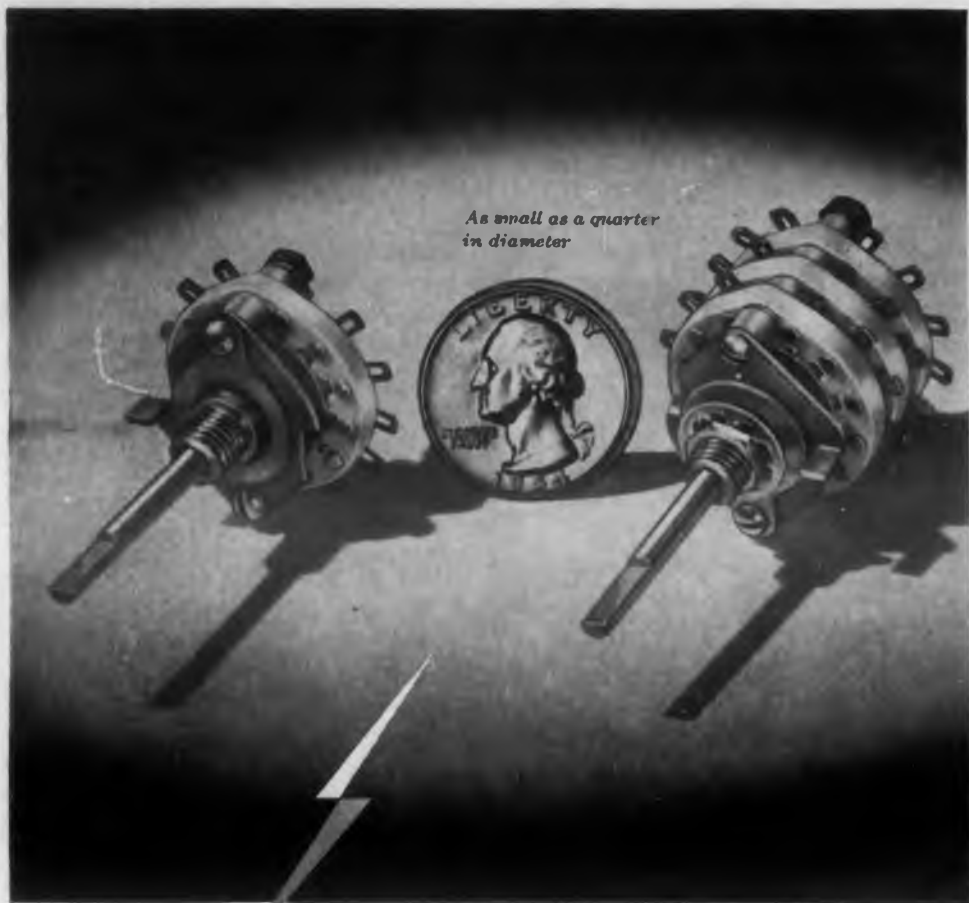
This complements the TECHNICRAFT 4.75 to 11.0 KMC/s Double Ridged Waveguide now available.

MOLDED FLEXIBLE WAVEGUIDE ASSEMBLIES
in one continuous length up to 100 feet.

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BEST IN MICROWAVE TRANSMISSION DEVICES**



CIRCLE 398 ON READER-SERVICE CARD FOR MORE INFORMATION



Multiple switching sequences

in a switch only 15/16" in diameter

For military and commercial applications...





Guided missiles

Band-switching in extra-small electronic equipment

Transistor circuits

Aircraft instruments

Centralab Series 100 Sub-Miniature Rotary Switch

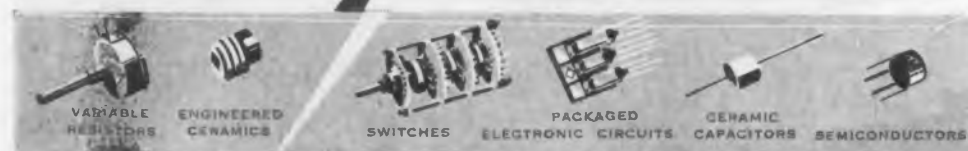
-  A lightweight, ultra-small switch with the electrical rating of larger switches.
-  Available up to 12 positions. Make and break, resistance load, 1 ampere at 6 volts d.c.; 150 milliamperes at 110 volts a.c.; current-carrying capacity, 5 amperes.
-  Sections are ceramic — Centralab Grade L-5 Steatite. Wafers can be stacked up three sections per shaft.
-  Meets the corrosion-resistance requirements — and exceeds the insulation resistance — specified by MIL-S-3786.

Write for Technical Bulletin EP-73 for complete engineering data.

P-2756

Centralab

A DIVISION OF GLOBE-UNION INC.
960 East Keefe Avenue • Milwaukee 1, Wisconsin
In Canada: 804 Mt. Pleasant Road, Toronto, Ontario



CIRCLE 400 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Sharp Cut-Off Pentode Frequencies to 400 Mc

Intended for critical military and commercial applications this sharp-cutoff pentode, designated 5636, incorporates a compact structure in which special attention has been given to features that enable it to resist shock and vibration. It has two separate control grids, each with a sharp-cutoff characteristic, a unipotential cathode and two cathode lead terminals to facilitate isolation of input and output circuits. The tube will serve with high efficiency in gated amplifier circuits, delay circuits, mixer circuits, gain-controlled amplifier circuits and many other applications, at frequencies up to 400 mc.

Radio Corp. of Amer., Tube Div., Dept. ED, Harrison, N. J.

Radio Engineering Show, Booths 1602, 1707.

CIRCLE 401 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Magnetic Counter And Frequency Divider

Compared to a conventional four-tube counter, the Magnivider shown here consumes only half the power and occupies only one-third the size. It is intended for random counting, frequency division, preset counting, numerical accumulators, synchronizing television sweeps and similar applications. Two outputs provide 40 v at high impedance and 4 v at low impedance. The Magnivider is available in three scales, 9, 10 and 11.

Counting rate is dc to 50 kc. Power requirements are 6.3 v at 0.3 to 0.45 amp; 150 v at 15 ma for 50 kc counting rate but at 12 ma for counting rates below 1 kc. Input: a positive pulse of 32-48 v (which may be obtained from another Magnivider), with a rise time of 0-2 μsecs and a pulse width 10 μsecs less than the pulse spacing. The high impedance output delivers a nominal 40 v above ground pulse to another Magnivider or to a 100 k load shunted by 25 μmf max. The low impedance output delivers a 4 v pulse to cables or transistors offering a 100 ohm impedance. The unit utilizes a printed circuit and one electronic tube. Dimensions are 3-1/2 in. x 5-1/2 in. x 1-1/4 in.

Magnetics Research Co., Dept. ED, 255 Grove St., White Plains, N. Y.

Radio Engineering Show, Booth 3944.

CIRCLE 402 ON READER-SERVICE CARD FOR MORE INFORMATION



Cancer can't strike me,
I'm hiding.



What I don't know
won't hurt me.



Cancer?

Lots of people die of it,
I know... but the
American Cancer Society
says a great many deaths
from cancer are **NEEDLESS**
deaths. That's why I do
what they tell me. I have
an annual medical
checkup however well
I feel. I know the seven
danger signals. And
when I want sound
information, I get it from
my Unit of the

AMERICAN
CANCER
SOCIETY



"Simplifies
assembly...
Improves
performance"

SAYS:
**SARKES TARZIAN,
INC.**



ART WIRE UPSET PINS

Sarkes Tarzian, manufacturers of television and radio equipment, use Art Wire and Stamping Company's special upset pins because their uniformly high quality eliminates manufacturing problems. They say: "Through the use of this part we have simplified assembly and improved performance."

We supply upset pins of any workable metal or alloy in diameters from .010 to .090. Thickness of upset flange head from .010 on fine wire to .062 on heavy wire. Angles precision positioned to your specifications.

Precision manufacture on modern high speed machines results in uniformly high quality, lowest production costs.

Why not let us quote on your next order? Send a blueprint or sample for a prompt estimate.



**ART WIRE
AND STAMPING CO.**
7 Boyden Place, Newark, New Jersey
CIRCLE 405 ON READER-SERVICE CARD

△ Rotary Latch Assembled on One Panel



Made of steel, cadmium plated, the rotary latch consists of four parts; latch-screw, shim plate, anchor block and latch-nut. The entire latch is assembled on the access panel only. The Paneloc Rotary Latch operates with a quarter turn. It is available in three standard sizes.

Scovill Mfg. Co., Dept. ED, Waterbury 20, Conn.
Radio Engineering Show, Booth 4007.

CIRCLE 406 ON READER-SERVICE CARD FOR MORE INFORMATION



Interference Detectors Eliminates Screen Room

This Model 2A interference detector can eliminate the need for a screen room. Used on production lines to compare the order of interference given off by samples of the same type it provides a simple means of quality control. The meter detects interference that may be a cause, or a potential cause, of malfunctioning of critical equipment. Used with an antenna (available as an accessory) it reports interference within equipment, and on secondary power lines, of an intensity of 1 mv or more. A broad spectrum in mc region may be observed, or specific bands picked out for observation, by means of band-pass filters. Standard filters cover four bands: 0.075 to 35 mc; 0.150 to 0.500 mc, 0.450 to 1.2 mc, and 1.0 to 35 mc; other band-pass filters can be supplied to order.

Interference Testing and Research Laboratory, Inc., Dept. ED, 150 Causeway St., Boston 14, Mass.

CIRCLE 407 ON READER-SERVICE CARD FOR MORE INFORMATION

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to continue receiving
ELECTRONIC DESIGN.**

1

NEW DESIGN WIRE

2

Tensolite
SPECIALTIES, INC.
198 MAIN ST. TARRYTOWN, N. Y.

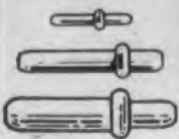
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BEAD CHAIN Multi-Swage Parts

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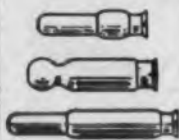
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Contact pins, terminals, jacks or any small tubular parts. Maximum 1/4" diameter x 1 1/4" length.

Send sketch for quotations.

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Designers — write to Fenwal Incorporated,
173 Pleasant Street, Ashland, Mass.

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Controls Temperature
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CIRCLE 411 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Frequency Meter
Allows 20-Channel
Servicing

A frequency meter capable of servicing multiple transmitter installations operating on from one to twenty channels in mobile radio communications systems, the Type 5890-A is portable and features transistorized circuitry. It can be utilized with any transmitter operating in the 25 mc to 470 mc band. The crystal-controlled meter can be used as a source for associated receiver alignment and for setting transmitter modulation deviation.

This meter's frequency source, a crystal oscillator/harmonic generator, has a stability of ± 0.0005 per cent, and is controlled by one of twenty pre-selected crystals. Four additional crystals can be supplied to generate intermediate frequencies for receiver alignment procedures. With the exception of the crystal oscillator stage, all circuitry is transistorized.

Allen B. DuMont Labs., Inc., Dept. ED, 760 Bloomfield Ave., Clifton, N.J.
Radio Engineering Show, Booths 3201-3203, 3301-3307.

CIRCLE 412 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Water-Sealed Splice
Has Nylon Sleeve



This permanent, water-sealed and insulated splice is composed of a highly conductive, electro-tinned copper link; a transparent nylon sleeve, and anodized aluminum sealing rings. It is installed with a ratchet-type, controlled-depth-of-indent tool, designated Hytool. The Sealink splice accommodates AN wire sizes #26 thru #10, and can be used (see the illustration) for two-wire or multi-wire applications. It is color-coded for size identification, and meets MIL-T-7929A.

Burndy Corp., Dept. ED, Norwalk, Conn.
Radio Engineering Show, Booth 4424.

CIRCLE 413 ON READER-SERVICE CARD FOR MORE INFORMATION



Engineering in
Action depends on
CASTELL

LOCKTITE Holder and Imported CASTELL Lead

CASTELL LOCKTITE Holders, armed with long sticks of graphite-saturated imported CASTELL 9030 lead, are used in practically every engineering and design office. Busy Pros are keen about LOCKTITE because it has a gun-rifled clutch that holds the lead like the jaws of a bull dog, preventing slipping or turning. They are keen about imported 9030 CASTELL lead, because it is identical to lead which made CASTELL wood pencil world famous.

Have you seen LOCKTITE 9800, with the patent-pending Degree Indicator. A turn of a brass collar indicates the degree in use. Pick one up from your Dealer today.

A.W. FABER-CASTELL
PENCIL CO., INC. NEWARK 3, N. J.



CIRCLE 414 ON READER-SERVICE CARD FOR MORE INFORMATION

OK! BUY HI-FI

But plan for the future



Wouldn't it be frustrating to buy a speaker and have to discard it when you are ready for something better? But not any more! You can buy a University speaker and add to it until you have the finest speaker system you'd ever want. University's P·S·E* makes this possible ... and it's so easy. Buy a

speaker or system now and enjoy immediate listening satisfaction. When because of musical taste, finances or just whim, you want a more elaborate system, you can add speaker components without discarding what you have.

P·S·E is really ingenious ... more than that, it is a blessing to all Hi-Fi'ers. If you're interested in "planning for the future" learn all the facts. Send for FREE illustrated brochure to Desk C44, University Loudspeakers, Inc., 80 So. Kensico Ave., White Plains, N. Y.

*P·S·E—Progressive Speaker Expansion Plan—is a concept first introduced by University...and is still the best.

LISTEN

University sounds better





△ **Miniature Crystal**
3 to 100 MC

This vacuum mounted quartz crystal unit, type BC6a, incorporates an AT-cut element. Aging of the unit is 2.0 ppm maximum during the first year of service under low drive conditions. The tolerance of the unit is ± 0.0005 per cent of nominal frequency at 25 C, stability is ± 0.0015 per cent maximum deviation from measured frequency at 25 C over an ambient range from -55 to $+90$ C. The overall dimension is 2-1/8 in., vacuum mounted in a T5-1/2 bulb, small button miniature base.

Bliley Electric Company, Dept. ED, Union Station Bldg., Erie, Pa.

Radio Engineering Show, Booth 2736.

CIRCLE 416 ON READER-SERVICE CARD FOR MORE INFORMATION



△ **Vibration Mounting**
Load Ranges 50-1000 lbs

An all-metal mounting construction of aluminum and load carrying stainless steel resilient elements that will attenuate 20 g impact shocks. The W164 series is available in load ranges from 50 to a 1000 lbs per unit. The non-linear spring rate of Met-L-Flex resilient elements produces increasing stiffness as loads increase. The natural frequencies of the W164 series are between 13 and 17 cy per second and will provide vibration isolation at disturbing frequencies above approximately 1250 cy per minute. When used as either a compression hanger type mount or an inverted hanger type, performance remains approximately the same.

Four 1/4 in. bolts are used for floor or structural mounting. The equipment is mounted through one 3/8-16 UNC tapped center hole.

Robinson Aviation Inc., Dept. ED, Teterboro, N.J.
Radio Engineering Show, Booth 2506, 2508.

CIRCLE 417 ON READER-SERVICE CARD FOR MORE INFORMATION

SAVE TIME & MONEY ON INSPECTIONS



FINE, AMERICAN-MADE INSTRUMENT
... AT OVER 50% SAVING

STEREO MICROSCOPE

FOR INDUSTRIAL OR HOBBY USE

Up to 3" Working Distance — Erect Image — Wide 3 Dimensional Field

FULL PRICE
\$99.50

Now, ready after years in development—this instrument answers the long standing need for a sturdy, efficient STEREO MICROSCOPE at low cost. Used in production—in research—in the lab, shop, factory, or at home; for inspections, examinations, counting, checking, assembling, dissecting—speeding up and improving quality control. 2 sets of objectives on rotating turret. Standard pair of wide field 8X Kellner Eyepieces give you 21 power and 34 power. Additional eyepieces available for greater or lesser magnification. A low reflection coated prism erecting system gives you an erect image—correct as to right and left—clear and sharp. Helical rack and pinion focusing. Interpupillary distance adjustable. WE WILL SHIP ON 10-DAY FREE TRIAL.

Order Stock No. 85,039-DA full price . . . \$99.50 f.o.b. Shipping weight approximately 11 lbs. Barrington, New Jersey

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BOARDMASTER VISUAL CONTROL

Gives you a Graphic Picture of your operations, spotlighted in color. You See what is happening at a glance. Facts at eye level -- saves you time, prevents errors.

Simple, flexible -- easily adapted to your needs. Easy to operate. Type or write on interchangeable cards, snap in grooves. Ideal for production, scheduling, sales, traffic, inventory, etc. Made of metal. Compact, attractive.

Complete Price **\$49.50** Including Cards

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CIRCLE 419 ON READER-SERVICE CARD FOR MORE INFORMATION

A MIGHTY MITE FOR FREQUENCY MEASUREMENT...

MINIATURE, SEALED TYPE FRAHM
RESONANT REED FREQUENCY METER



Hermetically sealed construction makes the Frahm Miniature Frequency Meter practically indestructible and foolproof in conditions of heavy moisture or fine dust. Design engineers who try Frahm Sealed Type Frequency Meters specify them

repeatedly for land, sea and airborne equipment because they withstand dirt, fungus attack, humidity and other destructive atmospheric conditions. The "miniature" is available in 2 1/2" and 3 1/2" sizes. **WRITE FOR BULLETIN 32P2-ED.**

ALSO AVAILABLE
IN STANDARD OR SPECIAL MODELS FOR PANELBOARD OR PORTABLE USE

Frahm Resonant Reed Frequency Meters are available in a variety of standard shapes and sizes to indicate alternating current frequency from 15 up to 1500 cycles per second. They are applicable to pulsating or interrupted D-C as well as A-C supply circuits. If you have special design requirements for range, methods of activating, scale graduations, etc., we invite your correspondence. We are confident we can meet your specifications.

WRITE FOR BULLETIN 32-ED.



FRAHM RELAYS AND OSCILLATORS

Frahm Resonant Reed Relays and Oscillators open a new era to designers of electro-mechanisms. The transmission of a number of control signals over a single communication circuit of any type is simplified by the use of these components. **WRITE FOR BULLETIN 33-ED (FRAHM RELAYS) AND BULLETIN 34-ED (FRAHM OSCILLATORS).**

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MANUFACTURERS: Power Rheostats, Fixed Resistors, Adjustable Resistors, "Econohm" Resistors, "Tru-rib" Resistors

**America's
TOP Line**

**"TRU-RIB"
VITREOUS
ENAMELED
RESISTORS**



Circuits requiring units of high current and wattage ratings at relatively low resistance values need TRU-RIB RESISTORS. They are especially adaptable to starter duty, but can be used in a wide variety of continuous duty applications.

Available up to 1500 maximum watts. Special units can be designed for specific applications.

Order from TRU-OHM . . . the world's largest producers of wire-wound resistors.

We always ship on time . . . and we expedite for you

**TRU-OHM
Power Rheostats**

Available from 25 to 150 watts . . . from stock or to your specifications.



Division of Model Engineering & Mfg., Inc.

General Sales Office: 2800 N. Milwaukee Ave., Chicago 18, Ill.

Factory: Huntington, Indiana

CIRCLE 421 ON READER-SERVICE CARD FOR MORE INFORMATION

**Grid-Controlled Indicator Tube
Monitors Transistor Circuits**



KP-125,
Actual Size

The KP-125 is a subminiature, grid-controlled indicator tube which operates with small signal voltages and negligible current. A gas-filled triode of the glow-discharge type, the KP-125 provides a visual glow which may be viewed end-on or from the side. Both the filament (very low drain hearing aid type) and the anode may be operated from the AC line and consume power in the milliwatts region. The tube glows with 0 volts on the grid and extinguishes with -3 volts on the grid. Flying leads are provided for direct soldering into circuits, such as on printed boards. The characteristics of the KP-125 make it useful in computer transistor circuits as an indicator of current conditions which does not load the circuit under test. Additionally it serves as an indicator for monitor service in remote control panels. *For details on this and other special purpose electron tubes, write:*

KIP ELECTRONICS CORPORATION
Dept. E, Stamford, Connecticut

CIRCLE 422 ON READER-SERVICE CARD FOR MORE INFORMATION

RELAYS

- FOR INDUSTRIAL USE
- FOR MILITARY USE
- SIMPLE OR COMPLEX
- STANDARD OR SPECIAL

Whatever your relay needs may be, Comar will design and "custom-manufacture" the right relay for you. Electrical characteristics, sizes and mountings are tailor-made to exactly fit your requirements. Precision-engineered, easier to install, more efficient in operation, economical in price. Send for details now!

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CIRCLE 423 ON READER-SERVICE CARD FOR MORE INFORMATION



**△ Magnetic Shift Register
Single Line**



This unit requires only one shift pulse generator, utilizes one magnetic core and one germanium diode per stage with vacuum tube driver, or one magnetic core and one transistor per stage with transistor driver. Drivers can operate up to 50 stages of a register. Units are available at operating frequencies from 0 to 10 kc, 50 kc, 100 kc, 250 kc and 500 kc.

These units have demonstrated life expectancies in excess of 40,000 hours. Normal packing density is 120 units per square foot of panel space. The magnetic core is encapsulated. The components are mounted on a printed circuit board which is sealed from outside moisture. These units are available with printed circuit lugs, solder lugs, or plug-in type headers, and also custom-packaged to meet special requirements.

Mack Electronics, Dept. ED, Div. of Mack Trucks, Inc., 40 Leon St., Boston 15, Mass.
Radio Engineering Show, Booth 1815-1817.

CIRCLE 424 ON READER-SERVICE CARD FOR MORE INFORMATION



**△ Transistor Clip
Resists Vibration**

This silver-plated beryllium copper clip will hold all transistors 0.235 x 0.375 in. including the 2N167 and 2N78. The clip has a four point grip and a stop tab to prevent the transistor moving longitudinally. Provided with a single 1/16 in. diam. mounting hole, the clip has an integral tab to be inserted in a second hole to prevent twisting. It is designed to meet aircraft and missile heat, shock and vibration requirements.

Atlas E-E Corp., Dept. ED, 47 Prospect St., Woburn, Mass.

Radio Engineering Show, Booth 4235.

CIRCLE 425 ON READER-SERVICE CARD FOR MORE INFORMATION

$= m_1 \ddot{x}_1 + c_1 \dot{x}_1 - k_1(x_1 -$

A PERSONAL TOOL FOR EVERY ENGINEER

Portrait of 1 engineer
doing the work of 2

ANALOG COMPUTER

MODEL 3000

Simplified analog computer solves wide variety of engineering problems. Detachable problem boards and plug-in components facilitate rapid problem set-up. Function generator, multiplier, chopper stabilizer, and other accessories available. Write for complete data. Model 3000, \$1150 FOB Factory.

Problem board \$95

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816 Golindo Street
Concord, California



CIRCLE 427 ON READER-SERVICE CARD

△ Multi-Channel Programmer

Small and Accurate



The MPR-13 multi-channel programmer provides up to 13 channels for repeat cycling or random programming. It has an accuracy of 0.002 per cent. It is designed for missile and aircraft use.

This unit provides for an insulating tape similar to 35 mm photographic film to be advanced between 13 contactors. The tape is marked lengthwise in time and divided in 13 channels. The Programmer MPR-13 weighs 3 lb, 10 oz and measures 2 x 3 x 6 in.

Photographic Products, Inc., Dept. ED, 1000 N. Olive St., Anaheim, Calif.

Radio Engineering Show, Booth 3001.

CIRCLE 428 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Germanium Junction Photocell

Miniature Size



The PG40A miniature germanium junction photoelectric cell is designed to sense punched cards and perforated tape. It has a diameter of 0.093 in. which makes mass grouping in a small space possible.

This cell passes saturation current practically independent of the applied voltage. When the cell is illuminated, the current increases by an amount directly proportional to the illumination.

Due to their large current or voltage output a suitable relay or cold cathode trigger tube may be operated directly from the cell. It can be used at low light levels.

International Standard Trading Corp., Dept. ED, 22 Thames St., New York 6, N.Y.

Radio Engineering Show, Booth 2008.

CIRCLE 429 ON READER-SERVICE CARD FOR MORE INFORMATION

GYROS

for every application

For hours in aircraft or minutes in missiles, gyros must possess ruggedness and dependability that will assure performance of the mission.

Kearfott Gyros possess this ruggedness and dependability coupled with extremely high accuracy. That is why they are so widely used in all types of aircraft and missiles. Kearfott Vertical, Rate, Free, Directional and Floated Rate Integrating Gyros as well as Stable Elements are designed to meet the most stringent airborne requirements.



**Unsurpassed in Performance
Unequaled in Compactness**

Kearfott Miniature Vertical Gyros satisfy the requirements of MIL-E-5272 as regards shock test (Procedure II) humidity, salt spray, fungus resistance, rain, sand, dust, immersion and explosion proof. Duplicates the performance of standard vertical gyros in 1/2 the volume and weight.



Write today for technical data on Kearfott Gyros.

KEARFOTT COMPONENTS INCLUDE:

Gyros, Servo Motors, Synchros, Servo and Magnetic Amplifiers, Tachometer Generators, Hermetic Rotary Seals, Aircraft Navigational Systems, and other high accuracy mechanical, electrical and electronic components.



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Sales and Engineering Offices: 1378 Main Avenue, Clifton, N. J.
Midwest Office: 188 W. Randolph Street, Chicago, Ill. South Central Office: 6115 Denton Drive, Dallas, Texas
West Coast Office: 253 N. Vinado Avenue, Pasadena, Calif.

CIRCLE 430 ON READER-SERVICE CARD FOR MORE INFORMATION



TELL US

And We'll Tell 25,000 Others

You're coming to the Show and Convention to pick up some ideas. You're bound to get plenty as you visit some of the 800 plus exhibits and catch part of all the papers being read.

Why not get your design ideas published in **ELECTRONIC DESIGN**. If you stop to think about it, **ED** is the only technical magazine devoted exclusively to passing along practical ideas for design engineers. It reaches more strictly design engineers than any other publication.

The code of the scientist is to publish his findings. Research engineers and scientists who use the Proceedings and Transactions of the IRE for this purpose are to be congratulated. But what about you, the practicing engineer who learned how to do something better than before. Are you passing along your knowledge as you can?

WHAT ARE YOU GOING TO DO IN RETURN?

You'll no doubt bump into old friends and associates and tell them about your latest brainstorm. They'll probably congratulate you. But in reality, you're as communicative as a clam. Only about 0.0005 per cent of your available audience will hear you. (Even if you read a convention paper, you will expose, aurally and in print, only 0.05 per cent of the available audience to your idea.)

An editor will be on hand at Booth 1401 at all times. We will have an Author's Guide and a list of suggested topics for you.

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Services for Designers

White Noise Test Facility
50 cy to 10 kc



The first independent commercial "White Noise" testing facility on the West Coast has been established at Rototest Laboratories, Inc., of Lynwood, California. With the equipment now available, Rototest is able to subject a test specimen to sound level intensities of 150 db over a cross sectional area of 64 square inches. This sound level is obtainable on a random frequency basis covering the entire frequency range from 50 cy to 10 kc with the required sound pressure level energy present in each octave over the entire range. Using discrete frequency testing techniques (concentrating the available energy at one specific frequency or narrow frequency band) the equipment now available can provide sound energy levels from 150 to 155 db.

The intense noise levels produced by rocket and jet engines has been proven to definitely cause equipment failure and, as such, decreases the reliability of newly designed missiles and aircraft. The purpose of the new "White Noise" testing facility at Rototest is to provide testing conditions in the laboratory comparable to normal flight conditions.

The Rototest equipment features an audio supply of 540 electrical watts which is then converted into sound energy which is in turn concentrated by use of a logarithmically shaped sound horn chamber to provide 150 db over a 64-in. cross sectional area.

Aluminum Plating For Solderability

A new process for plating aluminum which makes electronic parts easily solderable is announced by E. S. Bennett, president of Anchor Plating & Tinning Co., Inc., El Monte, Calif. The new process discovery is known as "A-F14."

In addition to the exclusive process for plating aluminum, the firm plates precious metals, gold, silver and rhodium. Anchor Plating & Tinning is also an approved plant for plating of electrolytic tin, fused tin, white nickel, cadmium and copper on steel and most zinc base die castings. Quality work control is achieved through magna-gauge and drop-testing equipment to meet government specs.

Important Question No. 1



Who produces more custom-built delay lines than any other company in America?



1st in sales!

**1st company devoted exclusively to the
manufacture of delay lines!**

**1st in research, design and development
of custom-built delay lines!**

Exceptional employment opportunities for engineers experienced in pulse techniques.

See you at the I.R.E. Show — Booth No. 2843



ESC CORPORATION



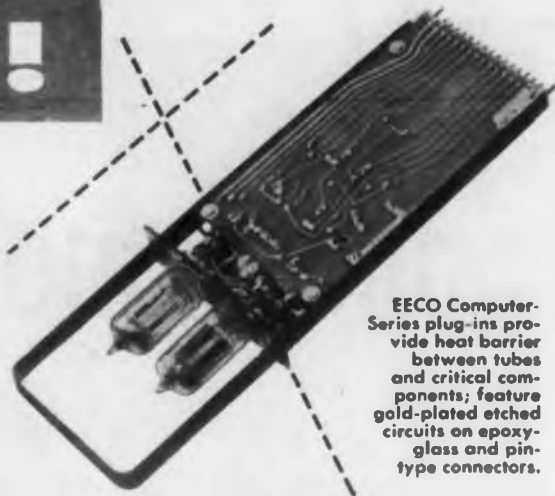
536 BERGEN BOULEVARD • PALISADES PARK • NEW JERSEY

CIRCLE 432 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW!

EECO COMPUTER- SERIES PLUG-INS

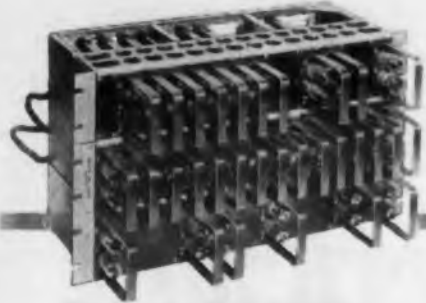
...a refinement of the building-block concept to a degree hitherto unknown, with each circuit a complete off-the-shelf packaged function.



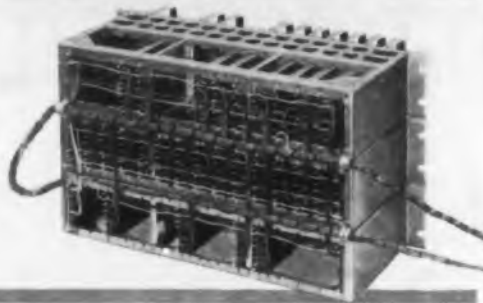
EECO Computer-Series plug-ins provide heat barrier between tubes and critical components; feature gold-plated etched circuits on epoxy-glass and pin-type connectors.

Originally developed for EECO custom systems and proven in critical use, this compatible series of digital and logic circuits is now available to the industry. Meet your project delivery schedules by reducing system-development time to a bare minimum and virtually eliminating drafting and layout time.

PERFORMANCE EECO Computer-Series plug-ins are performance engineered for application where ultra-conservative design at the component level is essential because of system complexity. System prototypes can generally be built directly, without need for the "breadboard" stage.

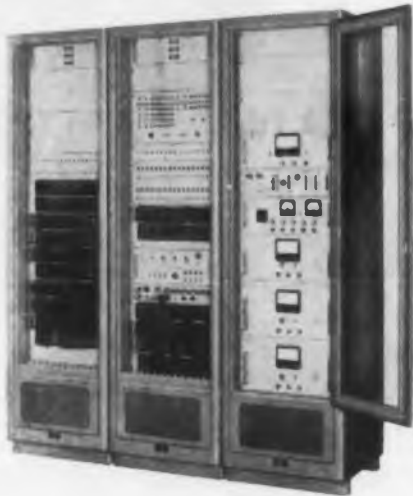


Three Mounting Frame Assemblies were stacked to house this Output Shift Register. Each Mounting Frame accommodates 15 plug-ins, is 3 1/2" x 19" for installation in 19" rack.



Rear view of Output Shift Register shows simplicity of point-to-point wiring.

Quick-Look section of EECO-built Project Datum installation at Edwards Air Force Base shows typical modular assembly of Computer-Series plug-ins



*** QUICK FACTS:** Tube dissipation de-rated 75%; cathode current de-rated 50%. 1% components used where 5% required and 5% where 10% required. Reliable operation with $\pm 20\%$ change in filament voltage, 30% change in tube transconductance. Isolating diodes on multiple inputs eliminates crosstalk. Low output impedance—in general, cathode follower. (One flip-flop will trigger another at the end of a 50-foot length of twisted pair!) Signal levels clamped. Computer-type tubes. Circuit trouble-shooting already done; layout basically completed. Packaging, heat-barrier, and ventilation problems solved. In-circuit test fixture available.

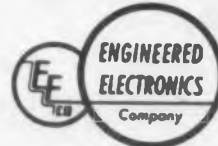
CIRCUITS You can concentrate on the design of systems, knowing you have available a full line of reliable, tested, and proven circuits, including:

Flip-Flops	Quadruple Cathode Followers
Shift Register Elements	One-Digit Adder Matrixes
DC "NOT" Circuits	One-Digit Subtractor Matrixes
Delay Units	One Shots
Pulse Mixer Amplifiers	Neon Drivers

plus 28 Diode Logic Units incorporating "And" and "Or" circuits. In addition, EECO stands ready to design diode logic circuits and produce plug-in units to yield any equation you may require. In short, custom-built logic to order—quickly!

*Detailed information on new Computer-Series plug-ins, as well as on 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.

ELECTRONIC ENGINEERS AND PHYSICISTS—EECO offers immediate opportunities for qualified engineers in the transistor, amplifier, data-handling, pulse, timing, and systems-design fields. Send a resume of your qualifications to R. F. Lander, Dept. CS.



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CIRCLE 436 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature

Miniature Bearing

A miniature ball and roller bearing line is shown in a catalog of 16 pages. Drawings, photographs, full descriptions, dimension tables and mounting information are presented. A number of inch dimensioned open and sealed radial bearings are listed in ABEC Class 1 and 5 tolerances. Two pages of the catalog illustrate applications for major type bearings. The booklet also contains technical data on tolerance standards, internal clearances, load capacity calculations, speed limitations, lubrication, packaging and handling and mounting. Landis & Gyr, Inc., 45 W. 45th St., New York 36, N.Y.

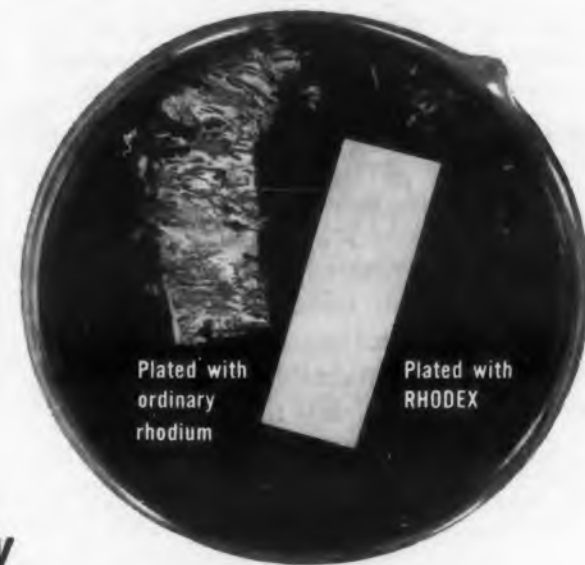
438

Magnets and Thermistors

"Trends and Developments for Electrical Design Engineer" is a 12-page booklet of information on permanent magnets, thermistors and Thyrite varistors. The illustrated publication discusses its subjects in relation to a designer's problems. It points out new approaches, possibilities and methods for using the products. How magnets help designers miniaturize products, determining the proper magnet for a specific application, and how thermistors and Thyrite varistors can be harnessed for products are some of the topics covered. General Electric Co., Metallurgical Products Dept., Detroit 32, Mich.

439

Eliminate Rhodium Plate Rejects!



Sel-Rex only
RHODEX
produces compressively stressed deposits

assuring crack-free, peel-free service. Here's proof! The photograph demonstrates the high tensile stress of conventional rhodium electroplate and the CS of RHODEX. Dissolving the basic metal caused the conventional rhodium electroplate to disintegrate into small crystalline flakes. The Sel-Rex RHODEX electroplate remained unimpaired, and in a continuous film. RHODEX does not peel or crack regardless of thickness! Write for details.

Precious Metals Division

SEL-REX CORPORATION

155 Manchester Place, Newark, N. J. Dept. ED-3



Offices: Detroit—Chicago—Los Angeles.

CIRCLE 440 ON READER-SERVICE CARD FOR MORE INFORMATION

Strain Gages

446

A price list on SR-4 strain gages instruments and accessories has been issued. In addition to offering flat grid gages and other products, the 16-page list contains a thorough discussion of gages and methods of using them. It constitutes a complete guide to proper gage selection. Other products priced are self-compensated gages, a complete high temperature and room temperature foil gage line, and an assortment of cement kits. The booklet is illustrated with graphs and sketches. Baldwin-Lima-Hamilton Corp., Electronics and Instrumentation Div., Waltham, Mass.

Power Supply Equipment

447

Standard low voltage rectifier power supply equipment is listed in the 16 pages of a recent catalog. A "Power Equipment Questionnaire" form for requesting information and quotations on special and custom-built power supplies goes with the booklet. Opad Electric Co., 69 Murray St., New York 7, N.Y.

Instrument Choppers

448

A complete chopper catalog is now available which includes electrical, technical and mechanical specifications.

The illustrated catalog describes the low frequency (from 10 cps to 120 cps) and the high frequency (from -350 to -500 cps) operation. James Vibrapowr Co., 4050 No. Rockwell, Chicago 18, Ill.

Electrical Contacts

449

The materials, properties, forms and uses of a line of electrical contacts have been outlined in "short-form" catalog C-522. A convenient, up-to-date condensation, the publication is designed to aid in contact selection and use. Discussed are contacts manufactured from fine silver, palladium and nickel; silver alloys including coin silver; and many powdered metal compositions. Featured is an outline showing the best contacts for various applications. The 4-page folder is illustrated with photographs. Gibson Electric Co., Frankstown Ave., Pittsburgh 21, Pa.

ELECTRONIC HARDWARE

**PARTS for ELECTRONIC,
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- Dial and Shaft Locks
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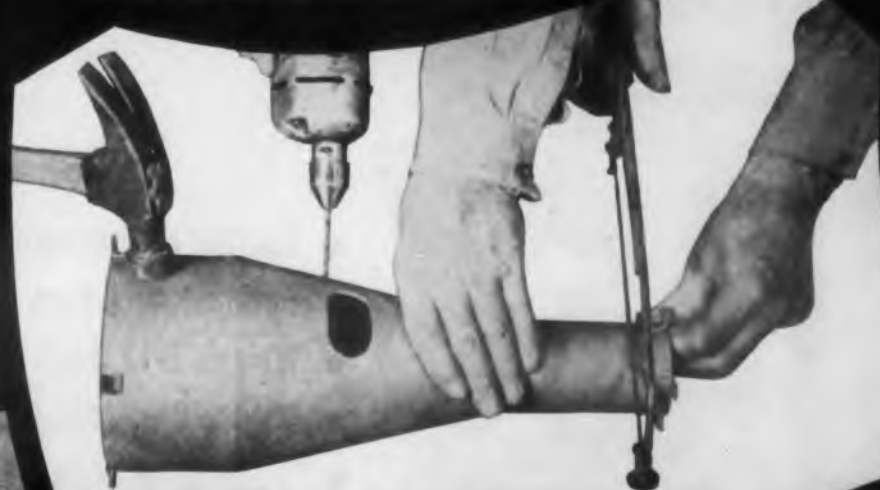
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GENERAL COMPONENTS, INC.
225 EAST 144th STREET, NEW YORK 51, N. Y.
Telephone: MO 5-0740

CIRCLE 450 ON READER-SERVICE CARD FOR MORE INFORMATION

THE ONLY PERMANENTLY EFFECTIVE MAGNETIC SHIELDING

**ECONOMICAL FERNETIC® CO-NETIC®
HELPS MINIATURIZATION**



Permanently unaffected by shock or vibration from usage, drilling, punching, bending, etc. For maximum effectiveness, all possible joints are heliarc welded.

Provides simultaneous high and low intensity shielding as well as high and low frequency shielding, or any one of them.



Sheds magnetic forces like a duck's back sheds water. Will not become magnetized. Permanently non-retentive (no residual magnetism).

Miniatuize by placing components close together, even mounted on the shield itself, reducing bulk circuit and costs and increasing efficiency.

Economical—competitively priced. Lasts indefinitely. Never requires rejuvenation. No need to buy new shielding periodically.

Comparatively lightweight.

CONSTRUCTION FEATURES

Fernetic® is a special medium permeability high saturation steel rolled specifically for high intensity shielding and coated with ferrite and ferrous powders.

Co-Netic® is an extremely high permeability steel rolled specifically for low intensity shielding and coated with ferrite and ferrous powders.

Material rendered permanently insensitive to shock and non-retentive by unique controlled magnetic aging process accomplished by the special coating which reduces circulating currents, raises the saturation point and holds the domains of the steel in random order as annealing places the domains in random directions.

NOTE: You may order these special steels uncoated and fabricate your own parts. Coating may be done in our plant or in yours as desired.

Permanently effective *Fernetic® Co-Netic®* is the only magnetic shielding material whose protective qualities continue undiminished indefinitely—regardless of shock, vibration or length of service.

Successfully used in hundreds of applications. Specify economical, reliable *Fernetic® Co-Netic®* for your magnetic shielding problems. Write for complete technical data.

To help us help you faster, send full details on your shielding problems today.

MAGNETIC SHIELD DIVISION
PERFECTION MICA COMPANY

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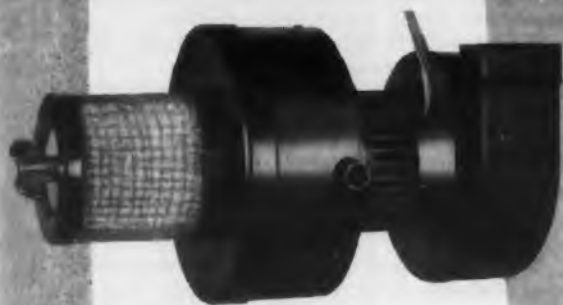
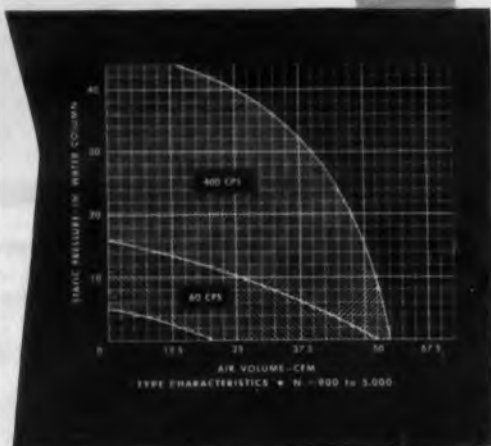
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Originators of Economical, Permanently Effective *Fernetic® Co-Netic®*
Magnetic Shielding

CIRCLE 451 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: 8 1/4" 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
- 1 ϕ or 3 ϕ
- 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 456 ON READER-SERVICE CARD FOR MORE INFORMATION

Glass Fiber Yarn 458

Form TYN-1, an 8-page brochure about glass fiber textile yarns is now available. The bulletin includes a description of the product and some end uses, a table comparing glass fiber continuous-filament yarn with other yarns, nomenclature and manufacturing processes. L.O.F. Glass Fibers Company, 1810 Madison Ave., Toledo 1, Ohio.

Silicon Junction Diodes 459

Data Sheets describing eight silicon junction diodes have been released. The sheets show that each of these diodes has a high-temperature device, characterized by good forward conductance, together with extremely high back resistance. These diodes have a very sharp back voltage breakdown, and evidences extremely low saturation current throughout wide temperature ranges.

They are illustrated and include the specifications, physical and typical characteristics of each diode. Hughes Aircraft Co., International Airport Station, Los Angeles 45, Calif.

Photo Reproduction Materials 460

A 16-page catalog, in two colors, describing complete line of photographic reproduction materials for drawings is available. The materials include silver-sensitized papers, vellums, films and tracing cloths for making negatives and prints, and also positive-to-positive prints.

One of the features of the bulletin is a guide to help in the selection of the best material for a particular job, and the use of these materials, with complete processing directions and development time. Grant Photo Products, Inc., 19000 Detroit Ave., Cleveland 7, Ohio.

Pressure Transistor 461

Bulletin 501 features a low differential pressure transmitter. The booklet describes the style H electric transmitter with ranges 0 to 2, 4, 6, 8 and 10 inches of water and with working pressure 50 lbs. per standard in. gage. Illustrations show construction, dimensions and operation. Burgess-Manning Co., Penn Instruments Div., 4110 Haverford Ave., Philadelphia, Pa.

SPEEDS...up to 20kc

WITH THE

"NOMOTRON"

COLD CATHODE DECADE COUNTER

For reliable, high-speed
Counting • Stepping • Distributing

- High cathode power output
- Instantaneous positive transfer
- Immune to photoelectric effects



Type
G10/241E

The "Nomotron" operates at speeds hitherto unattainable with tubes of this type. It contains 10 separate cathodes—providing ample output power to control external circuits *without* additional amplification.

Complete immunity to photoelectric effects assures dependable operation in brilliant sunlight or total darkness.

Full information contained in technical brochure CVX2223. Write to Dept. Y-135

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CIRCLE 457 ON READER-SERVICE CARD FOR MORE INFORMATION

Applications include:

- MISSILE GUIDANCE SYSTEMS
- TELEMETERING CIRCUITRY
- MULTIPLEXING CIRCUITRY
- AUTOMATIC MACHINE CONTROL
- DATA PROCESSING
- BUSINESS OPERATIONS AUTOMATION
- HIGH-SPEED COUNTING
- See us in the GREAT BRITAIN ROOM at the IRE Show.



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Industrial Periscopes 462
Periscopes for distant viewing of inaccessible places and hazardous processes are depicted and described in a catalog of 4 pages. Several practical examples show how they have solved observation problems. A special stroboscopic periscope is also discussed. Lenox Instrument Co., 2010 Chancellor St., Philadelphia 3, Pa.

Thermostatic Controls 463
Tubular-type thermostats that make or break an electrical circuit by responding to changes in temperature or electrical load are discussed in a booklet of 8 pages. The design, construction, operation, and applications of the thermostat are treated in detail. The brochure is illustrated with cross-section drawings and photographs of models having various lead and terminal arrangements. Charts give sizes, capacities and other information. Research, manufacturing and testing facilities are also depicted and described. The Franklin Dales Co., 180 E. Mill St., Akron, Ohio.

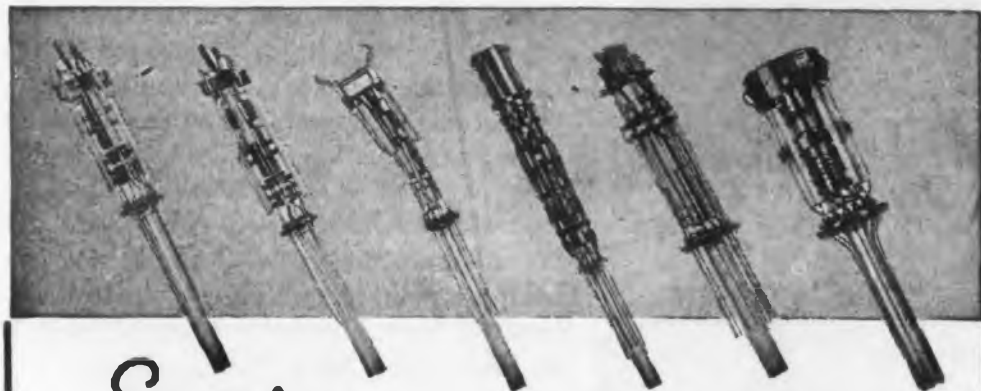
Converters and Dynamotors 464
Bulletin No. 1256A describes the converters and dynamotors which are now available, and are made to operate diesel locomotive, telephone emergency standby, marine radio, mine, forestry and other industrial communications systems.

Several models of the converter and dynamotor are shown with a wide selection of ac and dc input voltages, and output specifications up to 750 watts.

The bulletin is printed in two colors and includes descriptions, performance charts and technical data. Carter Motor Co., 2711 W. George St., Chicago 18, Ill.

Electro-Magnetic Brain 465
Bulletin No. 571 describing an electro-magnetic sensory and director system with "package" controls is now released.

The illustrated bulletin fully explains in detail the working functions of the system. Among the features are a safe-start and pulse forming network and cycle sequence control. Sensory Inc., New Vernon, N.J.



Superior manufactures superior ELECTRONIC GUN MOUNTS!

For the CRT industry, SUPERIOR offers a full range of magnetic, electrostatic and color gun mounts including mounts for the 110° narrow neck tubes . . . all precision engineered. SUPERIOR makes a complete line of electrostatic focus and deflection guns for radar and industrial purposes including character and Vidicon-type mounts. You may order standard types or we will design and build to your specifications.

Whether your order be large or small, you will enjoy all the benefits of our rigid inspection, testing and control. For complete satisfaction based on dependable service, call or write to

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BOOTHS 2321-2327



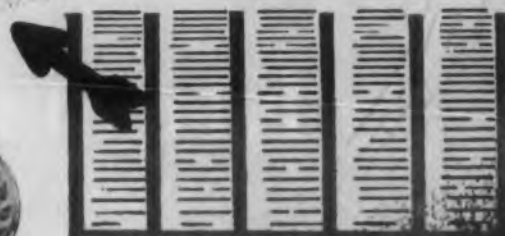
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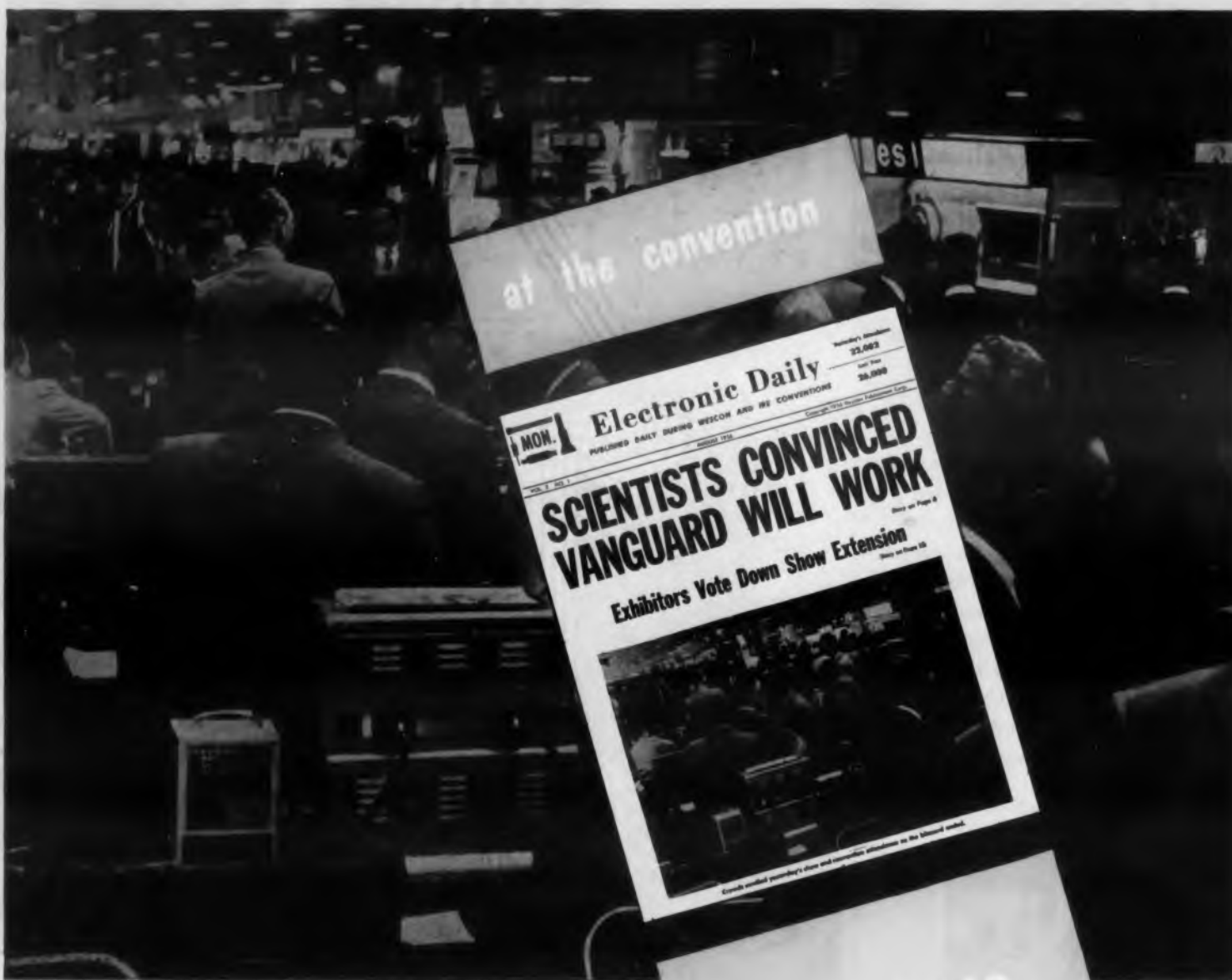
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chicago 50, illinois

AMPHENOL

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to the
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N.Y. COLISEUM
MARCH 18-21
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Electronic Daily will be your news source and guide at the Radio Engineering Show. Published each day during the convention, **ELECTRONIC DAILY** will give the news behind the news, list daily events, meetings, etc. Look for your copy ... available in major hotels or from **ELECTRONIC DAILY's** booth at the convention.

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HAYDEN PUBLICATIONS CORPORATION

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Magnetic Tape Recorder

468

Capabilities and characteristics of an instrumentation tape recorder are described in a 20-page booklet now available. Detailed specifications are also provided in the booklet, which is printed in four colors.

Numerous illustrations show transports, heads and modular electronic assemblies used with graphs provided to clarify specifications and recorder operation.

The recorders are used in data acquisition, storage, analysis and reduction, in machine and process programming and in dynamic simulation. Data may be recorded and reproduced in the dc to 100 kc frequency range on one to 14 tracks at any of six standard tape speeds, 1-7/8 to 60 inches per second. Ampex Corp., Instrumentation Div., 934 Charter St., Redwood City, Calif.

Electrical Insulating Materials

469

Illustrated and completely indexed, Catalog 20 contains 32 pages of information on electrical insulations for repair and maintenance of motors, generators and electrical or electronic equipment. Descriptions, photos, prices and ordering data are presented. Among the products covered are tying cords and twines; cotton, asbestos, and woven glass tapes; cotton, glass, and varnished or saturated tubing and sleeving; mica plates and laminates; varnished cloth and combination insulations; dispenser packaged rag paper and paper-"Mylar" insulation coils; slot insulation creaser-cutters; formed fibre or wood wedges; fibre washers; fishpaper and vulcanized fibre sheets; papers; fibre rods and tubing. Silicone varnishes, treated cloths, and laminations; baking and impregnating varnishes; and pressure-sensitive tapes. Insulation Manufacturers Corp., 566 W. Washington Blvd., Chicago 6, Ill.

Die Casting

470

A booklet on die casting with zinc alloys, presenting specific operating details on requirements of alloys which affect properties both mechanical and physical of the casting produced is now available.

It discusses gating and venting of the die—and the advantages of a heavy gate with an opening of about .040 in. or better, depending on thickness of casting.

Proper venting and use of overflow wells; gate runner design which permits the development of increased uniform pressure at the gate opening; metal injection pressure which should be used in excess of 1000 to 1600 lbs/sq in. and maintenance of proper die temperatures are explained in detail.

The booklet is illustrated and contains many interesting items. Henning Bros. & Smith, Inc., 91-127 Scott Ave., Brooklyn 37, N.Y.

Thermometers and Hydrometers 474 Tubular-Plastic Wire Markers 476

Bulletin 40 contains 24 pages of information on: thermometers and hydrometers. A complete listing of ASTM, and general and specific purpose thermometers and hydrometers is presented. ASTM thermometers are listed by number and test. Complete specifications and prices are given for all items, many of which are illustrated. The booklet also contains directions for reuniting mercury in thermometers, general facts about hydrometers and their use, and suggestions for assuring accurate hydrometer readings. Central Scientific Co., 1700 Irving Park Rd., Chicago, Ill.

A time-saving, permanent method of coding wire with plastic tubular markers is described in bulletin now available. It is used to identify complicated thermoplastic wiring circuits.

The illustrated bulletin states that the markers resist attack from oil, grease, acids and heat, and withstand temperatures of at least 150 C (302 F). E.C.P. Corporation, 6808 Wade Park Ave., Cleveland, Ohio.

Technical Catalog for 1957 477

Revised catalog of Technical Data Books is now available covering every branch of engineering. These pocket size reference books each have approximately 140 pages of authoritative data, conversion tables and general information, including current advances.

Some of the subjects covered are aeronautics, automotive and steam engineering, AC Motors & Generators, Television & FM, General Mathematics, Metallurgy and others. Lefax Publishers, Philadelphia 7, Pa.

Arms 475

"How Good is Your Arm" is a 16-page analysis of basic problems involved in arm design. Written in simple language and illustrated with numerous charts, the booklet covers such design aspects as resonance, tracking, tracking error, torsional resonance and pivot design. Fairchild Recording Equipment Co., 10-40 45th Ave., Long Island City, N.Y.



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Microsized Socket Screws 484

Microsized socket screws for electronic equipment and industrial and scientific instruments are the subject of a 4-page folder. The brochure presents descriptions, photographs, drawings, and tabular data on threads per inch, length, recommended installation torques, and shipping weight. Listed are alloy and stainless steel socket head cap and set screws in sizes from No. 0 to No. 3. Standard Pressed Steel Co., Jenkintown, Pa.

Nuclear Fuel Elements 485

"Rolling Mills for Processing Nuclear Fuel Elements" is a 12-page booklet which discusses in detail the special equipment employed in rolling and fabricating the new metals required for the atomic energy program. The text covers the solution of many unusual problems confronted in the nuclear field with regard to avoidance of radiation hazards and special rolling techniques. Ample illustrations of facilities and equipment accompany the text. Stanat Mfg. Co., Inc., 500 Shames Dr., Westbury, N.Y.

Ceramic Magnets 486

Details about Indox V ceramic magnets are presented in Bulletin 16. The 2-page sheet outlines the magnetic properties and typical characteristics of the magnet and points out its design possibilities. Also discussed are the magnet's uses, and its advantages and limitations. In addition, there is a list of available standard sizes. The bulletin is illustrated with photographs, dimensional diagrams, and a graph showing demagnetization and energy product curves for Indox V and Indox I. The Indiana Steel Products Co., Valparaiso, Ind.

Non-ferrous Alloy Chart 487

Engineers and designers who specify the use of non-ferrous alloys can speedily find detailed information in a comprehensive wall chart. Standard brass, bronze and nickel silver casting alloys—37 in all—are described. The 17 x 22-inch chart lists designations for Navy, S.A.E., A.S.T.M. and Federal specifications. Also given are chemical compositions by percentages of ingredient metals. Henning Bros. & Smith, 91-127 Scott Ave., Brooklyn 37, N.Y.

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Glass Products

490

A 65-page catalog, entitled "This is Glass," covering the manufacturing methods, applications and history of glass, has just been released.

The colorful brochure deals with such topics as "What is Glass?", "How is Glass Made?" and "How is Glass Used?" Illustrations, charts, and over 100 photographs are included in this catalog. Corning Glass Works, Corning, N.Y.

Industrial Television

491

This brochure just released covers a line of industrial television equipment. The booklet contains many illustrations of latest developments in cameras, monitors, controls, lenses and other accessories that are required for any type of camera chain.

Included are cameras with full remote control for adjustment of focus and iris apertures and for both high and low speed tilt and pan, and also listed are special weatherproof and explosion resistant housings as well as various lenses and turret heads. Philco Corp., Govt & Industrial Div., 4700 Wissahickon Ave., Philadelphia, Pa.

Research Facilities

492

Electrical Engineering Research facilities at the Admour Research Foundation of the Illinois Institute of Technology in Chicago are described in five 4-page folders. The literature explains research being conducted in the following areas: computer systems; electric machines, components, and measurements; electronic instrumentation; and communications and radio frequency applications. Armour Research Foundation, Electrical Engineering Research Dept., 10 W. 35th St., Chicago 16, Ill.

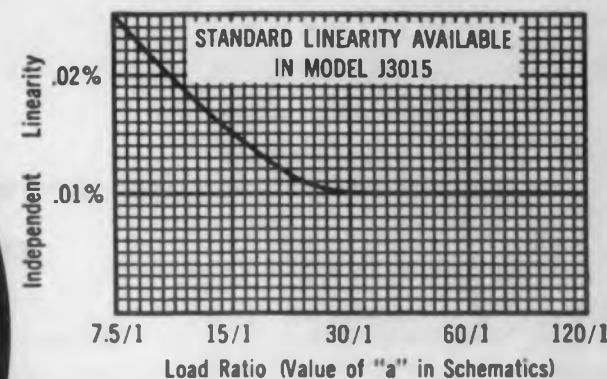
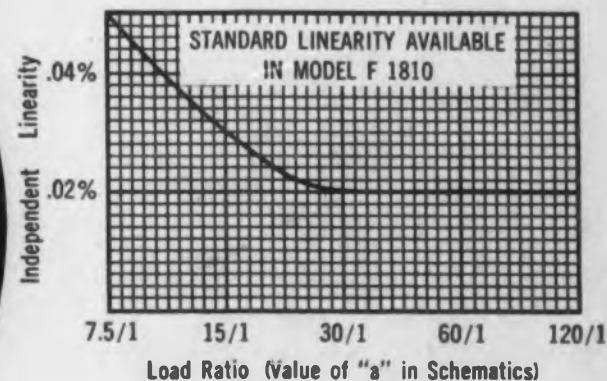
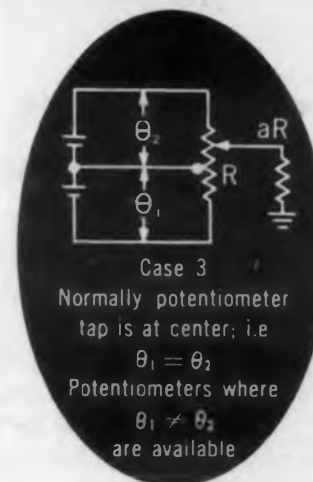
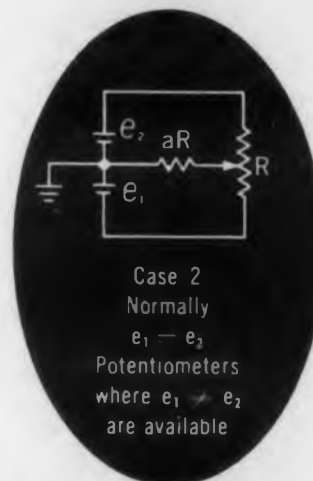
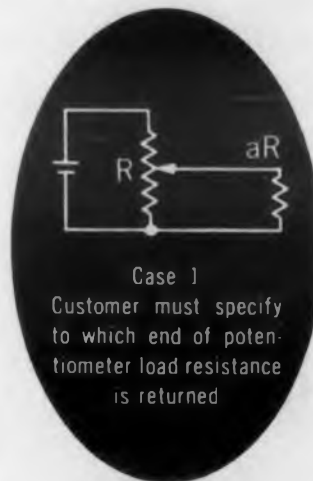
Fasteners and Parts

493

Design information on the manufacture of fasteners and small parts by the cold heading process is contained in a recent house organ issue. The 4-page illustrated publication is intended to give designers basic information on the possibilities and limitations of cold heading as a high-speed, low-cost production method for rivets, nails, screws, threaded parts, hinge pins, shafts, axles, spacers, and many other job-designed parts. John Hassall, Inc., Westbury, N.Y.

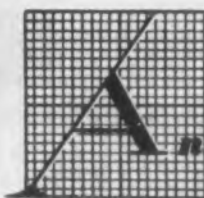
Load-Compensated Potentiometers for Driving Current-Sensitive Circuits without Isolation or Buffering

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measured in decibels, in percent of total signal or both. Results are indicated on a calibrated attenuator and on a meter. For permanent, detailed analysis, high and low impedance output are provided to drive a recorder. When equipped with its accessory servo system, the TP-625 will follow RPM, or multiples of RPM, in engines throughout an operating range.

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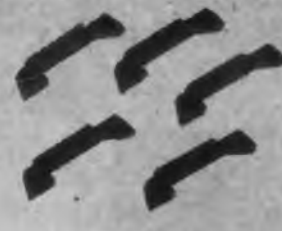
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Ideas for Design

Simplera

THIS light, compact, transistor test set features simplicity of operation, complete portability, and an accuracy better than many general junction transistor test sets available for use outside the laboratory. This is accomplished by subjecting the questionable transistor to a dynamic check as an amplifier in the common emitter configuration. A 1000 cycle, small test signal, supplied by a transistor oscillator, is applied to the base terminal of the device under test. The amplified signal from the collector is impressed on a full wave bridge measuring circuit, consisting of a 20 μ a meter movement and four 1N198 gold-bonded germanium diodes. The relatively low impedance of this bridge circuit tends to preserve the validity of the grounded emitter current amplification factor designated as (β) beta, so that the indicated value read with a factor of ten (that is, full scale reading equal to 200), is quite close to the true beta of the transistor.

The collector leakage current, I_{co} , is measured by operation of a ganged function switch which inserts the 20 μ a meter movement in series with the collector circuit while "floating" the emitter to achieve the test condition. I_{co} first appears on the 5 ma meter. If of sufficiently small magnitude, the 20 μ a meter shunt switch can be depressed.

P-n-p and n-p-n units are accommodated by switching the polarity of the self-contained battery supply and the metering circuits.

Proper bias is applied to the transistor by means of a potentiometer in the base circuit in conjunction with a current limiting resistor in series with the pot. The current is monitored in the collector circuit to preclude any degenerative effects of internal meter resistance in series with the emitter.

The test set is calibrated through the use of several premeasured units, the signal level being ad-

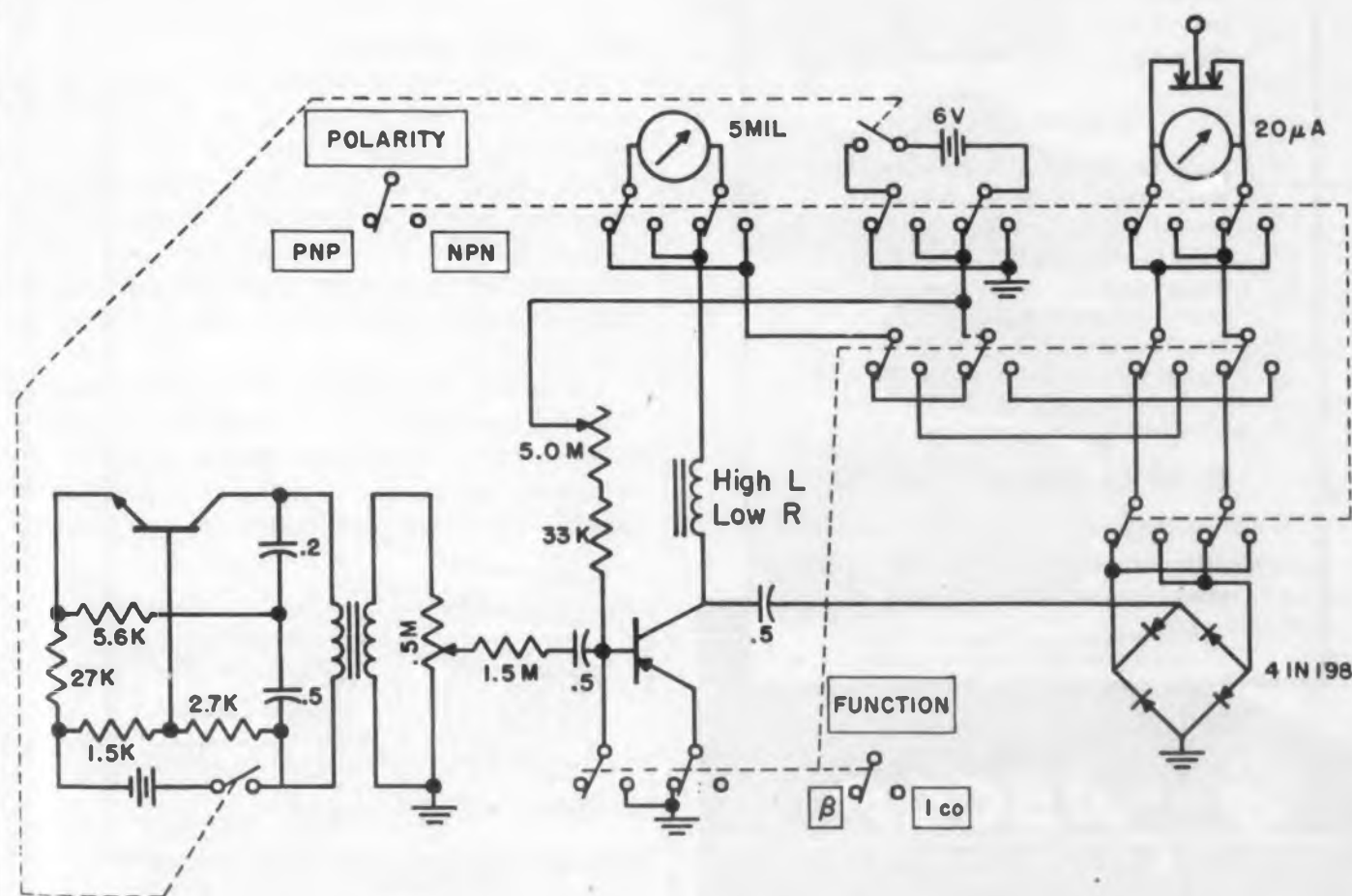
A new regular feature covering clever circuit and mechanical design ideas—individual contributors will be paid \$10 for items published.

Transistor Test Set

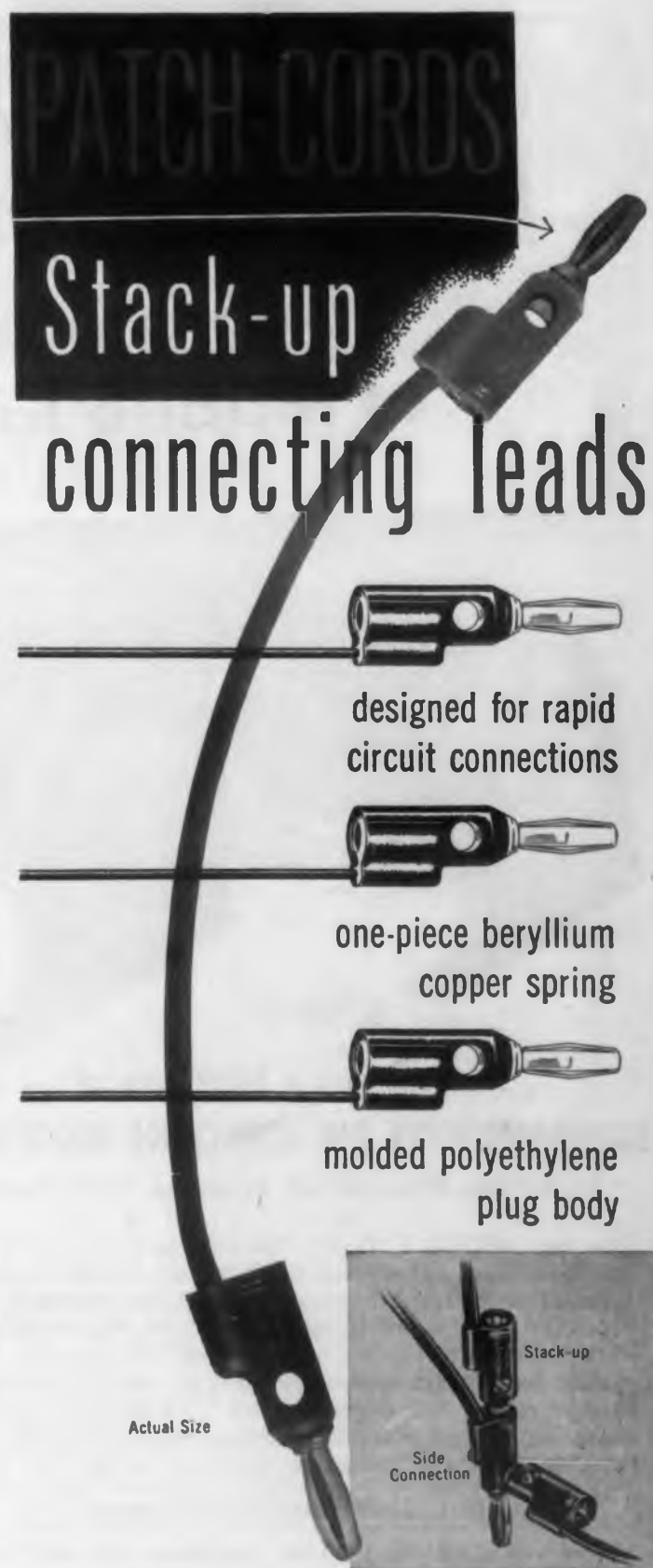
justed to correlate with the measured or calculated beta values. Adjusted this way, good correlation was obtained with laboratory test sets in measuring a batch of 50 transistors.

Construction is non-critical and the entire test set was made to fit into a volume of less than 90 cu. in. The choke in the collector circuit should be

of low resistance, so there is not too much of a drop in supply voltage. An alternate oscillator circuit using a phase shift oscillator may be used to replace the more expensive transformer. Oscillator transistor is not critical. Twelve-volt batteries are adequate.—Victor Boxer, Signal Corps Engineering Laboratories, Ft. Monmouth, N. J.



Circuit of test set for direct reading of β and I_{co} .



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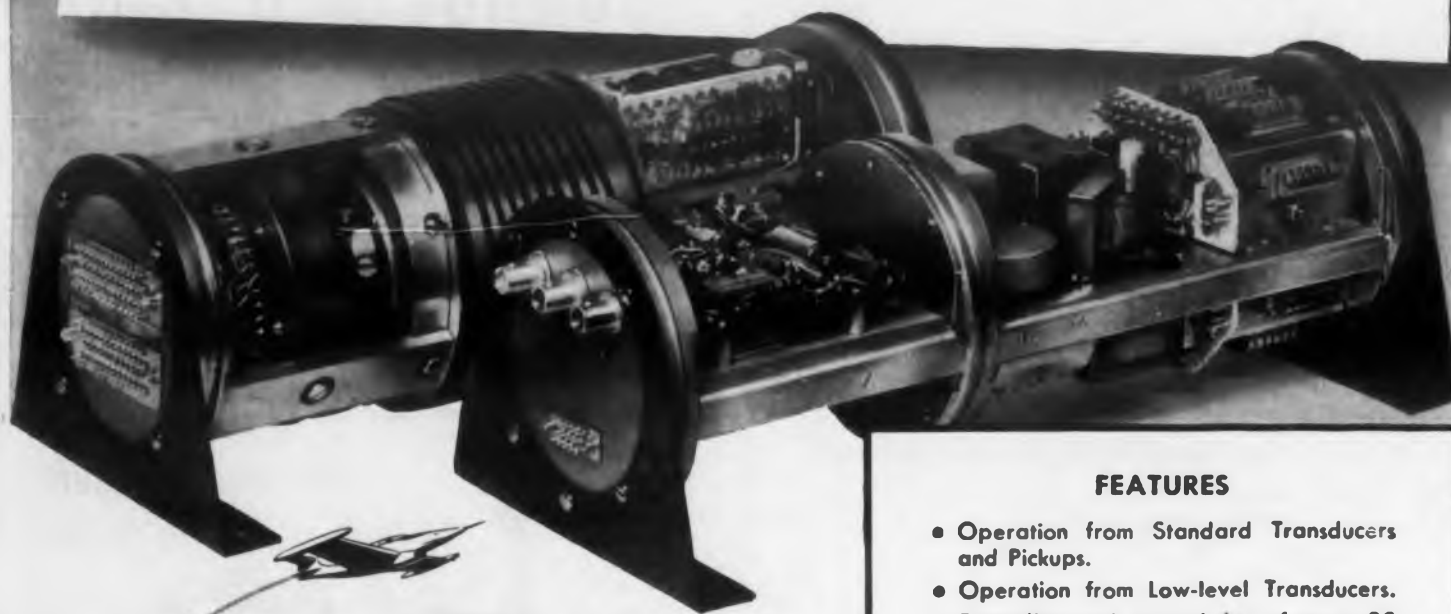


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Ideas for Design

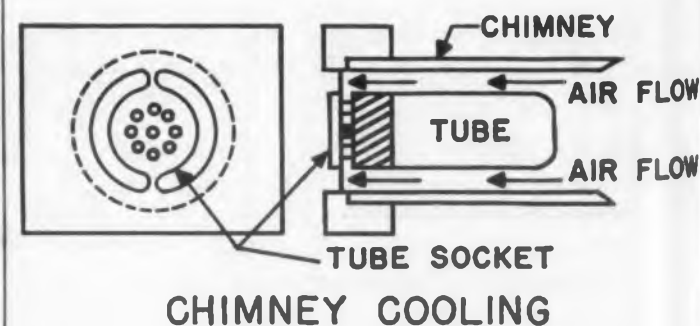
Tube Cooling with Chimneys

An electron tube envelope temperature is generally maintained below some predetermined level to obtain the desired life and performance from the tube. To accomplish this, a hollow cylinder or chimney can be placed over the tube and air forced through the annulus between cylinder and tube (Fig. 1). By properly selecting the air flow and the inner diameter of the chimney with respect to the tube diameter, the heat transfer coefficient from the tube surface can be controlled to give a desired tube envelope temperature.

Two temperatures are of interest, the maximum envelope or "hot spot" temperature, and the average envelope temperature. The hot spot temperature occurs only locally on the bulb, generally over a small area opposite the plate. The magnitude of the local hot spot is a function of the internal electrical design of the tube. Two tubes with identical envelopes and heat dissipations can produce different temperature profiles, and, therefore, different hot spot temperatures. Each tube type is a special case, and to predict the tube hot spot temperature is a difficult heat transfer problem. At the present state of the art, only if the hot spot temperature rise above average tube temperature is known for a particular tube type can the maximum envelope temperature be accurately predicted.

Three different chimneys were tested on two tubes (Fig. 2) over a range of air flows. Both tubes were pentode amplifiers with T-9 bulb types. One of the tubes was internally shielded while the other was internally unshielded. Temperature difference between the tube envelope and inlet air was recorded for each flow rate. Chimneys of three different inner diameters were tested: 1-5/16, 1-3/8 and 1-7/16 in.

The results are shown in Fig. 3. The internally shielded tube envelope operated at approximately uniform temperature over its entire surface and, therefore, the average envelope temperature and maximum envelope temperature are synonymous for



CHIMNEY COOLING

Fig. 1. Chimney Cooling.

this tube. The internally unshielded tube, however, had a hot spot temperature considerably above that of the internally shielded tube.

Melvin Mark, consulting engineer, 1384 Mass. Ave., Cambridge, Mass. Formerly with Raytheon Mfg Co.

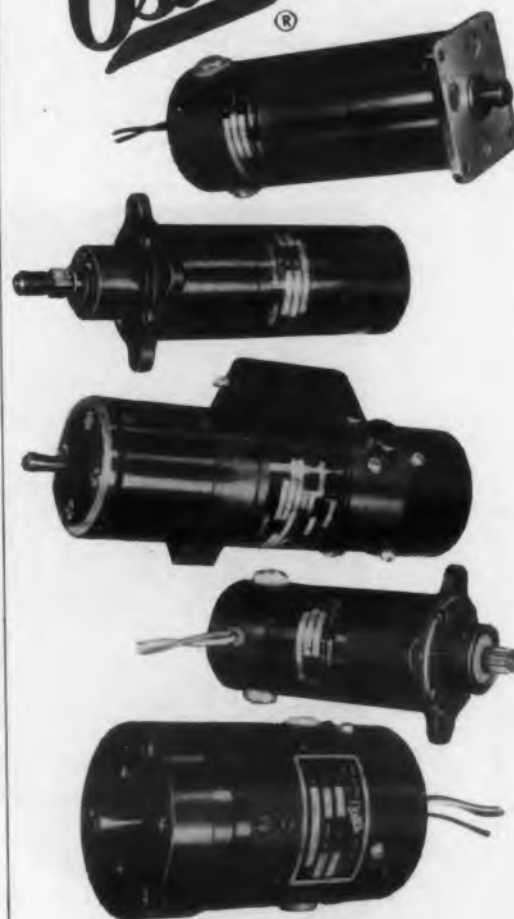
*Based on a paper presented at the National Conference on Aeronautical Electronics, May 1956.

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5.68:1	1800	28	24-32	0.4	1800	5.0	1.0	-55° To +85°C		13	3.777	P.M. GOVERNOR	FACE	13R-9102-00
17.9:1	600	28	24-32	0.4	600	12.0	1.0	-55° To +85°C		13	3.930	P.M. GOVERNOR	FACE	13R-9102-06
32.3:1	300	28	24-32	0.4	300	12.0	1.0	-55° To +85°C		13	3.935	P.M. GOVERNOR	FACE	13R-9102-02
67:1	150	28	24-32	0.4	150	12.0	0.8	-55° To +85°C		13	4.092	P.M. GOVERNOR	FACE	13R-9102-06
85:1	150	27.5	-	.25	130	50.0	0.7	-55° To +85°C		13	4.095	P.M.	FACE	13R-9101-11
109:1	100	28	24-32	0.4	100	32	0.8	-55° To +85°C		13	4.064	P.M. GOVERNOR	SYNCHRO	13R-9102-12
109:1	100	27.5	-	0.4	175	30	0.5	-55° To +100°C		13	2.843	P.M.	FLANGE	13R-9104-01
125:1	75-90	28	-	.25	70-85	20	0.3	-55° To +71°C		13	3.920	P.M.	FACE	13R-9101-13
157:1	60	28	24-32	0.4	60	12.0	0.8	-55° To +85°C		13	4.095	P.M. GOVERNOR	FACE	13R-9102-03
295:1	48	35	-	.25	40	160	0.8	-55° To +71°C		13	4.038	P.M.	FACE	13R-9103-01
333:1	30	28	24-32	0.4	30	12.0	0.8	-55° To +85°C		13	4.317	P.M. GOVERNOR	FACE	13R-9102-04
410:1	15	27	25-29	0.3	15	8.0	0.3	-55° To +85°C		13	4.400	P.M. GOVERNOR	FACE	13R-9102-11
1043.8:1	5-10	27	24-30	0.15	7	30	0.2	-55° To +71°C		13	4.450	P.M. BRAKE	FACE	13R-9105-01
1044:1	5-10	27	24-30	0.15	7	30	0.2	-55° To +71°C		13	3.910	P.M.	FACE	13R-9101-12
2214:1	3-4	6	-	1.2	3.4	30	1.2	-55° To +71°C		13	4.454	P.M.	FACE	13R-9101-04
3241:1	5.5	35	-	.35	5.5	18	0.4	-55° To +71°C		13	4.454	P.M.	FACE	13R-9101-03
5033:1	1.3	30	-	.13	1.3	30	0.15	-55° To +71°C		13	4.016	P.M.	FACE	13R-9101-10
21,707:1	2-3	120	-	.25	2-3	12	0.25	-55° To +71°C		13	3.475	P.M.	FLANGE	13R-9101-16
322:1	90	110	-	0.2	30	240	0.3	-55° To +71°C		15	3.915	SPLIT SERIES	FLANGE	15R-9201-01
407:1	22	27	-	0.2	20	8	0.2	-20° To +50°C		15	3.900	SPLIT SERIES	SYNCHRO	15R-9201-03
433:1	30	26	-	0.6	25	260	1.2	-50° To +80°C		15	3.110	SHUNT	FACE	15R-9201-02
955:1	33	27	-	0.6	12-18	420	1.0	-55° To +50°C		15	4.410	SPLIT SERIES	FLANGE	15R-9201-00
28:1	240	27.5	24-29	0.65	240	40	1.3	-10° To +71°C		17	5.315	SHUNT GOVERNOR	SYNCHRO	17R-9251-01
4.28:1	1000	28	-	0.6	1000	12	1.05	-30° To +55°C		24	4.840	SHUNT GOVERNOR	FACE	24R-9451-01

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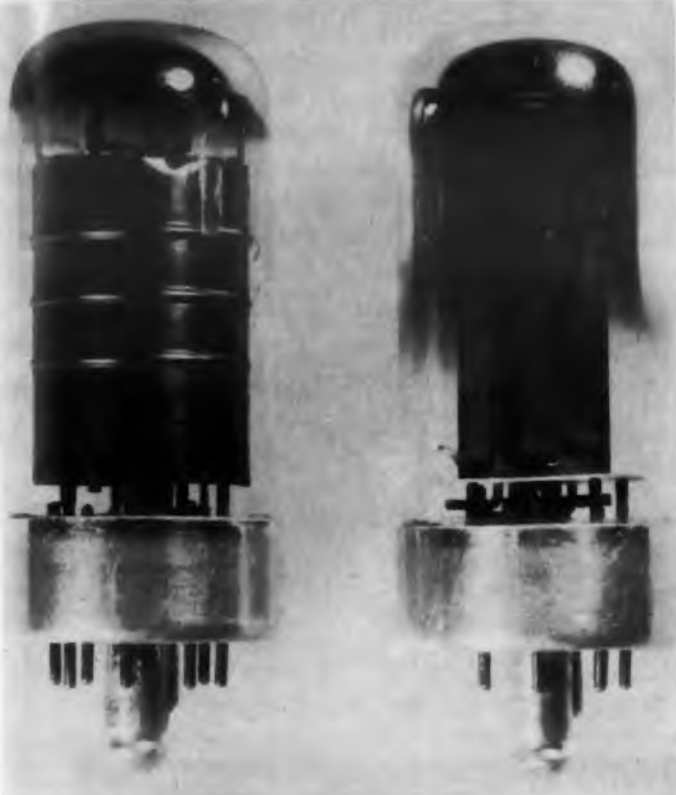


Fig. 2. Tube types tested.

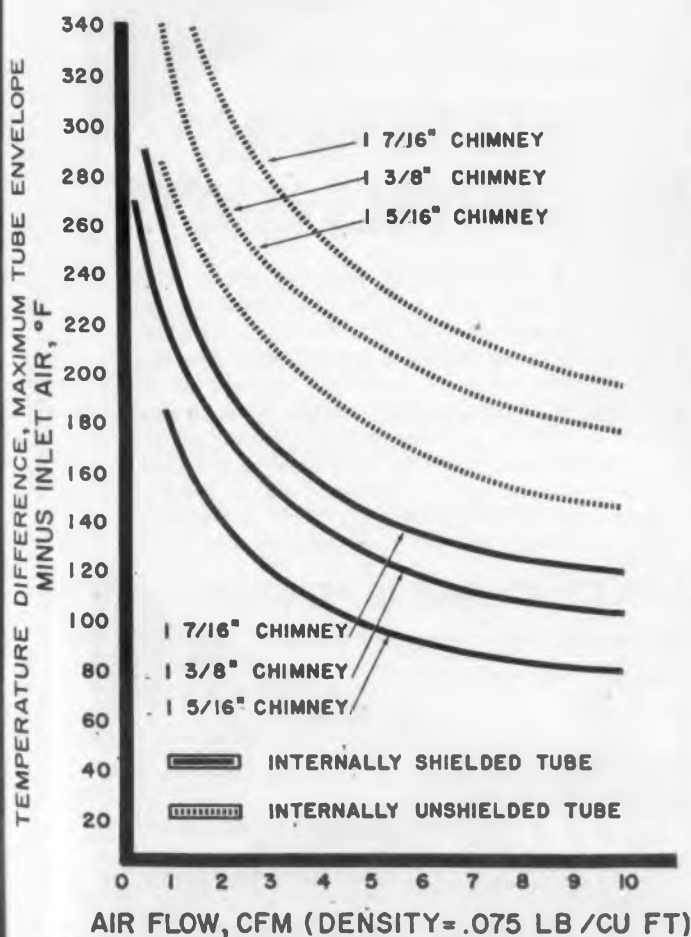


Fig. 3. Effect of various sized chimneys on cooling.

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Report Briefs

Direction Finding System

A sector-type radio direction finder bearing computer-recorder, a bearing integrator, related equipments, and techniques are described. The computer samples the intermediate frequency outputs of a twin-channel RDF system at a 25 cps rate, calculates the indicated bearing for each sample via a logarithmic analog, and (sample for sample) delivers at the output a stretched pulse the amplitude of which is proportional to the bearing deviation from a preset reference zero. *PB 122982 Equipment and Techniques for Sector-Type Radio Direction Finder Bearing Data Computing, Recording, and Reduction*, Albert D. Bailey, Illinois Engineering Experiment Station, Order from Library of Congress, Washington 25, D.C., Aug. 1955, 57pp, Microfilm \$3.60, Photocopy \$9.30.

VLF Ground Propagation

Amplitude and phase data for low, very low, and ultra-low frequency ground-wave propagation is given in this report. Curves detailing amplitudes and phase of waves in the 200 cps to 500 kc band over distances from 1 to 1500 miles are presented. Although ionospheric effects were not considered and the total field at over 200 miles may be modified, special techniques can be applied to correct for the sky wave, and lend significance to the curves, out to their limit. *NBS Circular 574, Amplitude and Phase Curves for Ground-Wave Propagation in the Band 200 Cycles per Second to 500 Kilocycles*, James R. Wait, and H. Herbert Howe, Supt. of Documents, U.S. Govt. Printing Office, Washington 25, D.C., May 1956, 17 pp. \$0.20.

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Quality Control

Product description techniques and inspection risks are detailed in two RETMA bulletins. Methods of efficient description of products are outlined, and AQL sampling procedures are described. *Quality Acceptance Bulletins No. 4 (Product Description) and No. 5 (Inspection Risks)*, Order from Quality Acceptance Procedures Committee, Engineering Dept., RETMA, 11 W. 42nd St., New York 36, N.Y., 4pp ea. \$0.25.

Aerosol Sampler Controlling Transmitter

This transmitter is the FM type and operates on a frequency of 39.3 mc with 1 kw power output. The transmitter is designed so that one or all of the 6 control tones may be imposed upon the carrier at one time without interaction. The preliminary testing was done in the AF Armament Center's Heavy Systems Bldg. Final test was accomplished in the field under simulated operating conditions. *PB 120012 Acceptance Test of the Aerosol Sampler Controlling Radio Transmitter*, D. M. Dechert, July 1955, Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 52, D. C., Microfilm \$2.40, Photostat \$3.30.

Transmission Line Heat Losses

Two expressions are derived for the ac resistance per unit length due to conductor heating losses in a microwave strip transmission line with rectangular inner conductor of arbitrary dimensions. One expression is accurate in the low-impedance range; the two check well in the region of intermediate impedance. *PB 122378 Conductor Heating Losses In Strip Transmission Lines With Rectangular Inner Conductors*, R. L. Pease, Tufts College, Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D. C., Dec. 1954, 23 pp, Microfilm \$2.70, Photocopy \$4.80.

Portable Radar Simulator

A portable radar simulator designed to train air traffic controllers in guiding simultaneously three aircraft, properly spaced, into a landing system, and the final approach is described. Several changes in the design of the device are recommended as a result of basic radar training of control personnel at selected airports. *PB 111847 Development of a Portable Radar Simulator*, T. K. Vickers, OTS, U. S. Dept. of Commerce, Washington 25, D. C., Report 285, Sept. 1956, 12 pp. \$0.50.

The Technitrol Variable Pulser

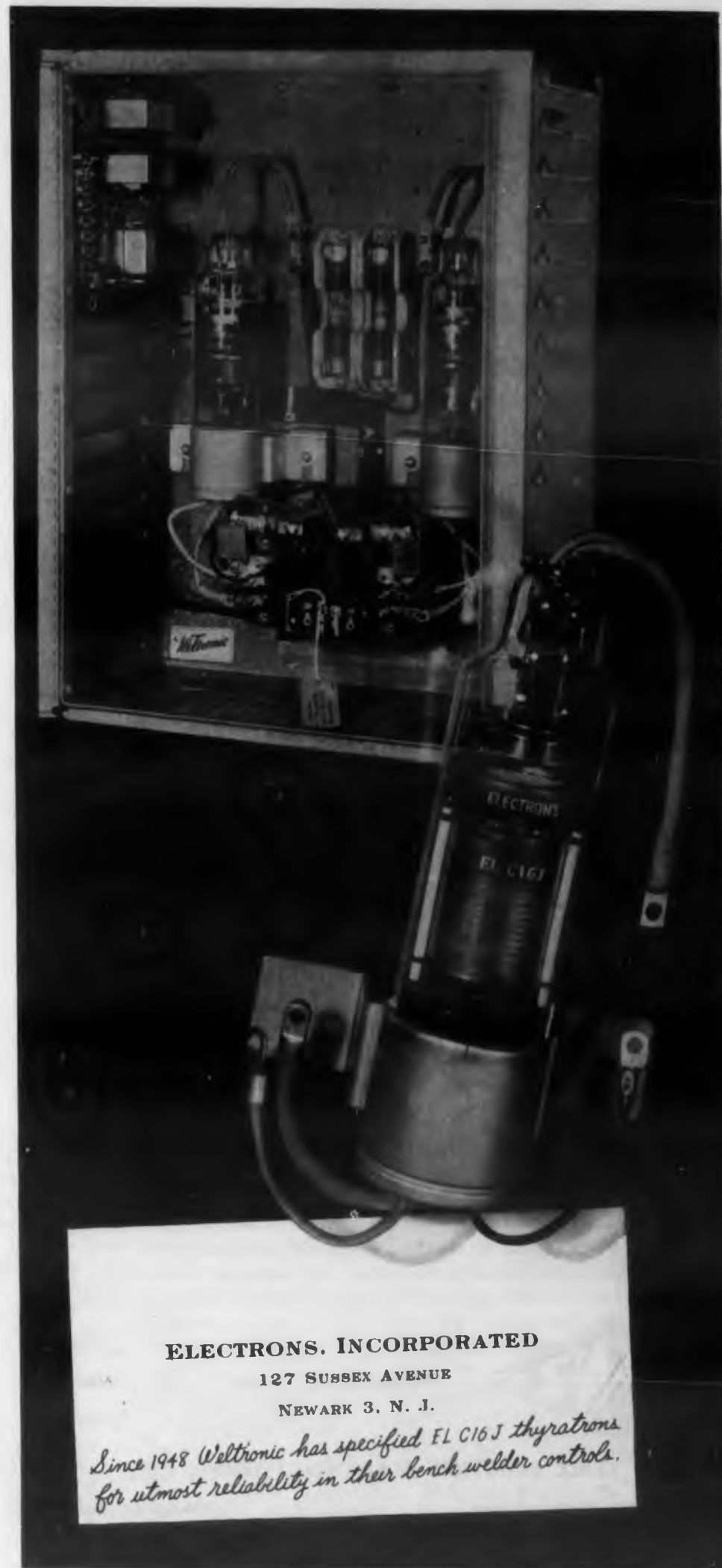


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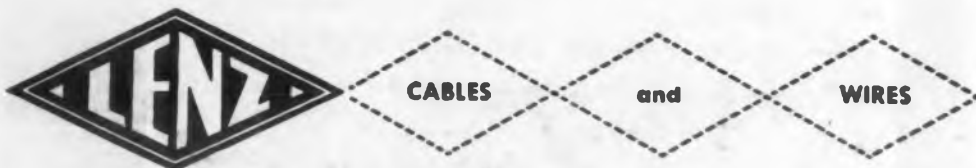
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Patents

Dividing Circuit

Patent No. 2,747,094. R. M. Walker. (Assigned to the United States of America)

Multivibrator circuits are frequently used for frequency dividing, however, as a class they are unstable. Also the value of circuit elements and stability of the voltage source must be relatively precise since they are critical. When it is desired to divide the frequency of a discontinuous series of pulses, it is desirable that the multivibrator be quiescent or not be free-running during the periods when there are no input pulses.

The circuit illustrated provides a multivibrator which overcomes the enumerated disadvantages of the usual circuit.

In the frequency dividing circuit shown in the figure, the triodes 10 and 11 are the multivibrator tubes. Because these two tubes use a common cathode resistor 12 and the grid of the tube 10 is grounded, the tube 11 is normally conducting and the tube 10 is normally non-conducting with the result that the circuit is quiescent when there are no input pulses. The input connection is made with the anode of the tube 10 through a diode 17. A negative pulse ap-



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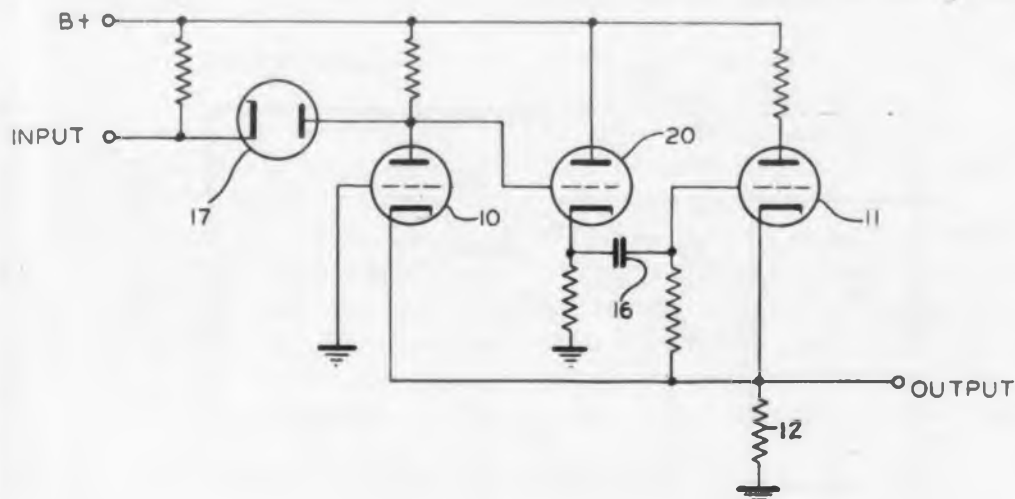
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to the cathode of the diode is transferred through the condenser 16 to the control grid of tube 11 so that this tube becomes non-conducting whereupon tube 10 becomes conducting. When the negative charge leaks off of condenser 16 the tube 11 becomes conducting and tube 10 is returned to non-conducting condition. When the tube 10 becomes conducting the potential on the anode of the tube 10 drops so that the diode 17 no longer can pass a positive input pulse until conduction is re-

stored through tube 10.

A simplified circuit from that illustrated in the figure connects the anode of the tube 10 directly with control grid of tube 11 through condenser 16. By making this connection through a cathode follower tube 20 as shown, the rapidity of discharge of the condenser 16 is increased which restores the circuit to its initial condition in a shorter time. As a consequence the range of the circuit to divide the input frequency into a higher divided frequency is increased.



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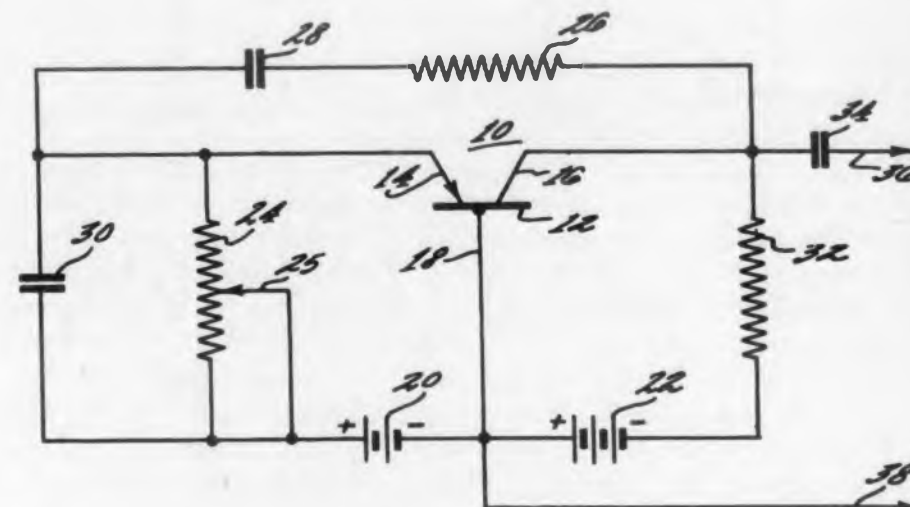
Semiconductor Signal Generator

Patent No. 2,745,960. B. D. Griffith. (Assigned to Radio Corp. of America.)

Feedback oscillators using vacuum tubes requiring either two tubes or a multi-element tube in order that the feedback voltage be in phase with the input voltage. A resistance capacity network can be used to achieve the same result but it is complicated. An effective oscillator of simple feedback circuitry can be made with a three element transistor. Such oscillator receives the full advantage of the inherent

advantages of this type of electronic element in requiring no heater circuit, being small in size and having high degree of ruggedness.

The transistor 12 includes the usual emitter and collector electrodes 16, 14, 16 respectively which are biased by the directional voltage sources 21 and 22. Feedback between the collector electrode and the input emitter electrode is secured by resistor 26 and condenser 28 connected in series between these electrodes and a resistor capacitor parallel combination of



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istor 24 and the capacitor 30 connected between the emitter and base electrodes. The selection of the values of resistors and capacitors the feedback energy can be made large enough to overcome the losses in the circuit which is the condition necessary for oscillation. The frequency is controlled by the value of the resistor 24 which may be adjusted by the slider 25. This oscillator is considerably simpler than its equivalent vacuum tube oscillator circuit.

Patent Briefs

Limited Amplifier

Patent No. 2,770,684. (Inventor, R. E. Thomas, AEC)

This patent relates to amplifier circuit designed to prevent a very large signal, impressed upon the amplifier, from overloading the interstage coupling capacitors, thereby rendering the amplifier inoperative. The plate resistor of the first tube is limited so that the maximum voltage change is less than the change in the cathode voltage of the second tube so that substantially no grid current flows in the second tube and the coupling capacitor re-

mains uncharged. The usefulness of the amplifier circuit is thereby increased for low level amplification.

Pulse Analyzer

Patent No. 2,760,064. P. R. Bell (Assigned to U. S. Atomic Energy Commission.)

An electrical pulse analyzer was designed to give an accurate indication of when the pulse conforms to certain preselected requirements. This function is particularly useful in proportional and scintillation counters which are extensively used in the nuclear field. In order to indicate the pulses above one selected threshold but below another, two channels are used each having a pulse height discriminator. The channel having the lower level discriminator has a delay circuit built in to compensate the time delay between passage of the two thresholds. The channel of the higher discriminator has a storage section to compensate for the shorter duration of the pulse seen by that circuit. An anti-coincidence circuit places these impulses in opposition so that output signal is produced only when the pulse crosses the lower but not the higher discriminator level.

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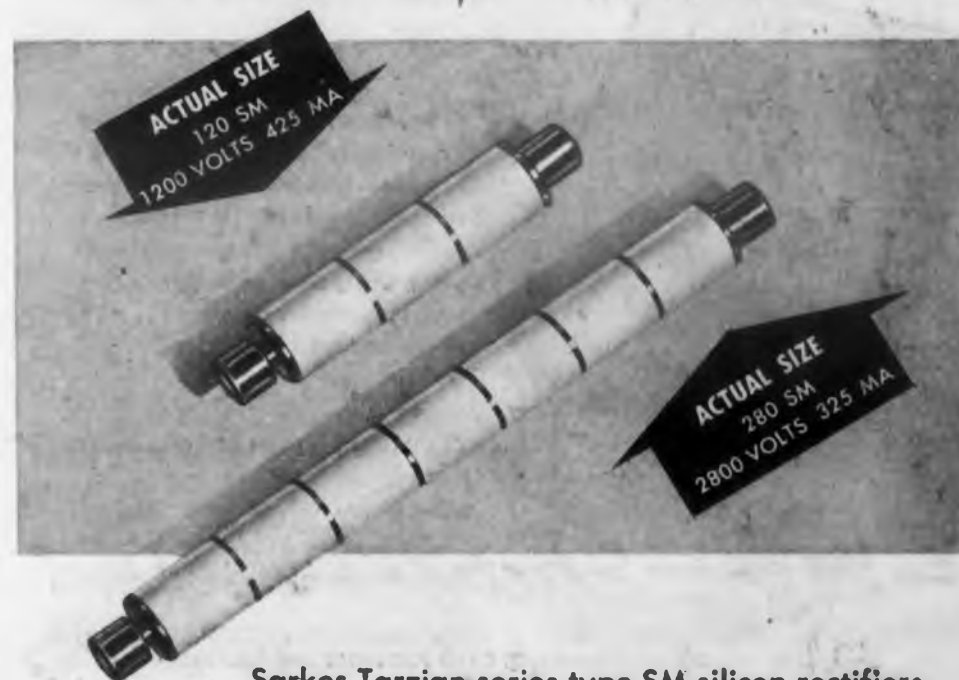
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120SM	1200	840	.425	.212	1.06	.530	4.25	2.12	25.5	12.7	1N1109
160SM	1600	1120	.40	.200	1.00	.500	4.00	2.00	24.0	12.0	1N1110
200SM	2000	1400	.375	.187	.940	.470	3.75	1.87	22.5	11.2	1N1111
240SM	2400	1680	.35	.175	.875	.437	3.50	1.75	21.0	10.5	1N1112
280SM	2800	1960	.325	.162	.812	.405	3.25	1.62	19.5	9.7	1N1113

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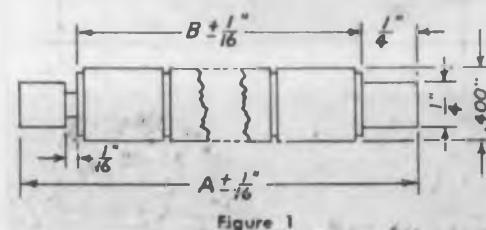


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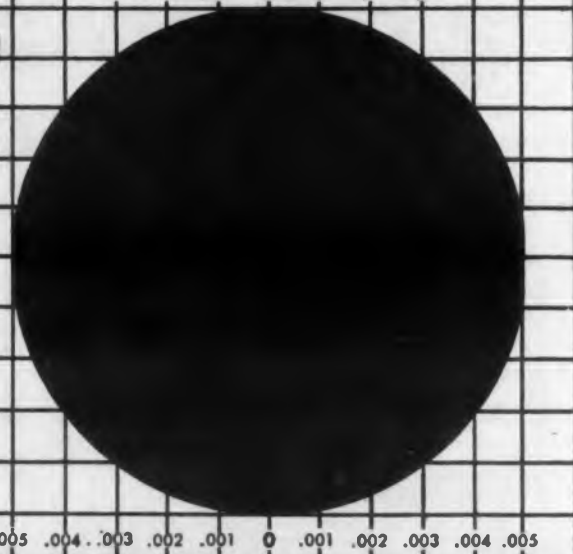
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Books

Documentation In Action

Edited by *Jesse H. Shera, Allen Kent and James W. Perry. Reinhold Publishing Corp., 430 Park Ave., New York 22, N.Y., 471 pages, \$10.00.*

This book records the proceedings of the 1956 Western Reserve Conference on the Practical Utilization of Recorded Knowledge. It presents a concerted up-to-date review of the science and art of effectively organizing and utilizing recorded information. Recent advances are summarized and evaluated with particular attention to systems, equipment for making information available as needed, use of recorded information in research and in decision-making and education for librarianship.

Blocking Oscillators

Edited by *Alexander Schure. John F. Rider Inc., 480 Canal St., New York 13, N.Y., 6 pages, \$1.25.*

In nonmathematical terms, this text attempts a comprehensive explanation of the operation features, design factors, and important applications of blocking oscillator theory. Particular attention is given to the role of the transformer. The book also contains qualitative discussions of the quiescent interval conduction due to grid bias, conduction due to regeneration, conduction due to circuit elements, the combined conduction effects, determination of conduction duration, termination of conduction and shock excited circuits.

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Electronics, Waves and Messages

John R. Pierce. Hanover House, Garden City, N.Y., 318 pages, \$5.00.

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electronics. In an entertaining style, Dr. Pierce has attempted to explain electronics to the general reader and to acquaint technically trained men with specialties other than their own.

Electronics Data Handbook

Edited by Nelson M. Cooke. Allied Radio Corp. 100 N. Western Ave., Chicago 80, Ill., 64 pages, 35¢.

For this handbook, Nelson Cooke has selected the formulas and data most often needed in radio and industrial electronics. Despite the fact that the information it contains is basic and for the most part obtainable from other sources, the guide should be a convenient and useful reference for design engineers. Formulas needed for basic circuit analysis, transmission line calculations, determination of vacuum tube characteristics, resonance calculations and meter calculations are among the many listed. Tables for directly interchangeable radio and TV picture tubes, interchangeable batteries, decimal equivalents of fractions, pilot lamps, logarithms and trigonometric functions are included.

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Russian Television Camera Tube

J. George Adashko

A NEW photoconductive television pickup tube of the Vidicon type was recently developed in Russia and designated LI-18.

The choice of material for the photoconductive target of the tube was dictated by the following design objectives:

1. Dark resistivity on the order of 10^{12} ohm-cm.
2. Sensitivity (ratio of dark to bright sensitivity) on the order of 2-3 with target illumination of one lux and one volt applied to the conductive layer.
3. Spectral photo-conductivity characteristics matching the operating conditions of the tube.
4. Minimum picture lag.

A study of various photo-conductive materials of the sulfide and selenide types has shown that the material most closely meeting the above requirements is stibnite (antimony tri-sulfide).

Pickup Tube

A schematic diagram of the tube is shown in Fig. 1.

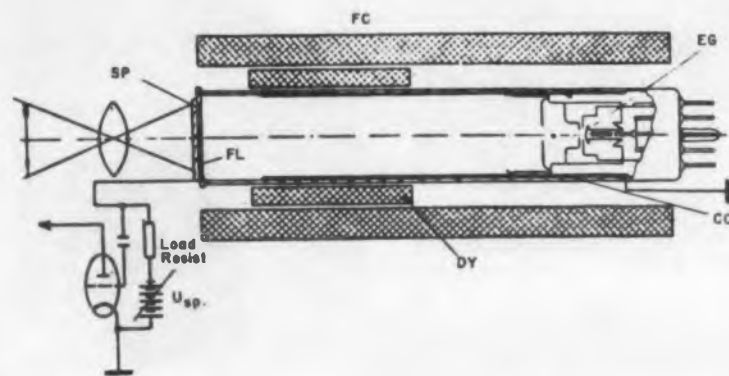


Fig. 1—Schematic diagram of LI-18 tube installation: SP—signal plate; FC—photo-conductive layer; CC—conductive cover; EG—electron gun; DY—deflecting yoke

The sensitive element employed is a thin layer of antimony tri-sulfide, which is deposited on the signal plate. One side of the layer is exposed to the scanning beam from the electron gun, and the other is illuminated by the optical image. The scanning beam is focused by means of an external uniform magnetic field reduced by a long focusing coil (FC) and is swept horizontally and vertically over the surface of the target by a magnetic deflection yoke (DY).

Fig. 2 shows the variation of the potential of a point (elementary area) on the raster. Before it is touched by the beam (Fig. 2a) the point is at potential U_{sp} (signal-plate voltage) relative to the collector, owing to the dark conductivity of the layer. When the electron beam makes contact with the point, the secondary emission charges the point to a certain higher potential. During the time between scans, leakage in the photo-conductive layer discharges the point, and its potential again nearly equals that of the signal plate. The second scan will again charge the point to a value

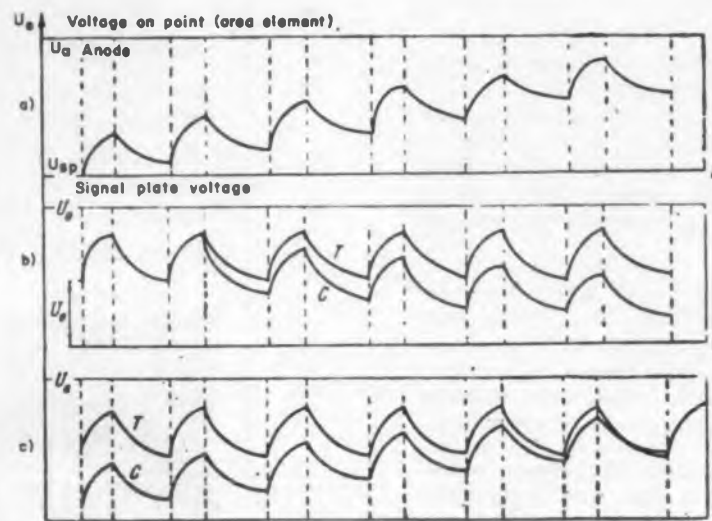


Fig. 2—Variation of potential: a—target point dark when scanned by electron beam; b—after start of target-point illumination; c—after conclusion of target-point illumination; T—point not illuminated; C—point illuminated.

approaching the anode potential, and the process will repeat until a steady state is reached, at which the rise in potential at the time of scanning is exactly compensated by the drop in potential due to leakage between scans.

Illumination increases the sensitivity of the photoconductive layer and reduces the resistance of the scanned point. This in turn decreases the dielectric time constant of the photo-conductive layer, and the steady-state values of the upper and lower potential thus become functions of the image brightness (Fig. 2b).

As in all iconoscopes, the image signal is produced in photo-conductive tubes at the instant of the scanning by the variable component of the secondary emission current that flows from the target to the collector. Passage of the electron beam from a dark point to a bright one changes the secondary-emission current in the collector circuit. The a-c component of the current flows in the signal-plate circuit and produces

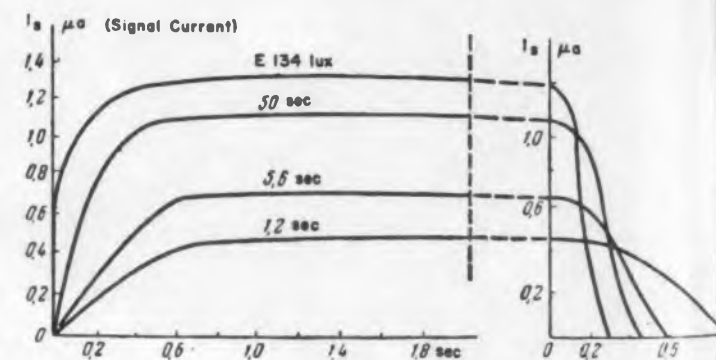


Fig. 3—Rise and fall time of signal at various values of tube illumination.

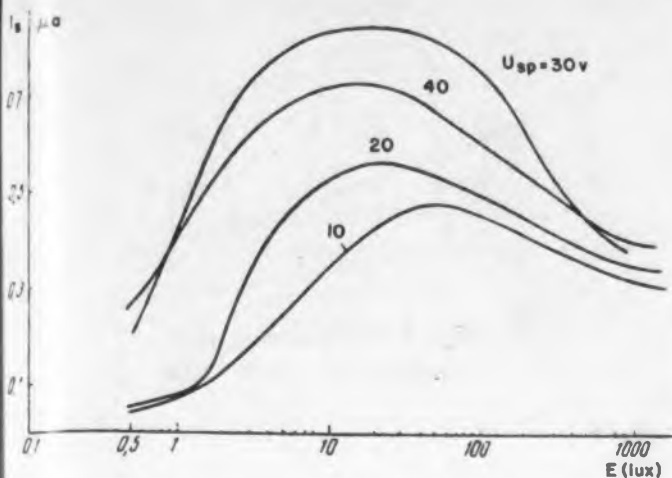


Fig. 4—Illumination characteristics of LI-18 tube

ess with a voltage drop across the load resistance, which is connected at the input of the television-channel pre-amplifier.

Picture Lag

A photo-conductive pickup tube introduces a time lag in signal storage and pick-off. Fig. 3 shows the rise and fall time of the signal for various values of target illumination.

A study of this lag shows that it is due principally to the time required to re-establish the potential equilibrium upon change in illumination. Experimental and theoretical investigations have shown that this lag can be reduced by one of the following measures: reduce the working voltage on the target, bringing it closer to the anode voltage; increase the beam current; reduce the gamma of the tube; reduce the coefficient of secondary emission of the photo-conductive layer and reduce the resistance of the layer (thereby reducing the time constant) by using lower-resistivity material; use bias lighting, supplementary heating, or higher target illumination.

Characteristics of the LI-18 Tube

The illumination characteristics shown in Fig. 4 establish the operating range of target illumination at various values of signal-plate voltage. The curves show that there is an optimum target illumination for all signal-plate voltages. This optimum depends on the physical and chemical constants of the layer and fluctuates from tube to tube. It is seen that to obtain the maximum useful signal it is necessary to work at the optimum signal-plate voltage, which ranges from 20-60 v (with respect to the anode). If low-signal-plate voltages (0-20 v) are used to reduce the picture lag, the target illumination must be increased to approximately 100 lux, and the resultant signal current is 0.1-0.4 microampere.

The temperature characteristics are shown in Fig. 5 and make it possible to determine the permissible



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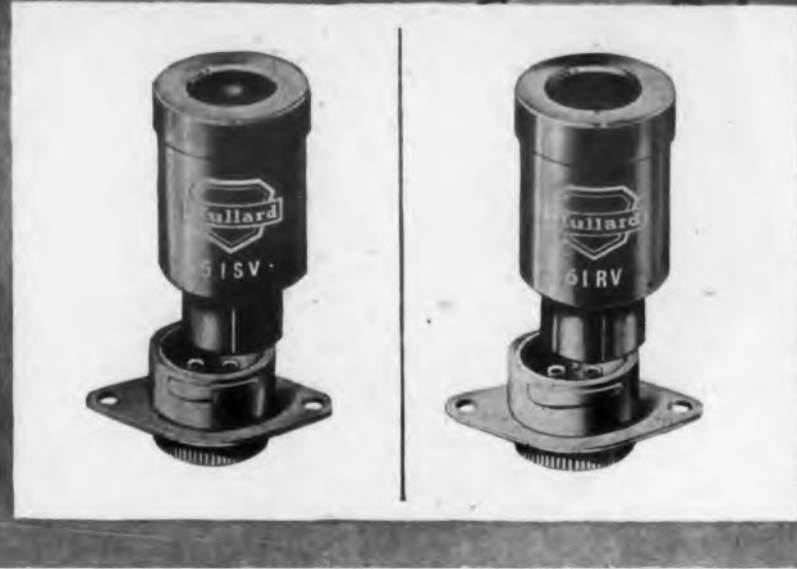
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Max. applied voltage	250V	100V

Sensitivity

a. Tungstenlight source at 2700°K	3.0mA/lumen	300 μ A/lumen
b. Black body at 200°C (radiation) energy 5.82 μ W; chopper frequency 800c/s; amplifier bandwidth 50c/s)	180V r.m.s./W peak to peak	1.66V r.m.s./W peak to peak

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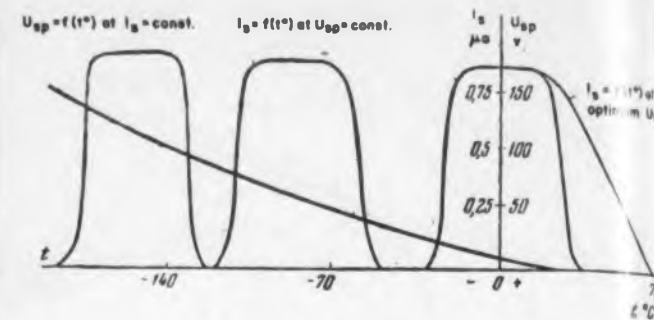


Fig. 5—Temperature characteristics of LI-18 tube

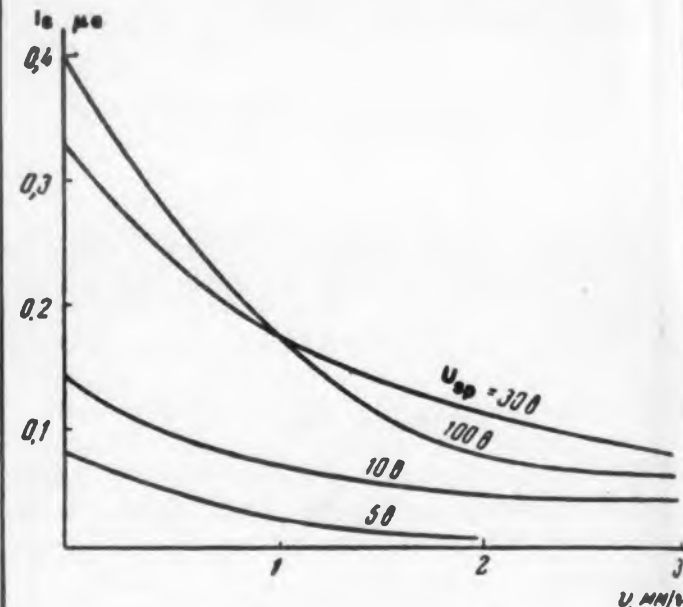


Fig. 6—Signal current (microamperes) vs. target speed, mm/sec

range of ambient temperatures. A change in temperature changes the conductivity of the layer, necessitating an adjustment in signal-plate voltage to keep the signal current constant. The curve marked $U_{sp} = f(t^\circ)$ gives the approximate variation of the working signal-plate voltage with target temperature at a constant signal.

Fig. 6 shows the variation of the signal current with the speed of the transmitted object at various signal-plate voltages. These curves were plotted using a special test pattern which was projected at various rates of speed required to obtain the prescribed image definition. This curve shows that as the speed of the object increases the signal current decreases for all signal-plate voltages, but that this decrease is at a minimum for the optimum voltage. Thus, for example, to use the tube at a projection speed of 3 mm/sec in the target plane it is necessary to employ a signal-plate voltage ranging from 0 to 50 v and varying from tube to tube.

Fig. 7 shows a plot of image definition vs. target illumination at various object speeds. Increasing the target illumination increases the definition up to a certain point, owing to the increase in the sensitivity

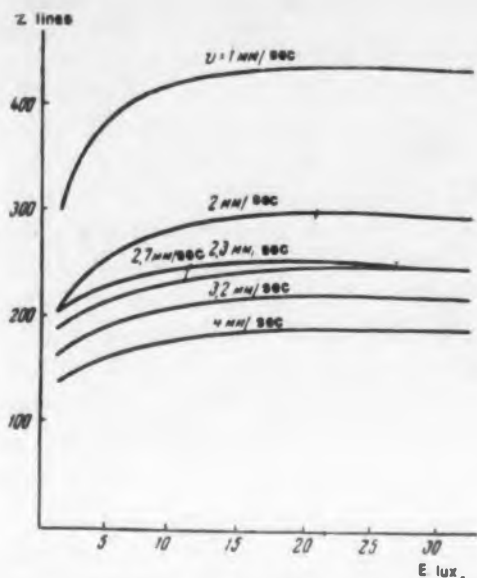


Fig. 7—Variation of definition (Z) with illumination (E) in lux for various object speeds.

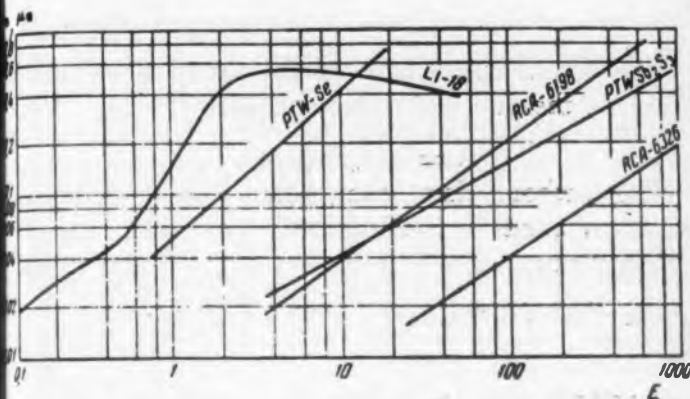


Fig. 8—Comparison of illumination characteristics of several photoconductive tubes; PTW-Se Resistron, LI-18, RCA 6198, PTW Sb₂S₃ Resistron, Motion-picture vidicon RCA-6326.

of the photo-conductive layer. The definition decreases as object speed decreases.

Investigations of the illumination and picture-lag characteristics of the LI-18 tube make it possible to establish the optimum operating conditions of the tube. For example, maximum current signal (in the transmission of still images) is obtained with target illumination on the order of 2-20 lux and with 50-100 v on the signal plate. The resultant signal current is 0.5-1 microampere with image definition up to 600 lines, although picture lag reduces both signal and image definition. The recommended optimum for the transmission of moving images is 5-50 lux target illumination and 10-50 volts signal-plate potential. Under these conditions, if the image projection does not move faster than 3 mm/sec, it is possible to obtain a signal current from 0.2 to 0.8 microampere at a definition up to 300 lines.

Fig. 8 compares illumination characteristics of several American and German tubes with the LI-18.

Abstracted from an article by N. L. Artem'ev, V. K. Sokolov, and S. K. Temirlazeva; Radiotekhnika i Elektronika No. 2, 1956, pp 245-252.

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What the Russians Are Writing

J. George Adashko

Contents of Radiotekhnika i Elektronika, No. 4, 1956

Equation for the Frequency of a Toroidal Cavity, V. A. Tepliakov, B. K. Shembel', (4 pp, 3 figs).

A simple empirical equation is proposed for the frequency of the capacitively-loaded cavity shown in Fig. 1. The empirical equation for the detuning due to the central post is

$$\Delta = \frac{\lambda - \lambda_0}{\lambda_0} = \left(\frac{2d + h}{D} \right)^2 \ln \frac{h}{b}$$

where λ_0 is the resonant wavelength of the cavity without the post.



Fig. 1.

This equation is valid as long as a radial mode exists in the cavity, and for $\Delta \leq 0.3$ the error of the equation does not exceed 5-10 per cent.

A more accurate empirical equation is

$$\ln \Delta \leq 0.64 - 1.7 \frac{b}{h} + 2.11 \ln \left(\frac{2d + h}{D} \right)$$

The value of Δ can be readily calculated from Figs. 2 and 3, the former giving the variation of Δ with

$\left(\frac{2d + h}{D} \right)$, the latter giving the dependence of Δ on

b/h for various values of $\left(\frac{2d + h}{D} \right)$.

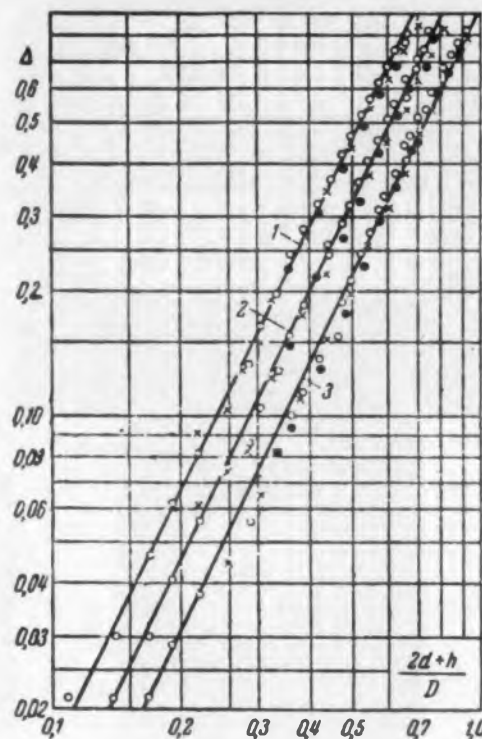


Fig. 2

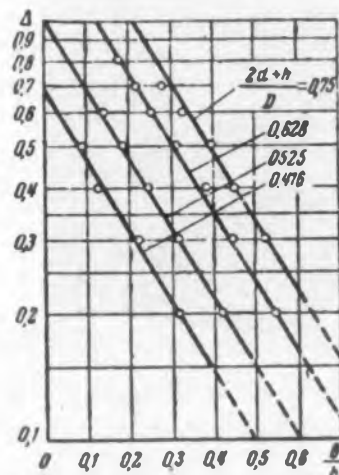


Fig. 3

The actual wavelength of the cavity is calculated from the theoretically-rigorous equation

$$\lambda = 1.31 D (1 + \Delta).$$

The authors claim that none of the theoretical equations cited in the literature give more accurate values for the resonant frequency of the toroidal cavity at the specified values of b/h and $\left(\frac{2d + h}{D} \right)$.

Television Systems with Statistical Matching, B. B. Gurfinkel', (19 pp, 3 figs).

Communication-theoretical treatise, dealing with television as a communication problem and with the statistics of television signals.

Investigation of Electromagnetic Field in Cavity Using Probe with High-Impedance Connecting Line, V. S. Lukoshkov, A. S. Bondarev, and B. N. Shvetsov, (15 pp, 17 figs).

The probes employed are miniature electric or magnetic dipoles and are placed, together with a miniature detector, in the cavity under investigation. The lead-in conductors comprise thin strips of high-impedance carbon paste coated on a quartz tube 2-3 mm in diameter. The resistance of the wiring is on the order of several tenths of a megohm per centimeter. The method is suitable for the study of fields produced in cavities at resonant and non-resonant frequencies; its accuracy is on the order of 5 per cent.

A probe of this type causes practically no distortion of the investigated field but does reduce the intensity of the field, and this is of particular importance in the study of cavities at resonance. The lower the Q of the cavity and the higher the lead resistance, the smaller the error introduced by the probe. Best results are obtained at lead resistances from 0.3 to 0.5 megohm/cm and at values of Q ranging from 200 to 400. Under those conditions, the change in field intensity is on the order of 3-5 per cent.

On the Theory of Ideal Coding of Binary Transmission, V. I. Siforov, (11 pp, 4 figs).

The article is devoted to finding the quantitative relationships between noise stability, bandwidth, and the parameters of an ideal code in the sense of Shannon's definitions. An approximate expression is derived for the probability of the decoding error as a function of the probability of the error in the elementary message, the number of messages in the code combination, and the bandwidth. Refers to Shannon's "Communication in the Presence of Noise," *Proc. IRE*, Jan. 1949, pp 10-22, and to C. A. Barnard's "Simple Proofs of Simple Cases of the Coding Theorem," Imperial College, London, 3rd Symposium on the Theory of Information, September, 1955.

Self-Oscillations in a System with Time-Delay Feedback, Iu. M. Az'ian, V. V. Migulin, (10 pp, 2 figs).

Theoretical discussion of self-excited systems containing no resonant elements (LC circuits or cavities) but in which the steady-state oscillations are produced by delaying the signal in the feedback loop. The mathematical treatment of such circuits is quite difficult, involving as it does non-linear integral equations, the solution of which is dependent on the initial conditions. The article discusses the theory of an idealized network of this type and some experimental investigations of an equivalent circuit.

Effects of Slow Fluctuations on Self-Excited Oscillator, V. I. Tikhonov, I. N. Amiantov, (5 pp, 2 figs).

Derivation of equations that define the statistical phase and amplitude characteristics of the response of a self-excited oscillator to slowly-varying fluctuations. The resulting phase fluctuations are computed.

Detection of Complex-Waveform Pulses, E. L. Gererot, (5 pp, 4 figs).

Each article treats a different phase of weak signal detection. The first derives an equation for the distortion accompanying the detection of a pulse of arbitrary waveform. The second discusses the transients in a detector circuit where the internal impedance of the current source cannot be neglected, and derives the load voltage resulting from detection of a pulse of arbitrary form.

Measurement of the Properties of Ferrites at Ultra High Frequencies, Part I, V. V. Nikol'ski, (22 pp, 15 figs).

Very extensive theoretical discussion of the measurement of the permeability and dielectric-constant tensors of ferrites using cavity resonators. Proposes various measurement schemes and cites certain experimental results.

Frequency Characteristics of Kinescopes, L. M. Selia-kov, (10 pp, 5 figs, 1 table).

Discusses the resolving power of the kinescope along the scan line. Derives the frequency characteristic of the kinescope, taking the halation effect into account. Shows the qualitative and quantitative rela-

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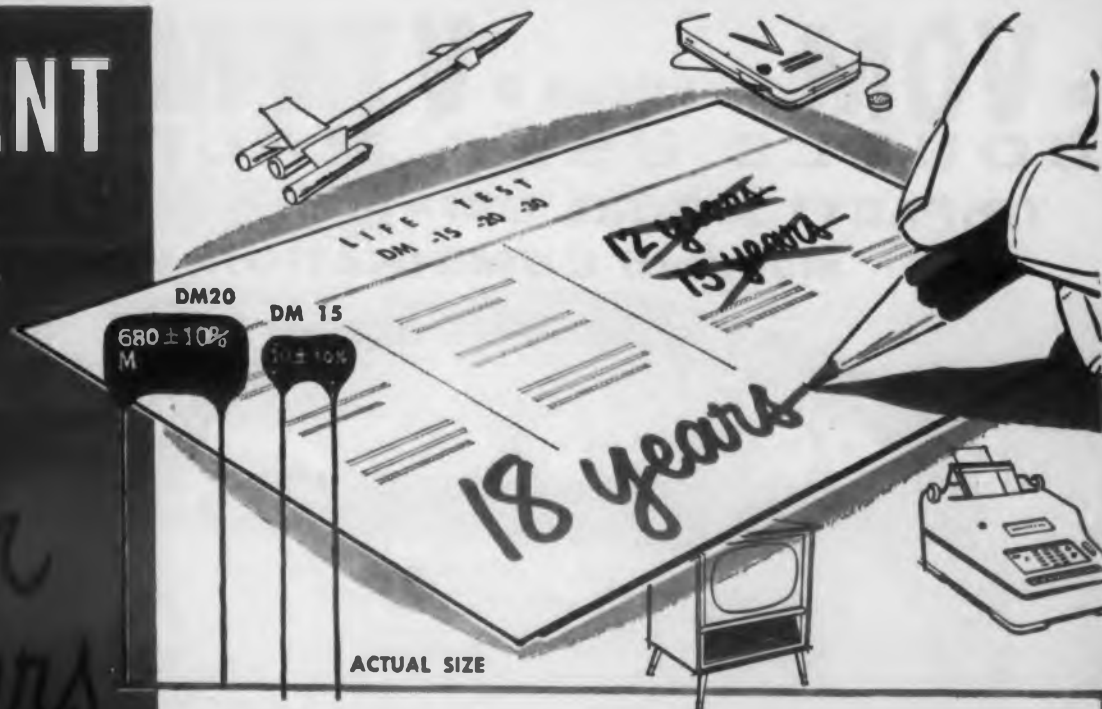
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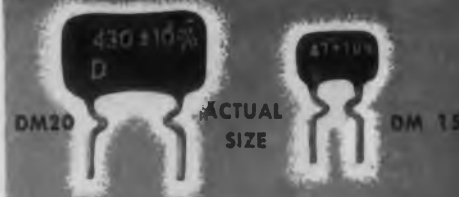
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tionships between halation and resolving power. Give experimental characteristics of certain Russian television kinescopes, and concludes that the optical distortion in modern kinescopes is quite high and requires correction.

Other Articles In This Issue:

"Transients Involved in the Detection of Weak Signals," L. S. Gutkin, (5 pp. 2 figs); "Microwave Spectroscopy for Observation of Electron Paramagnetic Resonance in the Centimeter Band," A. A. Manenkov, A. M. Prokhorov, (9 pp, 4 figs); "Secondary Electron Emission from Alloys," B. S. Kul'vanskaya, (13 pp. 1 figs); "Secondary Emission from Tungsten Carbide," L. M. Volkova, (2 pp. 2 figs).

Contents of Radiotekhnika i Elektronika, No. 5, 1956

Radio-Engineering and Electronic Problems in High Power Accelerators for Heavy Charged Particles, A. L. Mints, (17 pp, 11 figs).

Approximate Equation for the Propagation Distance in the Presence of Super-refraction, V. A. Fok, (15 pp).

Theoretical paper, in which the exact contour integral involved in such calculations is approximated by assuming the index of refraction to vary parabolically with height.

Propagation of Radio Waves Near the Horizon in the Presence of Superrefraction, V. A. Fok, L. A. Vainshtein, M. G. Belkina, (18 pp, 9 figs).

Another theoretical paper devoted to the calculation of the anomalous propagation of radio waves near the horizon in the presence of an inversion layer (which has no horizontal variation). Curves are derived for the attenuation factor for the case when the transmitting antenna is located high above the inversion layer, and the receiving antenna is located at low altitude and below the inversion layer (or vice versa). The results obtained may prove significant in the analysis of propagation of microwaves in the troposphere.

Optimum Linear Antennas, V. L. Pokrovski, (8 pp, 5 figs).

Discussion of current distribution in linear antennas with radiation perpendicular to the axis and with optimum directivity pattern. It is shown that a suitable mathematical approach (the Chebyshev-Akhiezer polynomials) leads to a solution of this problem even if the distance between radiators are less than half a wavelength.

Radio-Astronomical Methods of Antenna Investigation, V. S. Troitski, (10 pp, 1 fig, 1 table).

Gives several methods for determining the losses and directivity coefficients of antennas by using extraterrestrial radio signals. This involves calculating the losses from the intrinsic thermal noise of the antenna system.

Use of Orthogonal-Polynomial Method in the Solution of Certain Problems in the Analysis and Synthesis of Multi-Stage Amplifiers, S. V. Samsonenko, (4 pp, 2 figs).

Several applications of a method discussed in an earlier article (*Radiotekhnika i Elektronika*, No 3, 1956—see *ED*, Dec 15, 1956). Treated specifically are: 1. transient response of a system to an arbitrary signal (without using the convolution theorem), the solution of the synthesis problem for arbitrary signal, 2. the determination of the input waveform from known system parameters and known output-signal waveform.

Accumulation of Noise Caused by Signal Fading in FM Radio Relay Lines, Iu. B. Sindler, (11 pp, 4 figs).

Discusses the effect of amplitude limiters on the noise accumulating in fm communication lines. The treatment is similar to that used by V. I. Siforov in *Elektrosviaz'* No 5, 1956 but involves fewer simplifying assumptions.

Measurement of Ferrite Parameters at UHF, part II, V. V. Nikol'ski, (9 pp, 11 figs).

Continuation of article started in *Radiotekhnika i Elektronika* No 4, 1956. Refers also to article by Alberts and Schoenberg, *J. Appl. Physics*, 954, 25, 152.

Analysis of Nearly-Harmonic Transistor Oscillator Operating at Frequencies above Critical, K. S. Rzhavkin, L. A. Logunov, L. N. Kaptsov, (7 pp, 7 figs).

This oscillator was first analyzed by D. E. Thomas (*Electronics*, 27, 2, 130), but his approximations are claimed to be invalid for higher frequencies. The author extends the calculations to higher frequencies and determines the highest possible oscillation frequency. To be abstracted in a future issue.

Analysis of Processes in Transistor Blocking Generator, K. Ia. Senatorov, G. N. Berestovski, (16 pp, 15 figs, 1 table).

The analysis leads to equations for the design of circuit elements from prescribed pulse parameters. Lists the experimentally-obtained quasi-static (pulse) characteristics of Russian commercial junction transistors. To be abstracted in a future issue.

Equivalent Reactance Circuits Employing Junction Transistors, L. N. Kaptsov, K. S. Rzhavkin, (10 pp, 10 figs).

Reactance tubes (equivalent-reactance circuits employing vacuum tubes) are widely used in fm oscillators. This article gives a theoretical analysis of the transistor counterpart, citing both similarities and differences. To be abstracted in a future issue.

Calculation of the Entropy of Certain Special Probability Distributions, M. M. Bakhmet-ev, (10 pp, 6 figs).

Brief Communications:

Frequency Division with Reflex Klystron, E. N. Bazarov, M. E. Zhabotinski, (2 pp, 2 figs); Low-Loss Ferrites at UHF, R. G. Mirmanov, L. G. Lomize, N. V. Riumshina, (7 pp, 1 table).

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Abstract—German

Applications of Travelling Wave Tubes

THE recent rapid development of travelling wave tubes has made available a valuable component for measurement systems up to the centimeter wave length band, such as wobulator systems, frequency multipliers, or oscillators.

Fig. 1 shows the basic scheme of an active wobulator system which may be used to test a transmission system (e.g. filter as shown). Fig. 2 shows the basic block diagram of a swept frequency source with center frequency of 4000 mcps and 600 mcps band. The basic r-f signal is obtained from a reflex klystron (which should have an r-f output of about 50 to 100 mw such as a 2K56 or 2K45). The klystron reflector voltage is modulated with the line frequency (50 cps in Germany), and furnishes therefore a frequency which differs from the center frequency instantaneously because of the modulation. The klystron alone is not suited as a wobulator source, however, because the output amplitude is frequency dependent. The output of the klystron is decoupled from the rest of the system by means of the attenuator D_I (see Fig. 2). Attenuator D_{II} is used to adjust the input level to the travelling wave tube. Before the input of this tube a marker signal

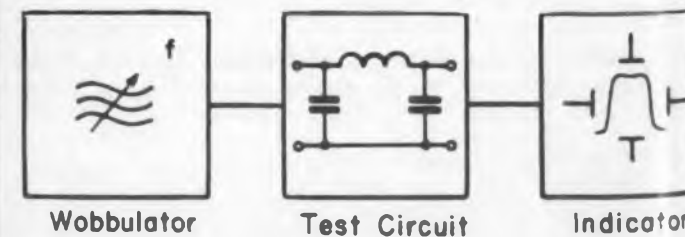


Fig. 1. Active wobulator system.

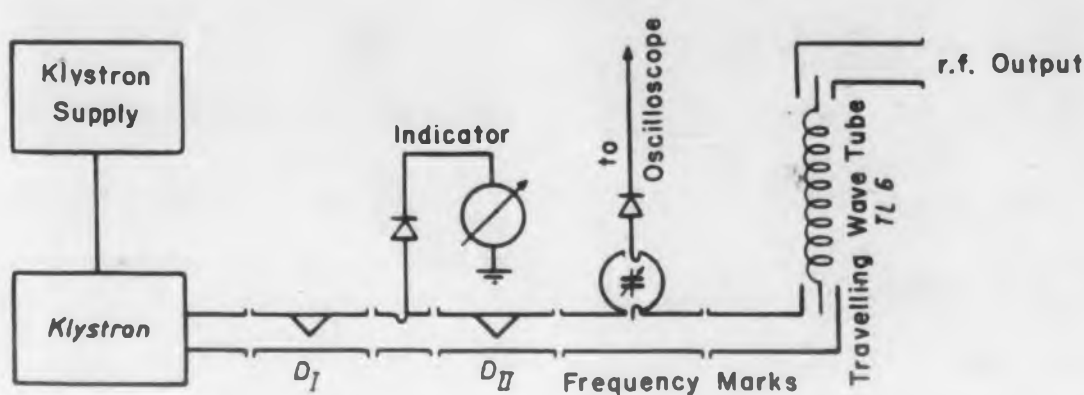


Fig. 2. Wobbulator at 4000 Mcps.

derived from the guide system for use on the oscilloscope. The travelling wave tube makes the output amplitude independent of the frequency.

The functioning of the klystron-travelling wave tube combination is explained in Fig. 3. Fig. 3a shows the output amplitude of the klystron N_a as a function of reflector voltage with the static reflector voltage adjusted to $U_{R opt}$. Fig. 3b indicates the frequency variations of the klystron which correspond to the instantaneous reflector voltage variations and Fig. 3c shows the input (N_e) - output (N_a) amplitude of the klystron. The characteristic of the travel-

ling wave tube shown is Figs. 3c and 3d explain how the constant amplitude output is achieved. The travelling wave tube which was used is the "Telefunken" type TL 6.

For frequency multiplication, in particular frequency doubling, the travelling wave tube may be used with an appropriate filter because of the large harmonic content of the output signal at high output levels.

Abstracted from an article by A. Lauer, Elektronische Rundschau, Vol. 10, No. 7, July 1956, p. 190.

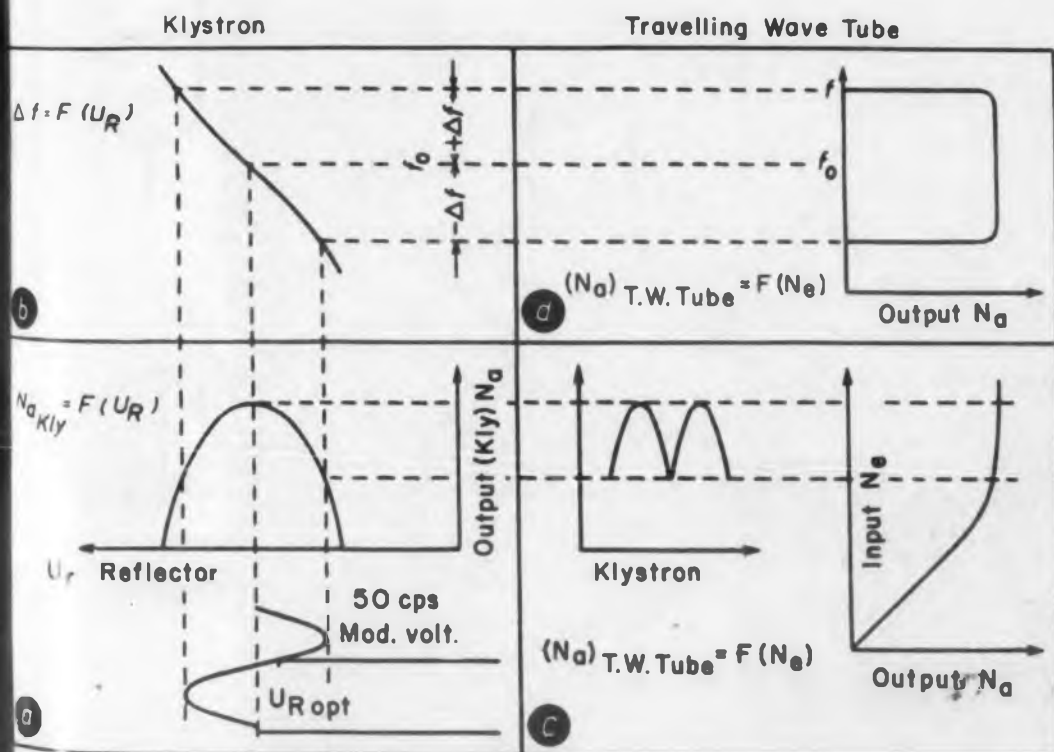


Fig. 3. Output amplitude of the Klystron as a function of reflector voltage.

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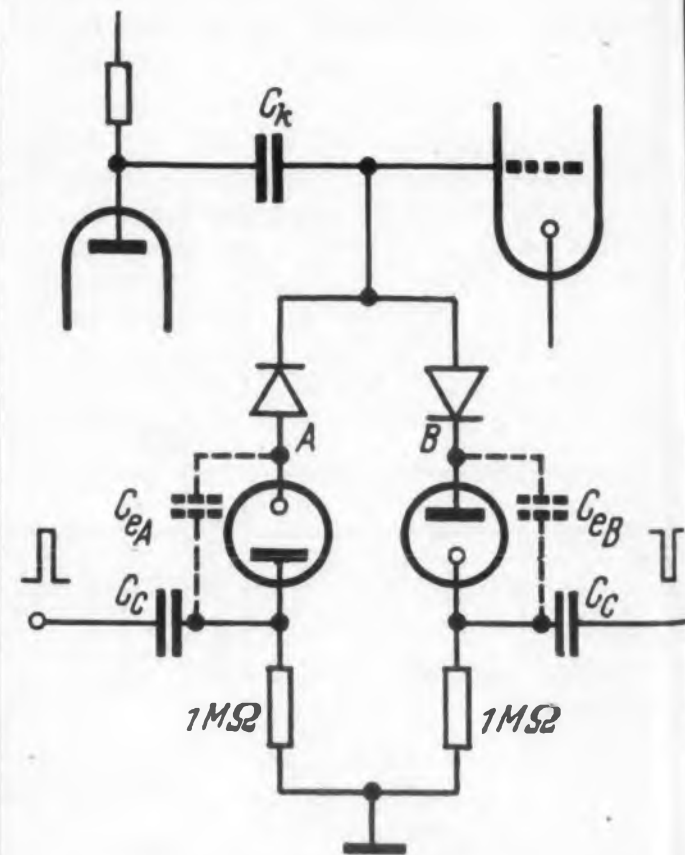
CIRCLE 528 ON READER-SERVICE CARD FOR MORE INFORMATION

Abstract—German

A DC Restorer

THE design of clamping circuits requires a sufficiently large discharge time constant together with a sufficiently small charging time constant. The series connection of germanium and vacuum diodes shown in the figure makes possible the minimizing of the effective shunt capacitance because the capacitance of such diodes is of the order of magnitude of one micromicrofarad. At the same time the benefit of the high resistance of vacuum diodes in the reverse direction is obtained. The effective capacitance at the grid is equal to the capacitance of the germanium diode so that a saving of ten per cent may be expected. This corresponds to an increase of band width, for that stage, of about twenty per cent. The circuit has considerable popularity in German television sets. The effects on the resulting picture are practically insignificant although linearity measurements on the amplifier stage, using sawtooth with 4 mc show some distortion.

Abstracted from an article by W. Dillenburger and E. Sennhenn, Frequenz, Vol. 10, No. 9, September 1956, pp. 283.



Clamping circuits with series diode.

A New UHF Diode

CHARACTERISTICS of a new diode, the EA-52 (Valvo Corp., Hamburg, Germany) with a frequency range up to 1000 mcps are reported in this article. Referring to the high frequency equivalent circuit shown in Fig. 1, the shunt capacitance for the tube is less than $0.5 \mu\text{f}$. The resonant frequency, $\omega_0 = (1/L_S C_P)^{1/2}$, is 5000 mc so that at the operating frequency the resonant rise of output voltage is only 4 per cent. At that frequency the inductance of transit time is negligible. The back resistance exceeds 10^4 megohms. The peak inverse voltage is 1 Kv for frequencies 100 mc and given by $V_{PIV} = 1000/f$, where f is in mc for frequencies above 100

mc. The frequency characteristics in a measuring application are shown in Fig. 2. Details of construction and other characteristics are also given.

Abstracted from an article by H. Stietzel, *Elektrische Rundschau*, Vol. 10, No. 2, Feb. 1956, p. 34.

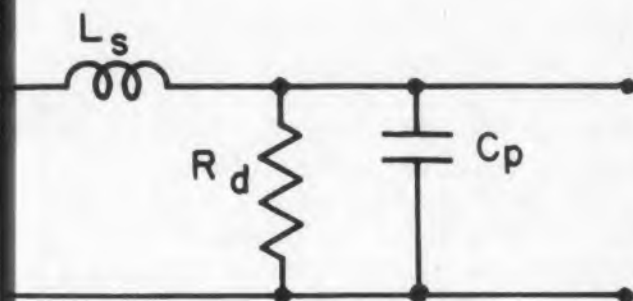


Fig. 1. High-frequency equivalent circuit of the diode.

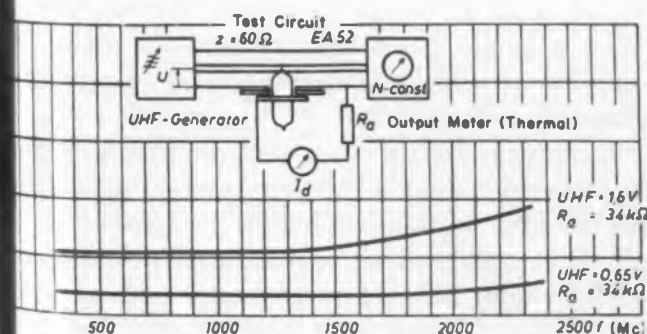
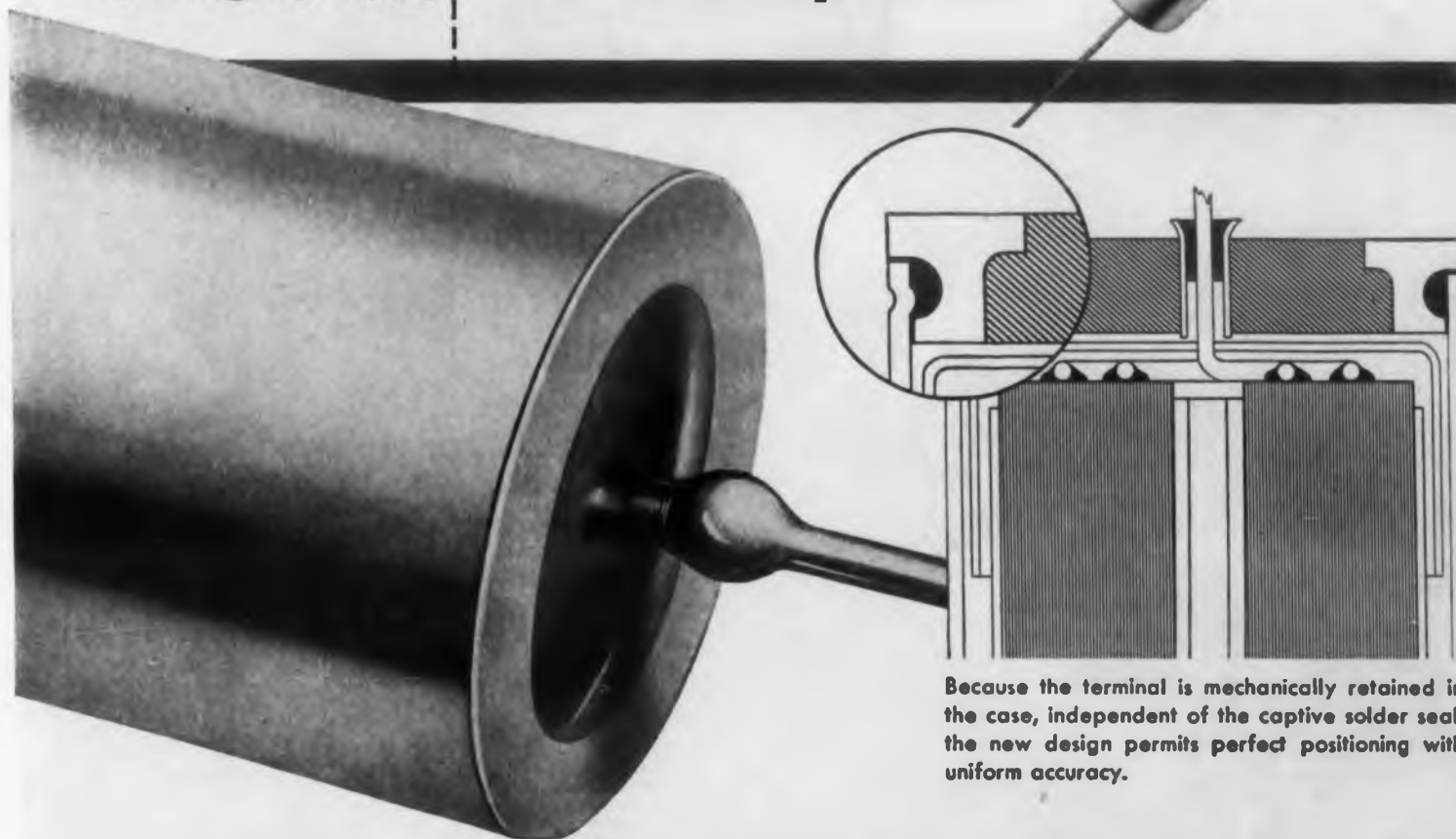


Fig. 2: Frequency characteristics of the EA-52.

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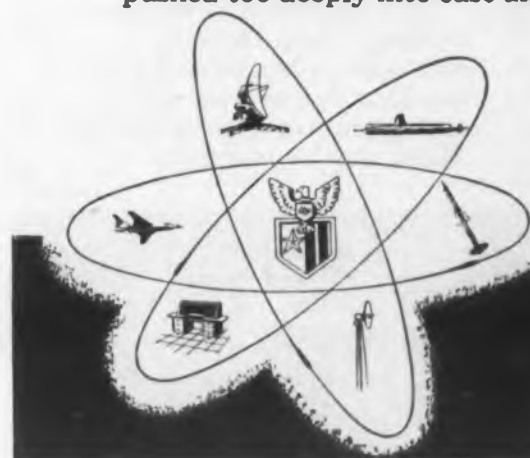
ends or section damage. It permits optimum performance and reliability through greater flexibility of internal design.

The solder is confined and automatically sealed. Solder or flux cannot run down inside case to cause life failures due to contamination. There are no cracked terminals due to solder time variation.

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Abstract—German

Audio Spectrum Analyzer

A NEW "tone frequency spectral analyzer" covers the frequency range from dc to 20.5 kc in two bands and presents the results on a cathode ray tube screen. The instrument is used primarily for the analysis of all kinds of mechanical vibrations.

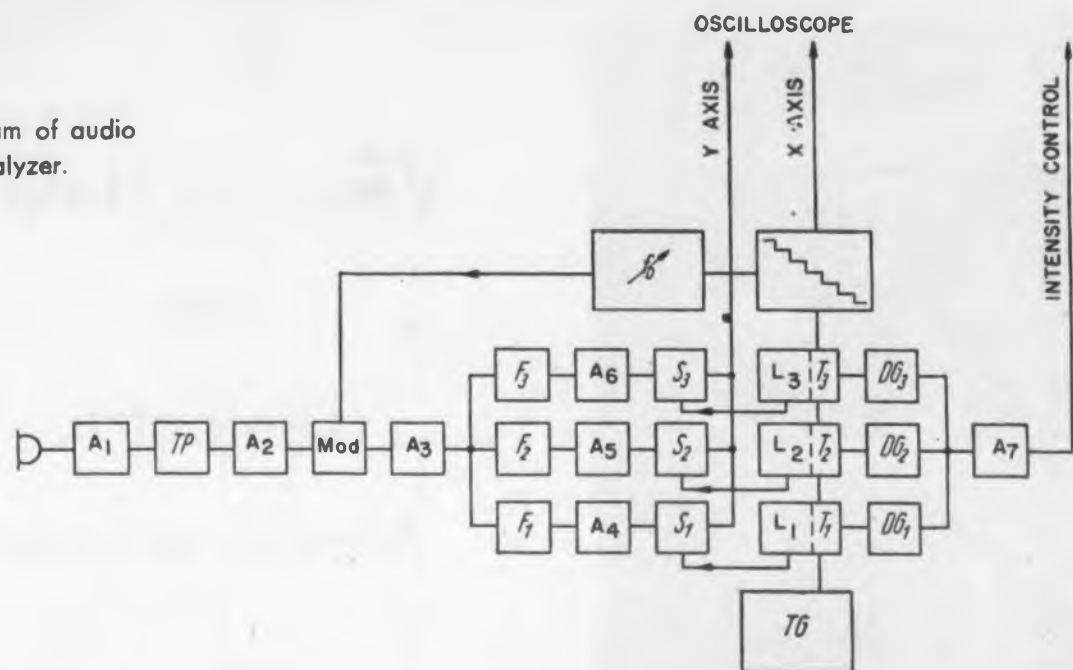
The system uses three 50 cps filters in Band I (0 to 1 kc) and three 500 cps filters in Band II (0 to 20.5 kc). Band I has 21 frequency marks at 50 cycle intervals, and Band II has 42 frequency marks at 500 cycle intervals, displayed (in two rows) on the screen of the oscilloscope.

The block diagram for one band is shown in Fig. 1. The signal is amplified in A_1 , passes through a low pass filter (cut off frequency 1 kc for Band I and 20.5 kc for Band II) and again amplified in A_2 . A variable carrier is mixed with the signal. The variation of the carrier frequency is obtained in steps by use of a reactance tube whose reactance is controlled in steps so that only selected points on the filter curves are obtained.

The output of the modulator, amplified in A_3 , is fed to three capacitively coupled band pass filters with 50 cps or 500 cps bandwidth, depending on the band. The filtered signals are amplified, detected, and passed through electronic switches S_1 , S_2 , and S_3 to the Y-axis of the oscilloscope. Since a single beam tube is used the three filter outputs are sampled sequentially and displayed in three rows on the screen.

In order to obtain clean pictures after each jump in frequency a sufficient time interval must elapse for the filter to stabilize before the signal is picked off. This synchronization is controlled from a timing generator (TG). This generator generates positive pulses at fixed time intervals. An impulse voltage stage T_1 closes electronic switch S_1 through an impulse limiter L_1 so that the output of filter F_1 is fed to the Y-axis of the oscilloscope. In order to blank out the transients of the electronic switch

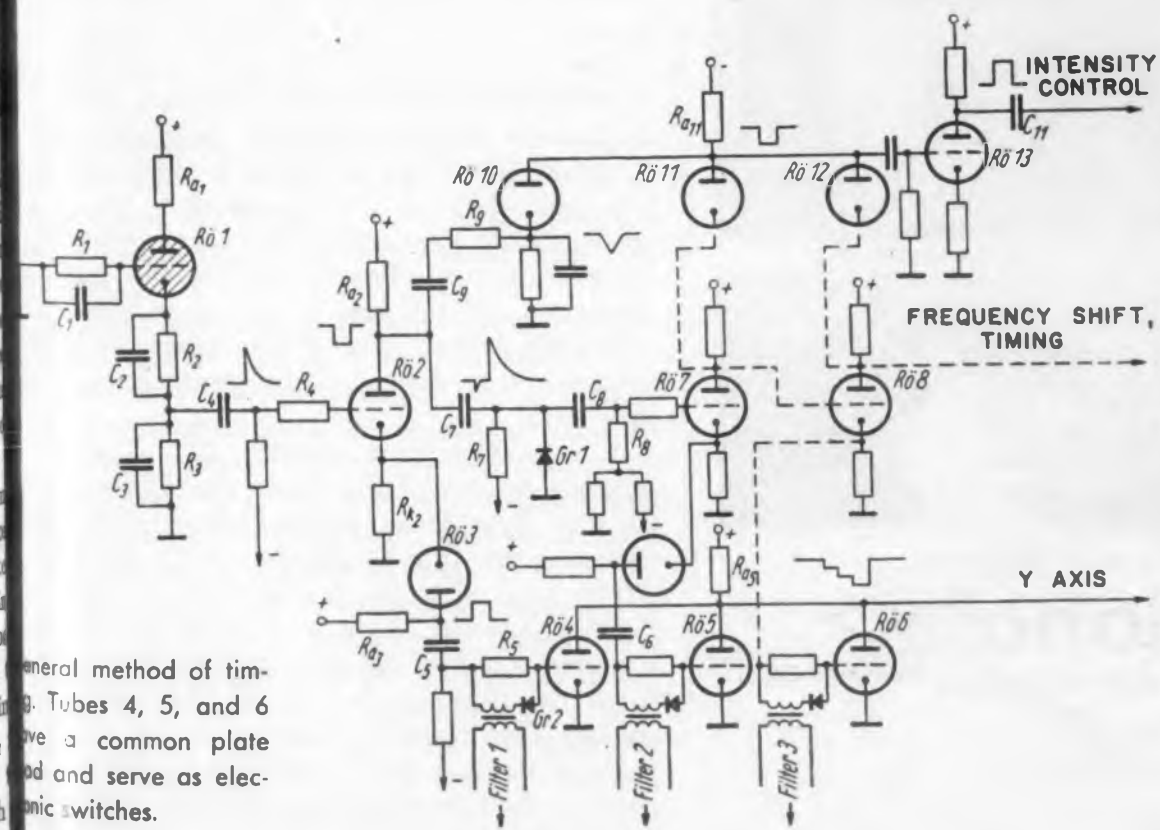
Block diagram of audio spectrum analyzer.



slightly delayed and differentiated impulse (DG) is used to control the intensity on the oscilloscope. After the impulse has activated stage 1, the process is repeated. Each time the frequency is shifted to the next increment. Band switching is accomplished by means of five relays.

The timing generator consists of a gas triode sweep circuit operating in Band I at 32 cps and in Band II at 170 cps. The impulses from the sweep circuit are shaped to furnish appropriate signals for intensity control, frequency shifting and electronic switching. The schematic is shown in Fig. 2.

Abstracted from an article by W. Kaule and A. Schöne, Nachrichtentechnik, Vol 6, No. 1, Jan. 1956, p. 35

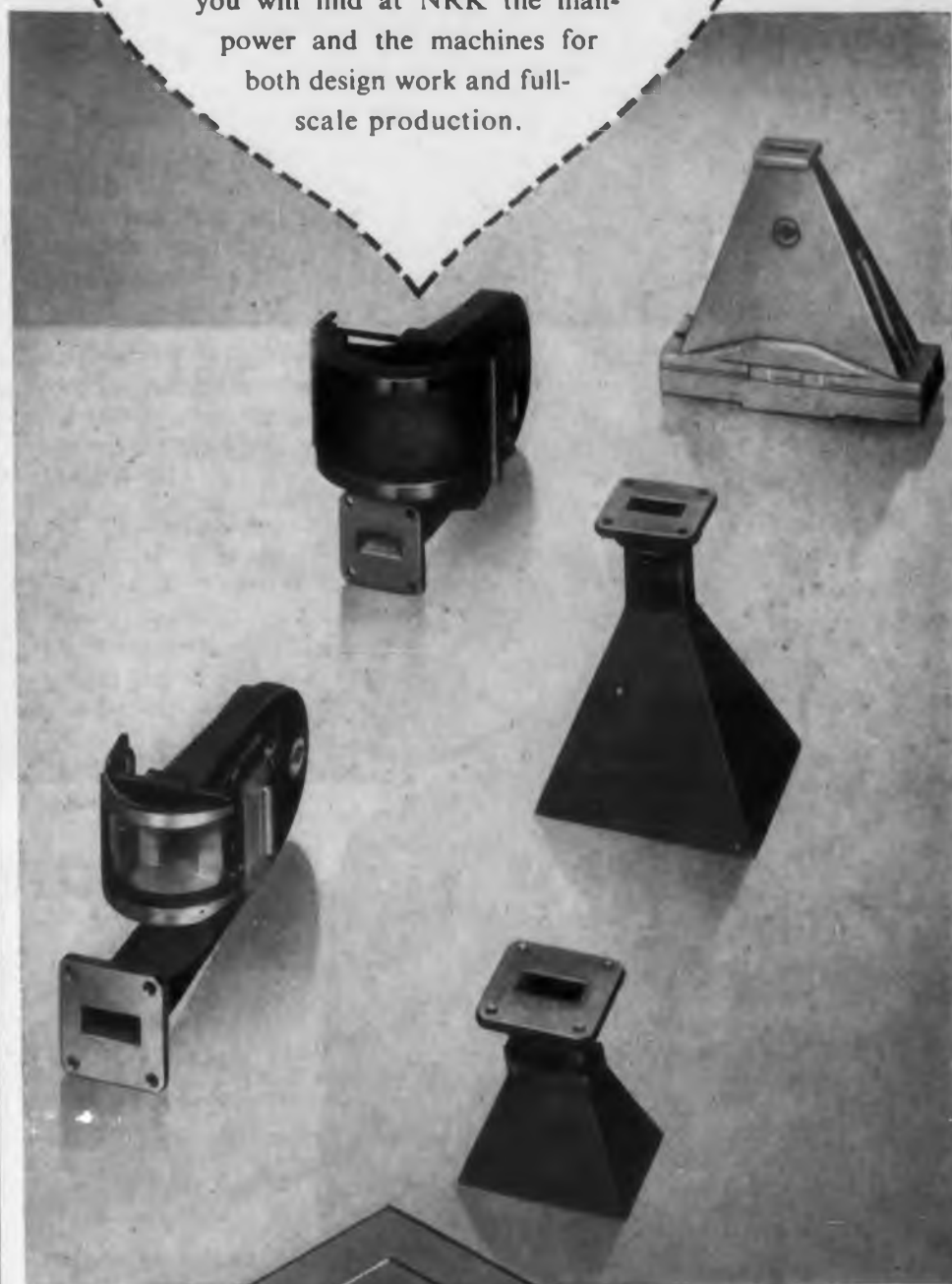


General method of timing. Tubes 4, 5, and 6 have a common plate load and serve as electronic switches.

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Versatile Holder for Dielectric Measurements

A VERSATILE specimen holder to be used with a bridge or resonant circuit in determining electrical properties of dielectrics over a wide range of temperatures and frequencies has been developed by the National Bureau of Standards. The instrument is designed to make precise measurements of the dielectric constants, dissipation factors, and thermal expansions of insulating materials.

Devices previously developed for measuring high polymer and ceramic insulating materials have been limited to use at a single temperature or over a comparatively small range of temperatures. Furthermore they did not measure thermal expansion of the specimen, nor were they sufficiently precise.

The device, shown in Fig. 1, is essentially a pair of gold-plated stainless steel electrodes, about 2 in. in diameter, between which the dielectric specimen is placed. The lower electrode is stationary, while the upper electrode can be moved up or down to accommodate the thickness of the specimen. A removable silver electrostatic shielding case covers the electrodes and the case in turn is enclosed in an electrically-heated oven for high-temperature measurements, or a cooling unit for measurements down to -40°C .

A thermocouple is inserted in a hole bored through the axis of the upper electrode to within 0.5 mm of its lower surface, permitting accurate measurement of the temperature of the specimen.

The upper electrode is constrained to move in a direction parallel to the axis of the electrodes. A micrometer adjustment gives absolute values of the specimen's thickness, before and after temperature change. The supporting frames and electrodes are made of stainless steel to minimize differential expansion; the micrometer can be used to determine

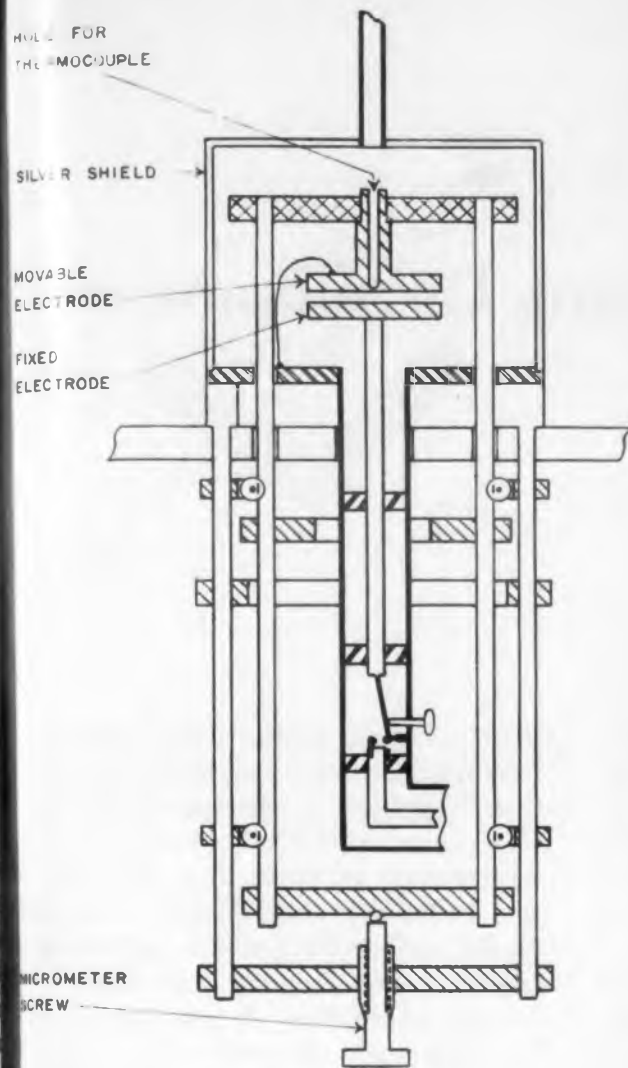
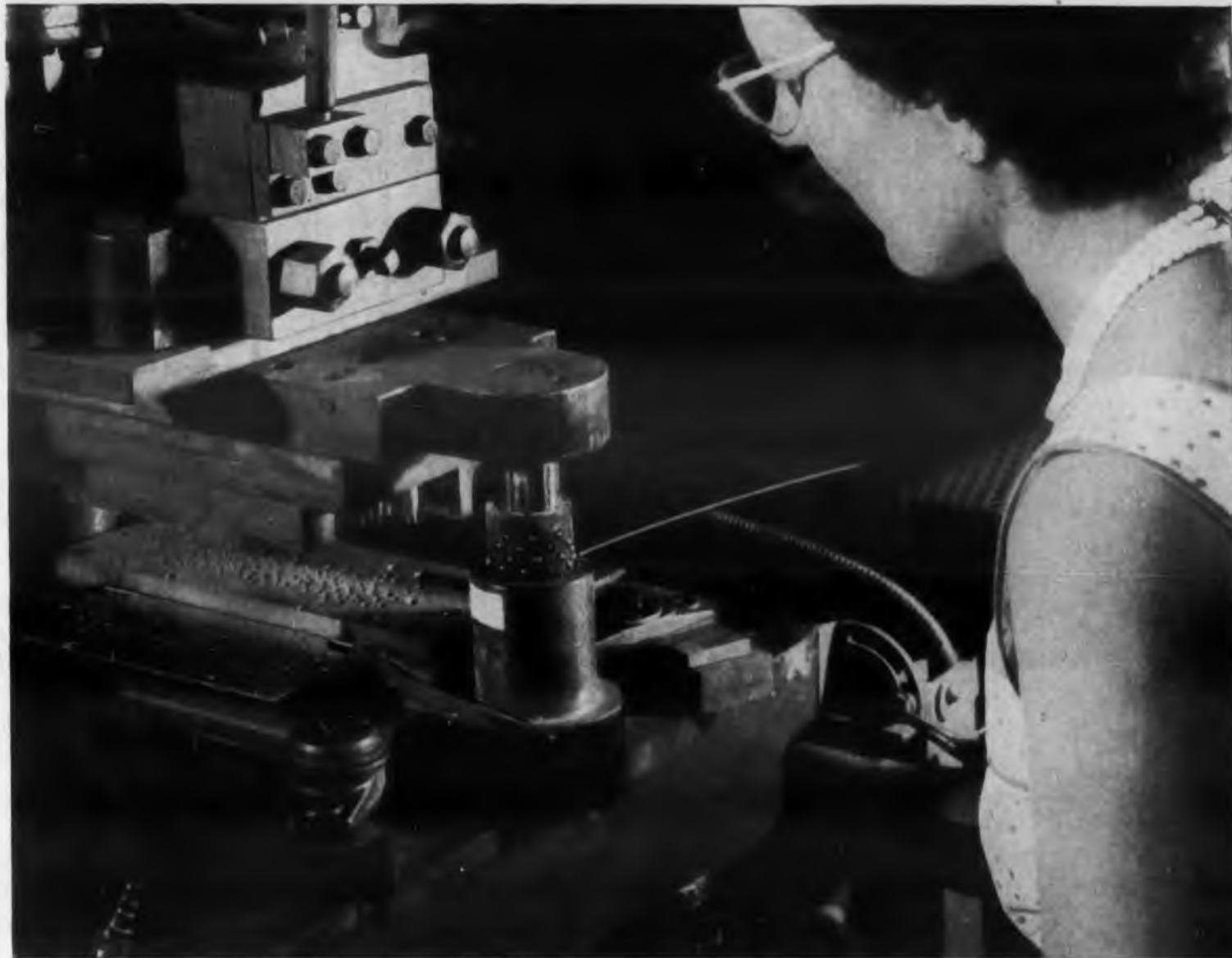


Fig. 1. Cross section drawing of dielectric specimen holder. Movement of upper electrode is controlled by micrometers.



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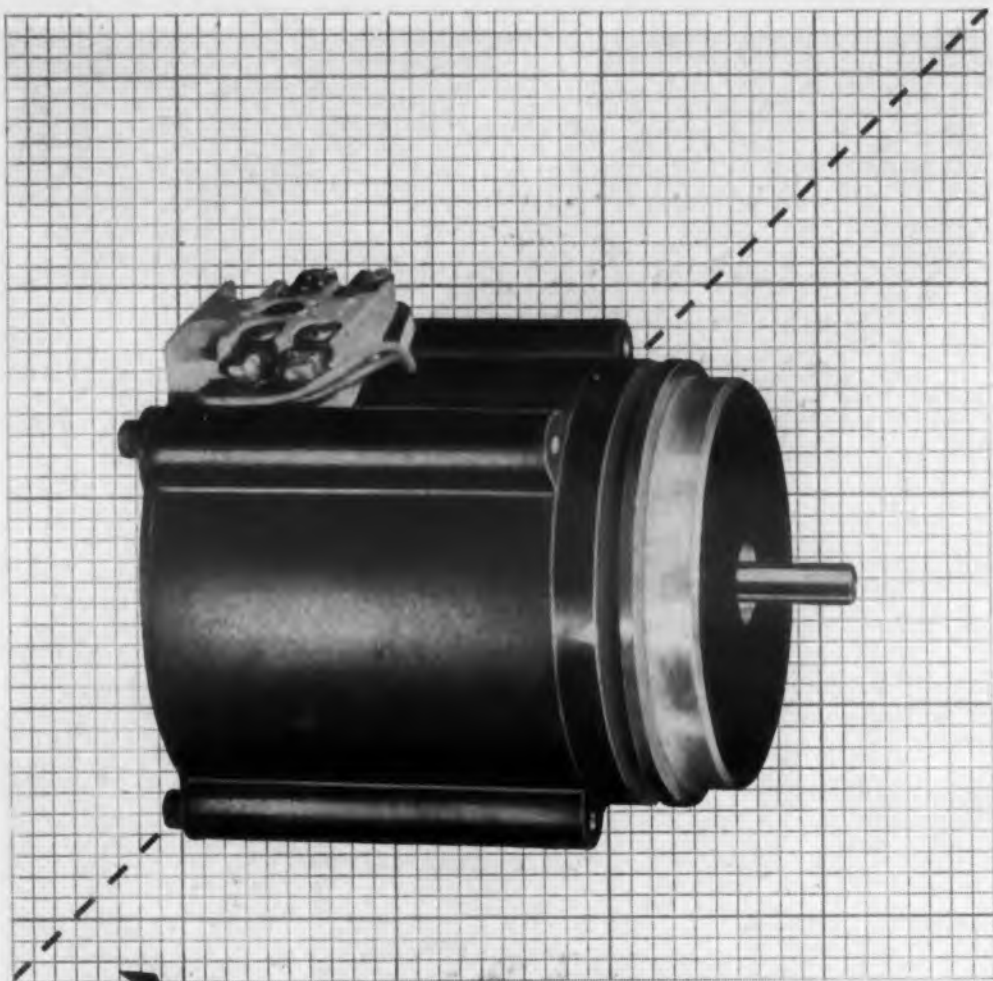
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British Component Developments

SEVERAL interesting examples of component developments in Britain are discussed briefly here. Components under investigation are tested for reliability, life-length, and high temperature stability.

Resistors

Gold-platinum alloy films. These are now in the pre-production stage; normal resistance values up to 10 or 20 megohms can be provided and tolerances are well within Grade I limits. Low and medium values of resistance are met by zig-zags on glass plates or by helices on glass tube and the highest resistances are made from metallized glass fiber.

Typical sizes are:

- 1/3 w-1 x 1/2 in. glass plate
- 1/8 w-1/2 x 1/4 in. glass plate
- 3/4 w-1 x 1/4 in. glass tube

These resistors have very high stability under both normal and tropical conditions. Their present temperature coefficient of 0.0003/deg C is too high and it is hoped that a small modification in the alloy will improve this.

Small resistors having very high values are being made from 0.001 in. glass fibers, metallized with the same gold-platinum alloy and then wound on tubular forms in the same way as wire. This metallized glass fiber has a resistance of about 5000 ohms/in. and the fiber resistors are similar to Grade I in stability and as good or better in noise, typical values being 0.02 to 0.1 μ v per volt under normal working conditions.

Metal film potentiometers. Long-life potentiometers are now in a late state of development. High resistance up to about 300 K Ω ohms is obtained by use of a "mean-

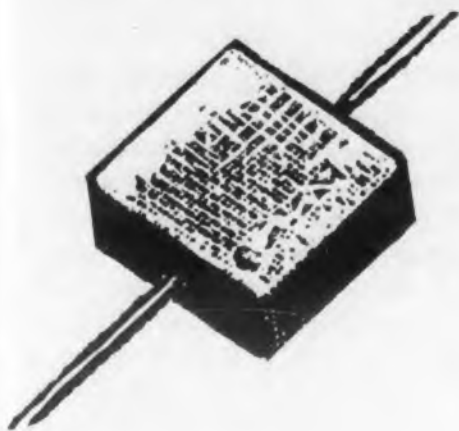
dered" film on a glass base; long life, building up contact strips by electrodeposition. In laboratory tests these potentiometers have withstood almost a million sweeps with no more than about 0.2 per cent to 0.4 per cent change in resistance. At the end of the test the potentiometer appeared good for much more life.

Metal oxide films. A considerable amount has been made of metal oxide resistors of the types originated by McMaster and Mochel, U.S.A. Stannic oxide systems containing small amounts of one or more of the oxides or antimony, bismuth and indium have received the most attention in this group. The best results have been with films of 93 per cent stannic oxide and 7 per cent antimony oxide; of the oxides this has the lowest temperature coefficient of resistance.

By cutting helices in films on 1 x 1/4 in. glass tubing, resistances as high as 1 megohm, and having stabilities better than 1 per cent after a 2000 hr electrical load at 70 C, have been made.

Very long-life wire-wound resistors. Early supplies, either from commercial stock or individually made for the job, were unsatisfactory. These resistors are made by winding 37-41 SWG resistance wire on aluminum oxide form and sealing it completely with a ceramic glaze. Sometimes the wire was nicked by cutters when making off, sometimes the glaze was crazed and sometimes the turns in the helix had slipped during glazing and were touching. In addition to the ordinary electrical tests every resistor is now examined under a low-power microscope and by X-rays.

In resistors for more normal usage



at low current densities may be due to crazing of the glaze which allows moisture to penetrate and electrolytic corrosion of the wire to occur.

Capacitors

Glaze-type having controlled temperature coefficients. Glass capacitors are made by coating metal sheet, strip or plates with a slip of special ceramic glaze, stacking or rolling and heating to fuse the glaze. A solid capacitor is formed whose characteristics depend in some measure on the composition of the glaze. It is important to match the coefficient of expansion of the glaze to that of the metal base; typical glazes are lead borosilicates modified by the inclusion of oxides such as those of barium, calcium, aluminum, zirconium and titanium.

Tests on three batches of production capacitors have shown stability within ± 0.25 per cent between -60 and 80 C.

Precision variable capacitor. A very precise and robust capacitor is now in production. It has a straight-line frequency law within ± 0.1 per cent and a temperature coefficient of -15 ± 10 ppm/deg C. Capacitors are matched to ± 0.03 per cent and the component will withstand the usual robustness tests without change. The long-term stability is comparable with that of the measuring equipment.

Electrolytic capacitors. Although many detailed improvements are being made, electrolytic capacitors are not reliable long-life components. Breakdown is frequently due to corrosion, although it can be controlled to a degree by using very pure metals and electrolytes. It has not, however, been possible to eliminate electrolytes com-

pletely; sealing, therefore, is inadvisable. Sealed capacitors for relatively short life can be made if a hydrogen acceptor is added to the electrolyte but the real answer would seem to be the production of a truly dry capacitor, free from electrolyte. Since the capacitance resides in the oxide film it seems reasonable to make this film either chemically or by anodizing, free it from electrolyte and metallize. Anodized aluminum plates having capacitances of $10,000 \mu\text{f}/\text{sq cm}$ and capable of withstanding 90 v have been made and a process is ready for factory trial. Most of these anodized films are hygroscopic so capacitors must be hermetically sealed.

In the remainder of the capacitor field progress has been on conventional lines and is unremarkable. Glass capacitors are not so fully developed as in the U.S. but very small tantalum electrolytics are available. High-stability polystyrene capacitors are also available and 30 years' life is expected from the paper capacitors in the transatlantic telephone repeaters.

Teflon dispersion film-dielectric capacitors have been made in considerable numbers experimentally. They are now in small production in the rolled type, mainly intended for low-loss, high-temperature capacitors. The production film thicknesses are around 52 microns, experimental thicknesses are from 3 to 1000 microns.

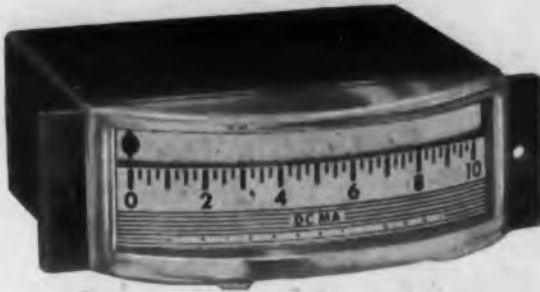
Magnetic Materials

Nickel is a scarce metal whose properties make it attractive in many important fields. Its use in components may be conserved by improvements in nickel-iron alloys so that they can be more economically used. Domain-oriented 65/35 nickel-iron with a coercivity of only 0.01 oersted has been made in the laboratory; commercial alloy is only 0.03 to 0.05.

As part of this work a new rolling technique has been developed which simplifies the production of very thin strip. Three microns thickness is the present limit but it is hoped to go further. As a result of this work the United Kingdom is not convinced that ferrites are the answer to every magnetic memory question. A metal tape-core delay line has been produced which works at over 200 kc and needs much less drive than a ferrite line. *Abstracted from Proceedings 1956 Electronic Components Symposium, A Review of Recent British Component Developments, C. E. Richards, May, 1956, available from Engineering Publishers, G.P.O. Box 1151, N. Y., \$5.00.*

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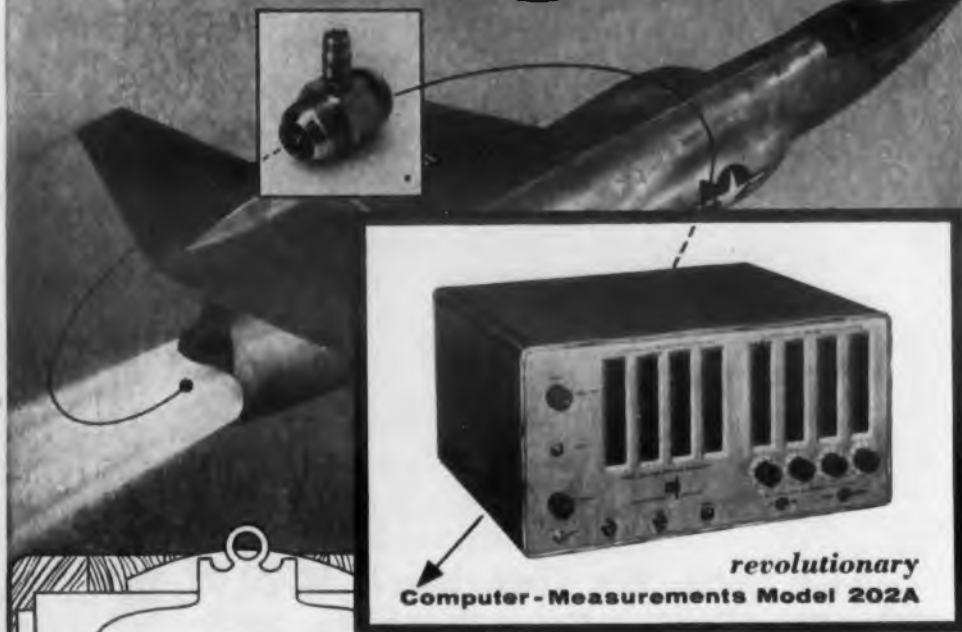
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Read-Out:	Direct. Four digits. (Five digits optional)
Display Time:	Automatic: Continuously variable, 0.1 to 10 sec. Manual: Until reset
Power Requirements:	117 volts ± 10%, 50-60 cycles, 250 watts (50-400 cycles optional)
Dimensions:	17" W x 8 3/4" H x 13 1/2" D
Weight:	35 lbs. net.
Finish:	Panel: Light grey baked enamel Case: Dark grey baked enamel <i>Data Subject to Change Without Notice</i>

*Model FL Flow Pickup: Courtesy—Wauha Engineering Co., Van Nuys, Calif.

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Standards and Specs

Sherman H. Hubelbank

ASTM Standards

1956 SUPPLEMENTS TO BOOK OF ASTM STANDARDS

Issued in seven parts, the 1956 Supplements gives in their latest form 420 specs, tests, and definitions which either were issued for the first time in 1956 or revised since their appearance in the 1955 book. Part 6 covers rubber, plastics, and electrical insulating materials and has 75 standards. These supplements can be obtained from the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., at \$4.00 per part, or \$28.00 for the complete set of seven parts.

Drawings

It has been announced by the military that MIL-D-9281 (USAF) DRAWINGS AND DRAWING INDICES; PREPARATION OF BY MANUFACTURERS (FOR PRODUCTION ELECTRONIC EQUIPMENT) has been cancelled and superseded by MIL-D-5028.

Relays

MIL-R-19523 (SHIPS), RELAYS, AUXILIARY, NAVAL SHIPBOARD, 10 SEPTEMBER 1956

High-impact (class HI) shockproof auxiliary relays are covered by this spec. These relays are for use in control circuits where a number of relays are interconnected to control the proper sequencing and functioning of a complex electrical, hydraulic, or pneumatic system or combination of systems. Such relays are also required to provide suitable indication and alarm circuits directly associated with these systems.

MIL-R-5757C, RELAYS, ARMATURE (FOR ELECTRONIC AND COMMUNICATION EQUIPMENT), AMENDMENT 1, 6 SEPTEMBER 1956

Detailed physical and electrical requirements have been added for relay types RY1003A3 and RY1003B3. Relay type RY1001B3 has been substituted for relay type RY1000B3.

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NEMA Bulletins

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NEMA BULLETIN, SIGNALING APPARATUS

Covered in this bulletin are standards for heavy-duty electrically-operated audible signaling devices; low-tension, manual-electric-reset signal-target-type annunciators; and symbols for use on architectural drawings. Copies of this bulletin may be obtained from the National Electrical Manufacturers Association, 155 East 44th Street, New York 17, New York, for 25 cents per copy.

NEMA BULLETIN WD 1-1956, RECEPTACLES, (OUTLET), ATTACHMENT PLUG CAPS AND APPLIANCE PLUGS

The configurations and dimensions necessary to provide for intended interchangeability are dealt with in this standard. Also covered is information regarding the proper use of receptacle outlets, attachment plug caps and appliance plugs in accordance with the National Electric Code. Copies of this bulletin may be obtained from the National Electrical Manufacturers Association, 155 East 44th Street, New York 17, N.Y. for 50 cents per copy.

NEMA BULLETIN, INSTRUMENT TRANSFORMERS

All instrument transformers except bushing current transformers which are mounted inside of circuit breakers and power switchgear assemblies are covered by these standards. They supplement the ASA Standard for Transformers, Regulators and Reactors. Ratings and dimensions of particular classes of transformers and limits and methods of test for radio influence voltage are included. Copies of the bulletin may be obtained from the National Electrical Manufacturers Association, 155 East 44th Street, New York 17, N.Y., for 20 cents per copy.

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			F-80*	F-80-L	
	M-40 M-50 M-64	F-40 F-50 F-64			.040 .050 .064 .080
DIMENSIONS (inches)	"A"	.052	.052	.046	.187
	"B"	.199	.199	.185	.185
	"C"	.234	.234	.234	.234
	"D"	.349	.349	.443	.443
	"E"		.510	.640	.640
	"F"	.691			
TORQUE					
Pin from body	4 in. oz.				
Body from 1/8" deck	8 in. oz.	8 in. oz.	7 in. oz.	7 in. oz.	
Body from 3/8" deck	11 in. oz.	14 in. oz.	14 in. oz.	14 in. oz.	
PULL					
Pin from body	25 lbs.	25 lbs.	25 lbs.	25 lbs.	
Body from 1/8" deck	15 lbs.	12 lbs.	25 lbs.	25 lbs.	
Body from 3/8" deck	25 lbs.	25 lbs.	25 lbs.	25 lbs.	
CAPACITANCE (at 1000 KC)					
1/8" deck	.5 MMFD	.5 MMFD	1.5 MMFD	1.5 MMFD	
3/8" deck	.9 MMFD	.9 MMFD	1.55 MMFD	1.55 MMFD	
FLASH OVER POINT (Short time—see level)					
	4500 VRMS	4500 VRMS	3000 VRMS	5000 VRMS	
COLOR white, red, green, blue, violet, yellow, orange, brown, grey, black.					
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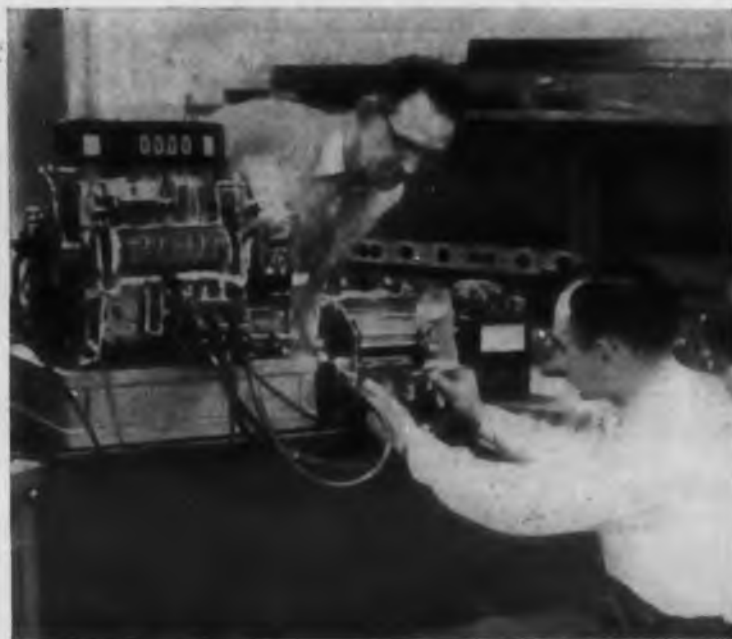


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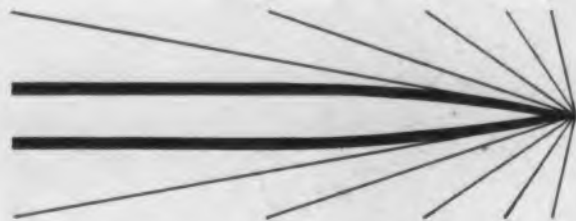
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5-A-58

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ELECTRICAL ENGINEERS
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ELECTRONIC ENGINEERS
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ENGINEERS DO ENGINEERING WORK AT ELECTRIC BOAT

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ELECTRIC BOAT DIVISION
GENERAL DYNAMICS CORPORATION
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Electronic Division
OTIS ELEVATOR COMPANY
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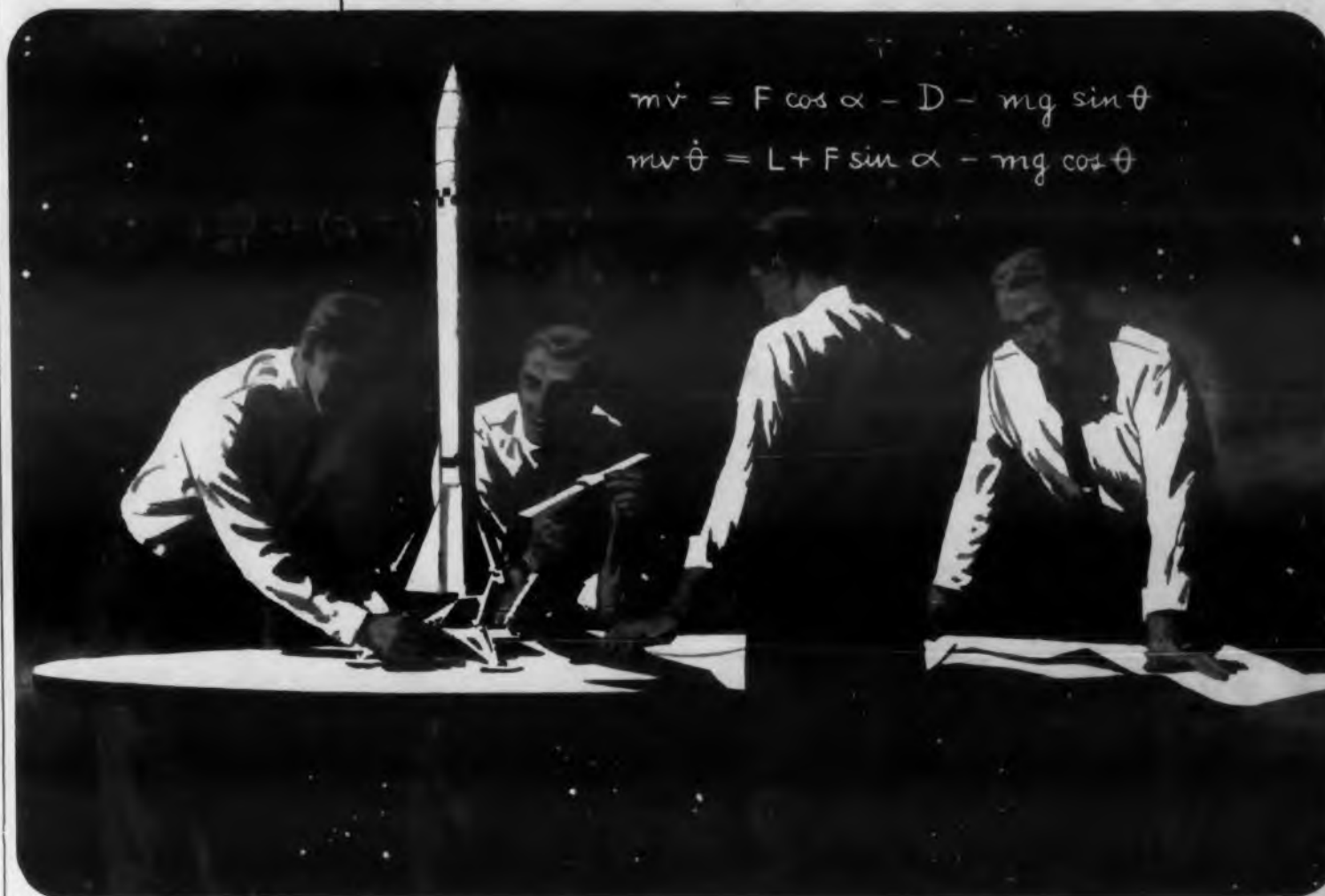
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IMPORTANT ACHIEVEMENTS AT JPL



Engineering Teamwork in Missile Development

The Jet Propulsion Laboratory is a stable research and development center located north of Pasadena in the foothills of the San Gabriel mountains. Covering an 80 acre area and employing 1700 people, it is close to attractive residential areas.

The Laboratory is staffed by the California Institute of Technology and develops its many projects in basic research under contract with the U.S. Government.

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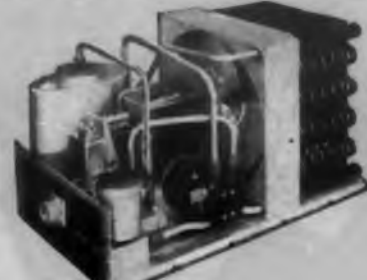
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MODEL E/HT-200, TYPE 201 DISSIPATION: 1,000 watts. **ALTITUDE RANGE:** sea level to 50,000 feet. **POWER REQUIRED:** 28 volts D.C. **WEIGHT:** 14 1/2 pounds. **SIZE:** 10" x 10" x 6" high.



MODEL NO. 5-A DISSIPATION: 1,000 watts. **ALTITUDE RANGE:** sea level to 5,000 feet. **POWER REQUIRED:** 100 to 110 volts D.C. **WEIGHT:** 10 pounds. **SIZE:** 7 1/2" x 13 1/2" x 9-1/16" high.

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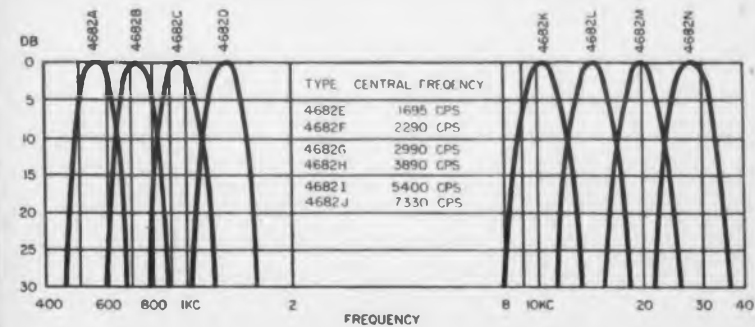
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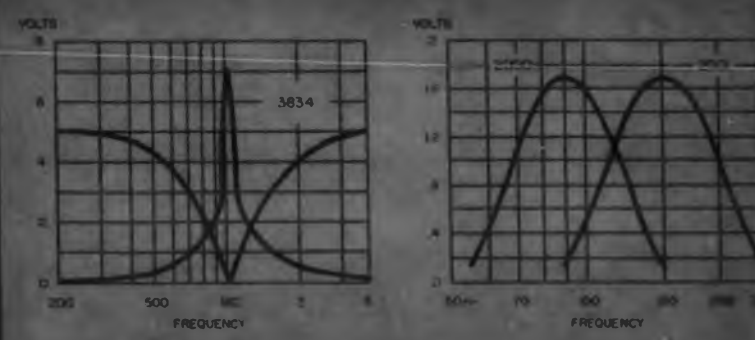
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Dimensions:
(4682A) 1 1/2 x 2 x 4"



Dimensions:
(3834) 1 1/4 x 1 3/4 x 2-3/16"
(2000, 1) 1 1/4 x 1 3/4 x 1 5/8"



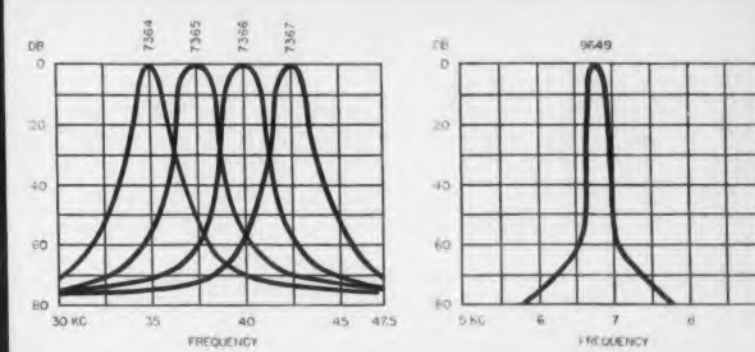
AIRCRAFT FILTERS

UTC has produced the bulk of filters used in aircraft equipment for over a decade. The curve at the left is that of a miniaturized (1020 cycles) range filter providing high attenuation between voice and range frequencies.

Curves at the right are that of our miniaturized 90 and 150 cycle filters for glide path systems.

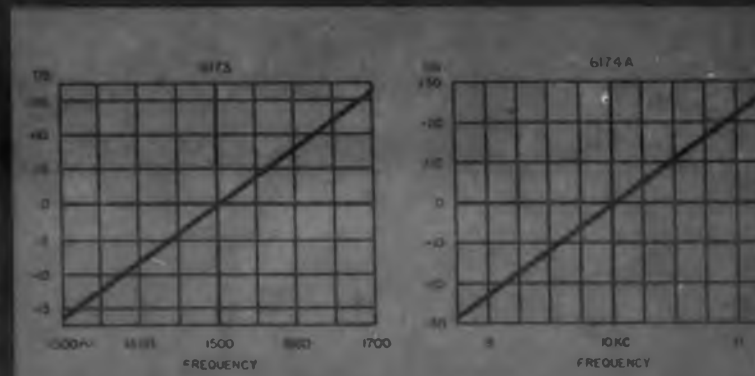
CARRIER FILTERS

A wide variety of carrier filters are available for specific applications. This type of tone channel filter can be supplied in a varied range of band widths and attenuations. The curves shown are typical units.



DISCRIMINATORS

These high Q discriminators provide exceptional amplification and linearity. Typical characteristics available are illustrated by the low and higher frequency curves shown.



Dimensions:
(6173) 1-1/16 x 1 3/4 x 3"
(6174A) 1 x 1 1/4 x 2 1/4"

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*Another
RCA first in
110° design*



RCA-17BZP4

- Weight—only 10 pounds
- Length—only 12 $\frac{9}{16}$ inches
- No Ion-Trap Magnet Needed

Scale: 1 square = 1 inch

Pioneer in the development of 110°-deflection picture tubes for compact black-and-white TV receivers, RCA presents the 17BZP4—the 17-inch-type, rectangular, glass tube designed specifically to meet popular demand for large-screen TV in smaller, lighter-weight cabinets. Here is a very short picture tube with a large viewing area of 155 square inches—3 inches shorter than types having the same size faceplate and 90° deflection. Super-aluminizing produces bright, high-contrast pictures that have made RCA picture tubes famous. The new RCA electron gun of the “straight-type” design **DOES AWAY ENTIRELY WITH THE NEED FOR AN ION-TRAP MAGNET!**

Available in quantity to meet your production schedule, RCA-17BZP4 is another important addition to RCA's expanding family of 110°-deflection types—including the RCA-21CEP4, the first commercially available 110° tube; a 14-inch developmental type now available for sampling to equipment manufacturers; and a 24-inch type in development.

For sales information and delivery schedule on RCA 110°-deflection types, call your RCA Field Representative. For technical data, write RCA Commercial Engineering, Section C18Q1, Harrison, N.J.

NOTE: RCA can supply you with the horizontal and vertical deflection tubes and components needed for 110°-deflection-angle systems.

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