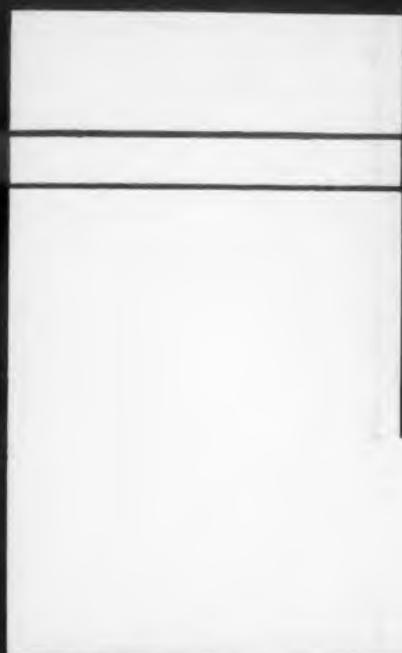


# ELECT D



Air-Operated Rotating Switch .....

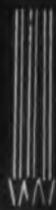
# R O N I C E S I G N

AUGUST 30, 1958

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# FREED

## MIL-T-27A TRANSFORMERS

### POWER TRANSFORMERS-STANDARD

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

Cat. No.	Hi Volt Sec.	ct	DC Volts	DC Amps	Filament Filament #1		Filament Filament #2		MIL Case Size
					Volt	Amp.	Volt	Amp.	
MGP1	400/200	✓	185	.070	6.3/5	2	6.3	3	HA
MGP2	650	✓	260	.070	6.3/5	2	6.3	4	JB
MGP3	650	✓	245	.150	6.3	5	5.0	3	KB
MGP4	880	✓	310	.175	5.0	3	6.3	8	LB
MGP5	900	✓	345	.250	5.0	3	6.3	8	MB
MGP6	700	✓	255	.250					KB
MGP7	1100	✓	419	.250					LB
MGP8	1600	✓	640	.250					NB

### FILAMENT TRANSFORMERS-STANDARD

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

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

### PULSE TRANSFORMERS

Cat. No.	Block E. Dec.	Int. Coupling	Low Perm. Out.	Pulse Voltage Microvolts	Pulse Duration Microseconds	Duty Rate	No. of Wdg.	Test Volt. KV RMS	Char. Imp. Ohms
MPT1	✓	✓	✓	0.25/0.25	0.2-1.0	.004	3	0.7	250
MPT2	✓	✓	✓	0.25/0.25	0.2-1.0	.004	2	0.7	250
MPT3	✓	✓	✓	0.5/0.5/0.5	0.2-1.5	.002	3	1.0	250
MPT4	✓	✓	✓	0.5/0.5	0.2-1.5	.002	2	1.0	250
MPT5	✓	✓	✓	0.5/0.5/0.5	0.5-2.0	.002	3	1.0	500
MPT6	✓	✓	✓	0.5/0.5	0.5-2.0	.002	2	1.0	500
MPT7	✓	✓	✓	0.7/0.7/0.7	0.5-1.5	.002	3	1.5	200
MPT8	✓	✓	✓	0.7/0.7	0.5-1.5	.002	2	1.5	200
MPT9	✓	✓	✓	1.0/1.0/1.0	0.7-3.5	.002	3	2.0	200
MPT10	✓	✓	✓	1.0/1.0	0.7-3.5	.002	2	2.0	200
MPT11	✓	✓	✓	1.0/1.0/1.0	1.0-5.0	.002	3	2.0	500
MPT12	✓	✓	✓	0.15/0.15/0.3/0.3	0.2-1.0	.004	4	0.7	700

### AUDIO TRANSFORMERS

Catalog No.	Application	Impedance		DC Current		Max Level DBM
		Prim Ohms	Sec Ohms	Prim. P. Size MA	Max. Unbal. MA	
MGA1	Single or P.P. Plates to Single or P.P. Grids	10K	900 Split	✓	10 10	-15
MGA2	Line to Voice Coil	600 Split	4, 8, 16	✓	8 8	-33
MGA3	Line to Single or P.P. Grids	600 Split	135K	✓	8 8	-15
MGA4	Line to Line	600 Split	600 Split	✓	8 8	-15
MGA5	Single Plate to Line	2.4K 4.8T	600 Split	✓	40 40	-33
MGA6	Single Plate to Voice Coil	7.0K 4.8T	4, 8, 16	✓	40 40	-33
MGA7	Single or P.P. Plates to Line	15K	400 Split	✓	10 10	-33
MGA8	P.P. Plates to Line	24K	400 Split	✓	10 1	-30
MGA9	P.P. Plates to Line	40K	400 Split	✓	10 1	-27

## TELEMETERING COMPONENTS

### BAND PASS FILTERS

Catalog No.	Catalog No.	3DB Bandwidth per cent of $F_0$	Center Frequency $F_0$ (KC)	Discriminators		
				Per cent Deviation of $F_0$	Per cent Linearity	Catalog No.
FBP-10	FBP-34	✓	4	✓	✓	DST-10
FBP-11	FBP-35	✓	5.6	✓	✓	DST-11
FBP-12	FBP-36	✓	7.3	✓	✓	DST-12
FBP-13	FBP-37	✓	9.6	✓	✓	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	✓	22.0	✓	✓	DST-25
FBP-26	FBP-50	✓	30.0	✓	✓	DST-26
FBP-27	FBP-51	✓	30.0	✓	✓	DST-27
FBP-28	FBP-52	✓	40.0	✓	✓	DST-28
FBP-29	FBP-53	✓	40.0	✓	✓	DST-29
FBP-30	FBP-54	✓	52.5	✓	✓	DST-30
FBP-31	FBP-55	✓	52.5	✓	✓	DST-31
FBP-32	FBP-56	✓	70.0	✓	✓	DST-32
FBP-33	FBP-57	✓	70.0	✓	✓	DST-33

### 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	.2 DB at 9% $F_0$ .7 DB at 1% $F_0$ 20 DB at 2% $F_0$ 30 DB from 2.5% $F_0$	
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		.05 DB at 9% $F_0$ .30 DB at third 50 DB at fifth Hermetic
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						
Characteristic impedance of LPI-10 thru 28=30,000!! of LPI-24 thru 28=5,100!!							

## MINIATURE COMPONENTS

For Delivery From Stock  
(MEET MIL-T-27A SPECIFICATIONS)

### MINIATURE AUDIO TRANSFORMERS

Catalog No.	Input Coupling	Power Level	Balanced DC Current	Unbalanced DC Current	Impedance Ohms	
					pri.	sec.
PMA-1	✓	+8	0	0	50/200/500	60,000 center tapped
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  $\pm 2$  DB 30 to 20,000  $\sim$ ; PMA 5 and 7  $\pm 2$  DB 200 to 10,000  $\sim$ . Case size 15/16"D x 1 1/2" high. Flanges 1 1/2" long.

### TRANSISTOR TRANSFORMERS

Catalog No.	200 to 15,000	300 to 15,000	Unbalanced DC Current	Max. Power Out	Impedance Ohms	
					pri.	sec.
TMA-1	+1	DB	MA	W.	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	

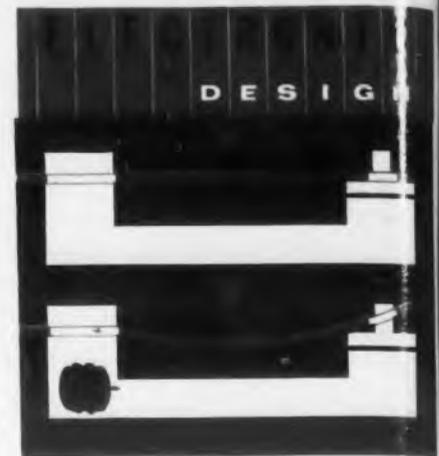
Case size 1"D x 1.5" high, flanges 1 1/2". Specify TMO for open, TMC for encapsulated units.

### MINIATURE HIGH Q TOROIDS

Cat. No.	Ind. MHY						
to 15 KC							
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						
F2069	2,000						

encapsulated units MR to Cat. No.

## HIGHLIGHTS OF ISSUE



### Air-Operated Rotating Switch (Cover) . . . . . 24

A jet of air, rotating at speeds of up to 20 cps inside this sampling switch, strikes contacts and closes them in rapid succession. As described on the cover, the jet of air tends to deflect the reed-like movable contact, drawing it into contact with the pin, which acts as the fixed contact.

### How To Design Pulse Magnetic Amplifiers . . . . . 20

With just two basic equations and some characteristics of magnetic material, you can design magnetic amplifiers for pulse work. Mr. White's lucid presentation shows how to go through the design and what the important design considerations are. Here, in the first of a two-part article he provides a step-by-step design procedure and a sample design.

### Pulse Oscilloscope List . . . . . 20

Forty-seven commercially available oscilloscopes having high frequency responses and fast rise times are listed along with the thirteen manufacturers producing these standard models.

</

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151 161 171 181 191	251 261 271 281 291	351 361 371 381 391	451 461 471 481 491	551 561 571 581 591
152 162 172 182 192	252 262 272 282 292	352 362 372 382 392	452 462 472 482 492	552 562 572 582 592
153 163 173 183 193	253 263 273 283 293	353 363 373 383 393	453 463 473 483 493	553 563 573 583 593
154 164 174 184 194	254 264 274 284 294	354 364 374 384 394	454 464 474 484 494	554 564 574 584 594
155 165 175 185 195	255 265 275 285 295	355 365 375 385 395	455 465 475 485 495	555 565 575 585 595
156 166 176 186 196	256 266 276 286 296	356 366 376 386 396	456 466 476 486 496	556 566 576 586 596
157 167 177 187 197	257 267 277 287 297	357 367 377 387 397	457 467 477 487 497	557 567 577 587 597
158 168 178 188 198	258 268 278 288 298	358 368 378 388 398	458 468 478 488 498	558 568 578 588 598
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106 116 126 136 146	206 216 226 236 246	306 316 326 336 346	406 416 426 436 446	506 516 526 536 546
107 117 127 137 147	207 217 227 237 247	307 317 327 337 347	407 417 427 437 447	507 517 527 537 547
108 118 128 138 148	208 218 228 238 248	308 318 328 338 348	408 418 428 438 448	508 518 528 538 548
109 119 129 139 149	209 219 229 239 249	309 319 329 339 349	409 419 429 439 449	509 519 529 539 549
150 160 170 180 190	250 260 270 280 290	350 360 370 380 390	450 460 470 480 490	550 560 570 580 590
151 161 171 181 191	251 261 271 281 291	351 361 371 381 391	451 461 471 481 491	551 561 571 581 591
152 162 172 182 192	252 262 272 282 292	352 362 372 382 392	452 462 472 482 492	552 562 572 582 592
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155 165 175 185 195	255 265 275 285 295	355 365 375 385 395	455 465 475 485 495	555 565 575 585 595
156 166 176 186 196	256 266 276 286 296	356 366 376 386 396	456 466 476 486 496	556 566 576 586 596
157 167 177 187 197	257 267 277 287 297	357 367 377 387 397	457 467 477 487 497	557 567 577 587 597
158 168 178 188 198	258 268 278 288 298	358 368 378 388 398	458 468 478 488 498	558 568 578 588 598
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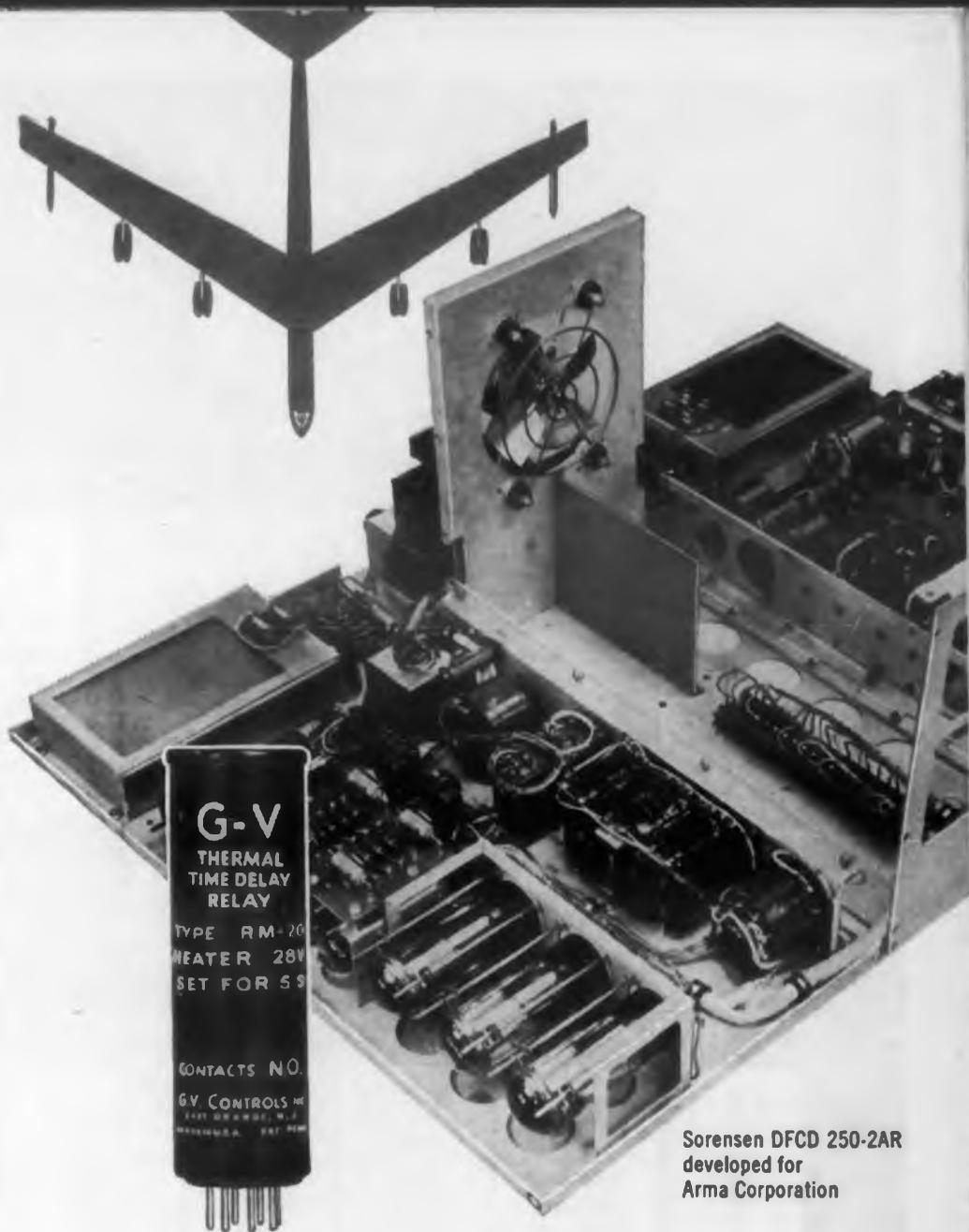
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### Germanium GLASS DIODES

TYPE	Working Voltage (max.) v	Forward Current at +1 volt mA	Reverse Current $\mu$ A at v	Type	Working Voltage (max.) v	Forward Current at +1 volt mA	Reverse Current $\mu$ A at v
<b>1N66A</b>	60	5	50 at -10	<b>1N191</b>	90	5	25 at -10
<b>1N67A</b>	80	4	50 at -50	<b>1N198</b>	80	5†	75† at -10
<b>1N68A</b>	100	3	625 at -100	<b>1N294A</b>	60	5	10 at -10
<b>1N95</b>	60	10	800 at -50	<b>1N297A</b>	80	3.5	100 at -50
<b>1N126</b>	60	5	50 at -10	<b>1N298A</b>	70	30*	250 at -40
<b>1N127</b>	100	3	25 at -10				

\*at +2 v †at 75°C

### Germanium VIDEO DETECTOR Diodes

for TV video and portable radio application;  
low capacity video detection; efficiency controlled at 50 Mc

### Silicon DIFFUSED JUNCTION GLASS RECTIFIERS

TYPE	Peak Operating Voltage -65°C to +150°C Volts	Ave. Rectified Current		Reverse Current (Max.) in $\mu$ A at Specified Voltage		
		25°C mA	150°C mA	Volts	25°C	100°C
<b>1N645</b>	225	400	150	225	0.2	15
<b>1N646</b>	300	400	150	300	0.2	15
<b>1N647</b>	400	400	150	400	0.2	20
<b>1N648</b>	500	400	150	500	0.2	20

### Silicon DIFFUSED JUNCTION RECTIFIERS

#### WIRE IN TYPES

#### STUD TYPES

TYPE	Peak Operating Voltage -65°C to +165°C Volts	Ave. Rectified Current		Reverse Current (Max.) at Specified PIV, 150°C mA	TYPE	Peak Operating Voltage -65°C to +165°C Volts	Ave. Rectified Current		Reverse Current (Max.) at Specified PIV, 25°C $\mu$ A
		25°C mA	150°C mA				25°C Amps.	150°C Amps.	
<b>1N536</b>	50	750	250	0.40	<b>1N253</b>	95*	3.0	1.0*	10
<b>1N537</b>	100	750	250	0.40	<b>1N254</b>	190*	1.5	0.4*	10
<b>1N538</b>	200	750	250	0.30	<b>1N255</b>	380*	1.5	0.4*	10
<b>1N539</b>	300	750	250	0.30	<b>1N256</b>	570*	0.95	0.2*	20
<b>1N540</b>	400	750	250	0.30	<b>CK846</b>	100	3.5	1.0	2
<b>1N1095</b>	500	750	250	0.30	<b>CK847</b>	200	3.5	1.0	2
<b>1N547†</b>	600	750	250	0.35	<b>CK848</b>	300	3.5	1.0	2
					<b>CK849</b>	400	3.5	1.0	2
					<b>CK850</b>	500	3.5	1.0	2
					<b>CK851</b>	600	3.5	1.0	2

† Same as 1N1096 \*to +135°C

All illustrations same size. Ratings at 25°C unless otherwise indicated.

1N253 through 1N256 available to MIL Specifications.

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CIRCLE 3 ON READER-SERVICE CARD

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# ENGINEERING REVIEW

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

## Ceramic-in-Glass Tubes May Improve Missile Performance

Development of a new "ceramic-in-glass" electron tube which puts a stacked tube into a conventional glass envelope, is expected to improve performance of guided missiles and satellites. As announced by Sylvania Electric Products Inc., Emporium, Pa., this new device is capable of withstanding extreme conditions of vibration, shock, and fatigue.

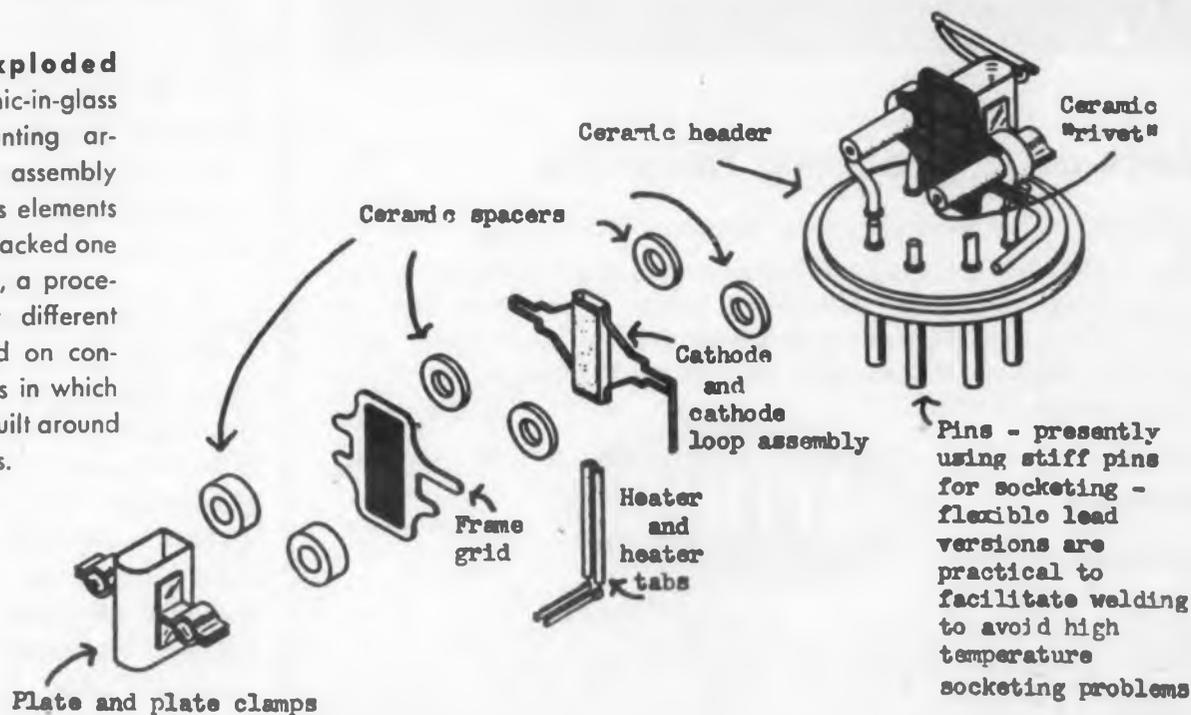
The tubes employ a planar structure in which tube parts and ceramic spacers are aligned on a ceramic post. The whole assembly is secured under compression by means of metal anchors

around the supports. According to Sylvania officials, the tubes are immediately adaptable to present automatic production techniques and equipment. There is no need for additional equipment tooling or circuit redesign. In addition, the stacked-mount-in-glass tubes will functionally replace existing tube types.

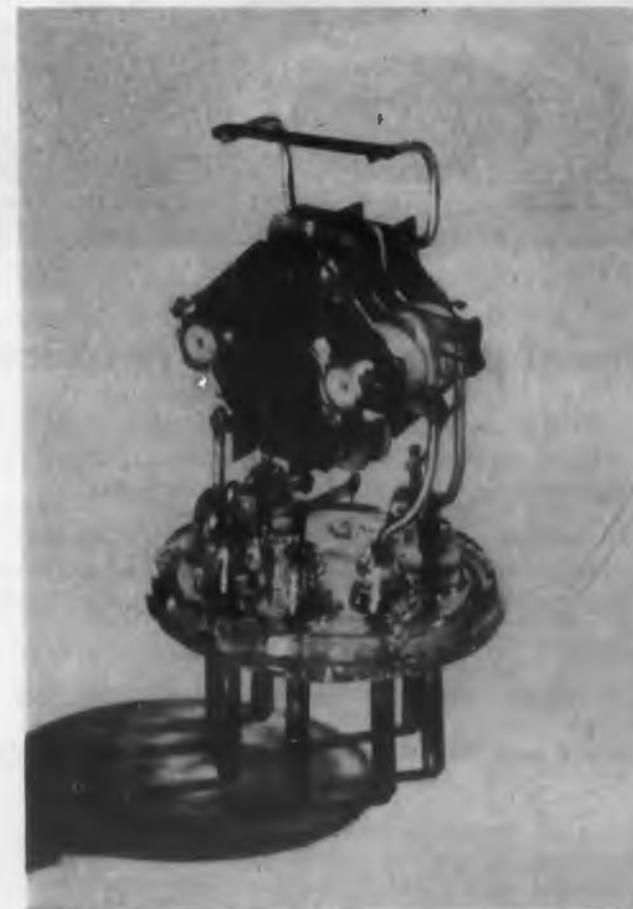
Two types for use in radar and ultra-high frequency communications, are presently available. Type 7244 is a dual triode, whose conventional counter-part is the 6J6WA, a medium-mu double

(continued on following page)

**Partially exploded view** of ceramic-in-glass tube of mounting arrangement. In assembly process various elements of mount are stacked one atop the other, a procedure radically different from that used on conventional tubes in which elements are built around a common axis.



Combining a glass envelope with the planar structure of the ceramic stacked tube, the ceramic-in-glass tubes are capable of surviving extreme conditions of shock, vibration, and fatigue. The new structure (below) is shown with standard (T5 1/2) 6J6 mount (above) with which it is directly interchangeable.





## Focal point for the requirements of a growing industry

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

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

first-rate performance and long, dependable life.

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### RAYTHEON MANUFACTURING COMPANY

Microwave and Power Tube Operations, Section PT-28, Waltham 54, Mass.



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Raytheon makes: Magnetrons and Klystrons, Backward Wave Oscillators, Traveling Wave Tubes, Storage Tubes, Power Tubes, Miniature and Sub-Miniature Tubes, Semiconductor Products, Ceramics and Ceramic Assemblies

## ENGINEERING REVIEW

triode for use in an oscillator, amplifier or mixer up to vhf. Type 7245 is a single triode, whose conventional counter-part is Type 6J4WA, a high-mu triode for use as a grounded grid amplifier in vhf applications. Additional types are reported under development with an audio beam power pentode and an RF pentode scheduled to be introduced later this year.

### May Eliminate Interference Problems

Communication interference problems may be partially relieved by a new power control device under development at General Electric, Syracuse, N.Y. Successful pilot tests in a two-way radio system operated by Niagara-Mohawk Power Corp. were reported by GE. Transmitted power of a base station is automatically adjusted to match the incoming power of a mobile radio. The outgoing power becomes inversely proportional to the signal received from a mobile transmitter.

Although initial tests were made with a 250 w station, the power control may be designed for operation with lower power base or mobile transmitters as needed.

It is hoped that the device will result in less co-channel interference and more effective utilization of the radio spectrum.

### Computer Aids Missile Sub Construction

Construction of the new Polaris missile-launching submarine will be speeded by the IBM 705 computer at Mare Island Naval Shipyard, Vallejo, Calif.

The computer will be put to work immediately on such problems as pipe stress analysis for the nuclear power plant of the submarine project. This job requires some 35,000 computations and would take an engineer some 20 days to complete manually. The 705 can do the job in 20 minutes. The 705 will

◀ CIRCLE 4 ON READER-SERVICE CARD

also provide a current picture of the work assigned to each area of production so that employment and material needs can be predicted and scheduled in proper sequence. Officials will also obtain a daily progress report on all construction under way from which potential trouble areas can be spotted and steps taken to avert costly delays.

### Russian Electronic "Arrow" Uses Beam Memory Tubes

The Russians are now producing a new digital computer, Strela (Arrow), for mathematical work at industrial and scientific research institutions throughout the USSR. No information is available on how many Strelas have been made, but the machine has a performance rating as high as BESM, the high speed electronic computer developed by the Russian Academy of Sciences.

Strela was developed at the Design Bureau of the Russian Ministry of Instrument Building and Means of Automation, over the course of a few years. Details on the design and logic have only recently been reported in the Ministry organ, *Proborostroyeniye* (Instrument Building).

Strela has an internal core memory which uses 43 electron beam memory tubes. The memory can store 2047 numerical characters or instructions in the form of spot electrostatic charges on the plates of the 43 tubes.

The external memory uses two magnetic tape units with 5 in. wide tape, 328 feet long. Each tape can store 253 zones of information groups with up to 200,000 numerical characters. Reading and writing speed is 1000 characters a second.

The computer's 16 standard programs, with up to 256 instructions, and constants to 256 numerical characters are stored in diode memory units with provision for manual dialing and switching of plug-in cells. Strela uses a floating decimal in both its storage and in its operations.



### ... Only the DUAL recti/riter® gives you two-channel rectilinear recording with direct time correlation!

Why synchronize two drive systems, handle two chart rolls, or for that matter, maintain two separate instruments? The DUAL "recti/riter" gives you two independent galvanometers, inking systems, and "recti/rite" linkages—with a single chart drive—enables you to record two variables simultaneously and visually correlate events to an accurate common time base. Record such variables as voltage and current, wind direction and velocity, temperature and pressure, torque and speed, input and output, and many others.

And, have the easiest of all recordings to read—true rectilinear side-by-side traces that you read at a glance with a simple ruler . . . no difficult interpretations so highly subject to reading errors as with old-fashioned curvilinear recordings.

Add these to the other outstanding features of the

"recti/riters" . . . galvanometer accuracy, easy frontal access for all routine operations, fingertip control of 10 chart speeds, dependable closed inking system, AC, DC, spring, or external drives . . . and you have the most work-saving recorder available.

Remember, too, that *only* the "recti/riter" and matching accessories provide these wide ranges for recording electrical parameters:

10 millivolts to 1000 volts  
500 microamperes to 1000 amperes  
Monitor standard frequencies—40, 60, 400 cps

When you write for specific information on the DUAL "recti/riter", Bulletin R-502, ask TI to include facts on the SINGLE "recti/riter", Line Voltage Monitor, and Model 301 All-Transistor DC Amplifier. You will be interested in the complete versatile line.



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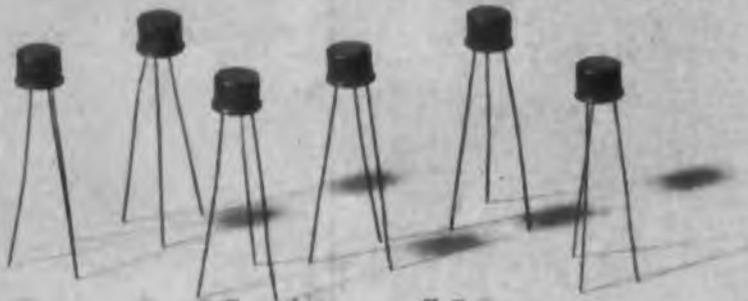
INDUSTRIAL INSTRUMENTATION DIVISION

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\*Identical Twins  
Ed and Gene Scroggins  
are TI Engineers

114



# Fairchild silicon transistors

## Milli-micro-second switching speeds and high current too

Where applications require transistor performance beyond previously accepted high limits, Fairchild Silicon Transistors offer an exceptional three-way combination:

1) **50 milli-micro-second typical rise time** — permits faster switching rates in computing devices. Total switching time is typically 0.2 microseconds.

2) **1 watt dissipation at 100° C.** — Saturation resistance is 10 ohms maximum. Resulting high-current capability provides opportunities to increase equipment performance while reducing circuit complexity.

3) **Silicon temperature performance** — Maximum junction temperature of 175° C. gives low leakage and more safety factor at any lower temperature.

These characteristics are the outcome of the solid-state diffusion technique used at Fairchild. Other important accomplishments of this process are excellent reliability and a high order of electrical uniformity throughout large production runs.

The accomplishment of a research-production team Singleness of purpose did it. Fairchild assembled a uniquely experienced team of research scientists and production engineers whose objective was to bring the advanced solid-state diffusion process under close control. They succeeded in putting laboratory-quality silicon transistors into quantity manufacture with firm product specifications exceeding anything previously offered.

### 2N696 and 2N697 SILICON TRANSISTORS

Symbol	Specification	Rating	Characteristics	Test Conditions
$V_{CE}$	Collector to Emitter voltage (25° C.)	40v		
$P_C$	Total dissipation Case temp. 25° C. Case temp. 100° C.	2 watts 1 watt		
$h_{FE}$	D.C. current gain		2N696 — 15 to 30 2N697 — 30 min.	$I_C = 150\text{ma}$ $V_C = 10\text{v}$
$R_{CS}$	Collector saturation resistance		6 $\Omega$ typical, 10 $\Omega$ max.	$I_C = 150\text{ma}$ $I_B = 15\text{ma}$

For full information and specifications, write Dept.



844 CHARLESTON ROAD • PALO ALTO, CALIFORNIA

The unretouched scope face below shows the time comparison of input (positive) and output (negative) pulses in a non-saturating mode. Time base is 20 $\mu\text{sec}$ . per large division on the scope face. Maximum collector current is 50 ma.



## ENGINEERING REVIEW

### Six Digit Voltmeter Aids Research

The first six-digit digital voltmeter ever produced has been delivered to the National Bureau of Standards. Developed by Non-Linear Systems, Inc., which was selected by NBS to undertake the project, the instrument is not slated for production according to NLS officials.

Voltages from one ten thousandth of a volt to one hundred volts may be measured automatically, at approximately four readings per min. These precise measurements are instantly displayed in numerical form in a readout window on the front panel of the instrument. The illuminated readout numerals are one in. high and appear with the appropriate plus or minus sign and correctly positioned decimal point.

Instrument calibration is automatic. Provision is also made for a control device and connections to operate an IBM Summary Punch machine which automatically punches the voltmeter readings on cards that can be fed into a computer or stored for later use.

NBS will use this instrument in a research program involving the precise measurements of minute voltages that must be taken during basic research being conducted on extremely pure forms of rare substances.



### World's Worst Weather Duplicated

The candy-striped bubble in the foreground is the radome of a Navy jet bomber's automatic armament system undergoing severe weather condition testing. The massive weather chambers that simulate the altitude of 90,000 feet, are capable of temperature ranges from -105 deg to 500 deg and humidity approaching 100 per cent, even with salt spray. The \$400,000 apparatus resembles a two-car garage 10 feet high, 18 feet wide and 16 feet deep. The tunnel is installed at the Westinghouse Friendship Airport plant, Baltimore, Maryland.

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ELECTRONIC DESIGN • August 20, 1958

# MICROWAVE GENERATORS

## 950 to 21,000 mc

### with MORE MODULATION CAPABILITIES

The extremely wide range of pulse width, delay and repetition rate are read directly on the front panel of Polarad microwave generators. In addition these units provide broadband internal FM and CW modulation, versatile external modulation capability and a sync output for all signals. These features provide the largest choice of microwave test signal combinations available in signal generators.

**Internal pulse rise and decay:** 0.1 microsecond.\*

**External pulse modulation:** positive or negative polarity, 10 to 10,000 pps, 0.2 to 100 microseconds width.\*

**Output synchronization pulses:** positive polarity, delayed and undelayed.

Rugged construction. Quick, easy inspection and servicing. Continuous UNI-DIAL tuning in each frequency range. Non-contacting tuning cavity chokes.

For every application, 950 to 21,000 mc.

Model	Frequency Range	Power Output
MSG-1	950 to 2,400 mc	0 dbm (1 milliwatt) to -127 dbm, directly calibrated
MSG-2	2,000 to 4,600 mc	
PMX	4,200 to 8,000 mc 6,950 to 11,000 mc	
MSG-34	4,200 to 11,000 mc	+10 dbm (10 milliwatts) to -90 dbm
PMK	10,000 to 15,500 mc 15,000 to 21,000 mc	

**AND MICROWAVE POWER SOURCES—1,050 to 17,500 mc.**

**High power output:** 14 to 700 milliwatts depending on frequency. **Modulation:** Internal square wave or external FM and square wave.



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**MAIL THIS CARD** for specifications. Ask your nearest Polarad representative (in the Yellow Pages) for a copy of "Notes on Microwave Measurements."



#### MODULATION CAPABILITIES\*

Generates CW, FM, internal pulse, internal square wave. Or can be externally modulated.

Pulse delay: adjustable from 2 to 2,000 microseconds.

Pulse repetition rate: adjustable from 10 to 10,000 pps.

Pulse width: adjustable from 0.2 to 10 microseconds.

Linear sawtooth internal FM modulation, 10 to 10,000 cps, 5 mc minimum frequency deviation.

Internal or external, pulse or sine wave synchronization.

\*Models MSG-34, PMX and PMK



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# MICROWAVE GENERATORS

18,000 to 50,000 mc.



## MICROWAVE SIGNAL GENERATORS

18,000 to 39,000 mc

7 interchangeable plug-in tuning units  
Calibrated power output: -10 to -90 dbm  
Direct-reading attenuator, accurate to 2%

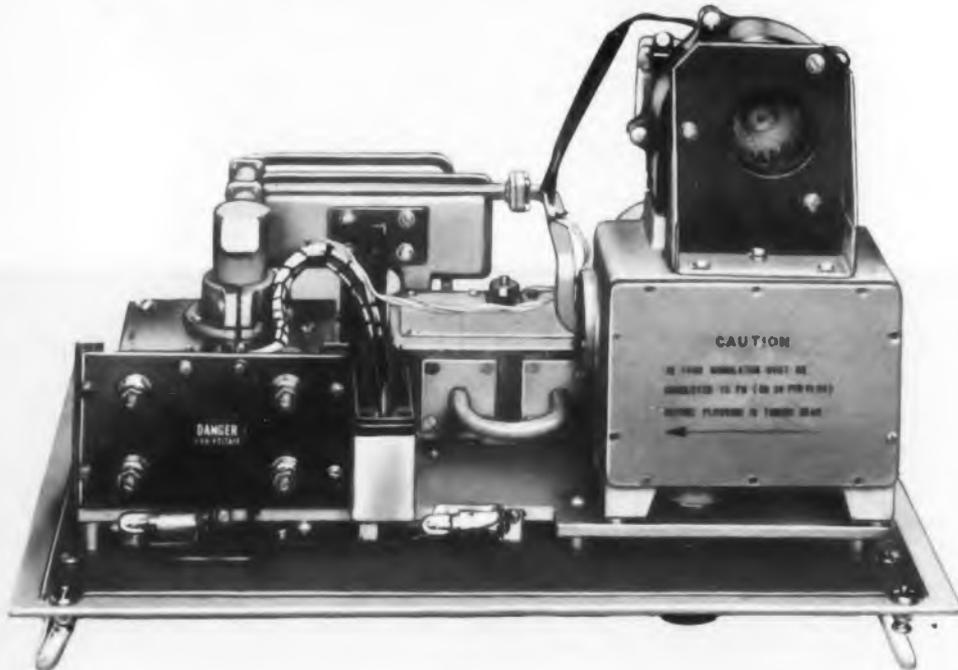
## MICROWAVE POWER SOURCES

18,000 to 50,000 mc

9 interchangeable plug-in tuning units  
High power output: 10 mw from  
18,000 to 33,520 mc.  
Between 9 and 3 mw in higher ranges,  
depending on frequency.

## PLUG-IN INTERCHANGEABILITY

Now you can work at Extremely High Frequencies with one basic microwave generator, using only the tuning units in the ranges you require immediately. Later, as your work expands to other frequencies, add only tuning units — not complete generators.



All instruments provide: a direct reading wavemeter, indicating frequency to 0.1% accuracy; continuous tuning over entire range; 1,000 cps internal square-wave modulation — or external modulation; direct waveguide output connectors. All are designed for quick, easy inspection and servicing.

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Recording Optical Tracking Instrument which sequentially photographed Sputnik II.

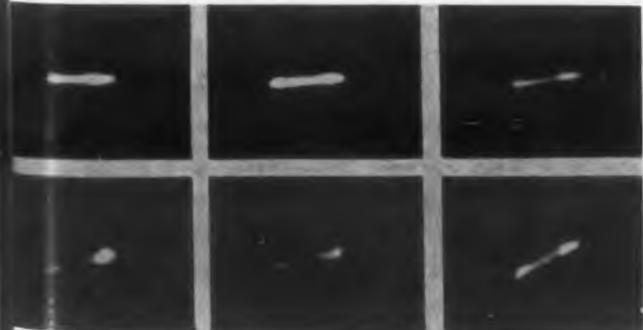
## How Long The "Moon"

The entire Soviet Satellite, Sputnik II, containing the dog "Laika", instrumentation, propellant tank, and motor, was from 74 to 84 ft long. This measurement was calculated from photographic evidence taken with the missile tracking camera, designed and built by the Perkin-Elmer Corp., Norwalk, Conn., for the Air Force Missile Test Center.

Trained on Sputnik II as it passed over Patrick Air Force Base, Fla. on December 21, 1957, the Recording Optical Tracking Instrument took the sequence of photographs necessary to determine the length.

Russian Satellite Beta (Sputnik II) passed within 200 statute miles of the Missile Test Center. Approximately 400 ft of 70 mm film was used by the tracking telescope. The telescope has a 24 in. aperture and focal length up to 500 in. Maximum focal length was used for this series.

The accompanying series of enlargements shows typical frames from the best or middle part of the photographic series at intervals of two seconds of time. All enlargements have been magnified 27.7 times from the original film. This magnification was determined from similarly enlarged photographs of the sprocket holes of the film and their known dimensions and spacing. Image size was measured on the enlargements to one-hundredth of an inch. These values divided by the magnification of 27.7 gave the size of the image on the original film. Further corrections were then made for angle distortions.



Two-second sequence shots of "Laika" aloft.

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## LEACH ELECTRONIC RELAYS

### SOLVE THESE PROBLEMS:

- malfunction due to vibration and shock**  
Exclusive counterbalanced armature with rigid central pivot eliminates armature flutter, insures overtravel and high contact pressure.
- internal contamination**  
Inorganic, contaminant-free ceramic actuator prevents formation of gases. Drawn aluminum can is crimped to header to prevent introduction of flux. Entire unit hermetically sealed and mass spectrometer checked.
- malfunction at elevated ambients**  
Magnet coil wound with Teflon insulated magnet wire on one-piece Kel F bobbin.



### BALANCED ARMATURE RELAY

Type 9229 2 PDT 5 amp, 3 amp, microamp

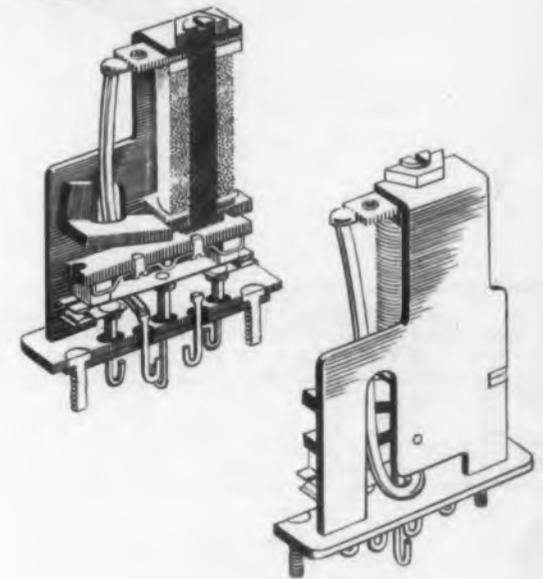
#### FEATURES

Rectangular configuration  
Stud or bracket mountings  
Terminals—solder lug or potted leads  
Silver alloy or gold alloy contact material  
Solid or bifurcated contacts  
Coils available for ac or dc

#### TYPICAL RATINGS

Contact ratings (resistive) @ 28 vdc or 115 vac single phase  
3 amp @ 125°C ac and dc  
5 amp @ 85°C (dc only)  
Minimum operating cycles—100,000  
Weight—approx.—0.125 lbs.  
Shock—50 G's  
Vibration—15 G's to 2,000 cps  
Temperature range—70°C to +125°C

Applicable specifications—MIL-R-6106C Class A5, A8, B8, minimum current tests applicable; MIL-R-5757B Class A and B  
Also available for special requirements such as microamp switching, high vibration and special mountings.



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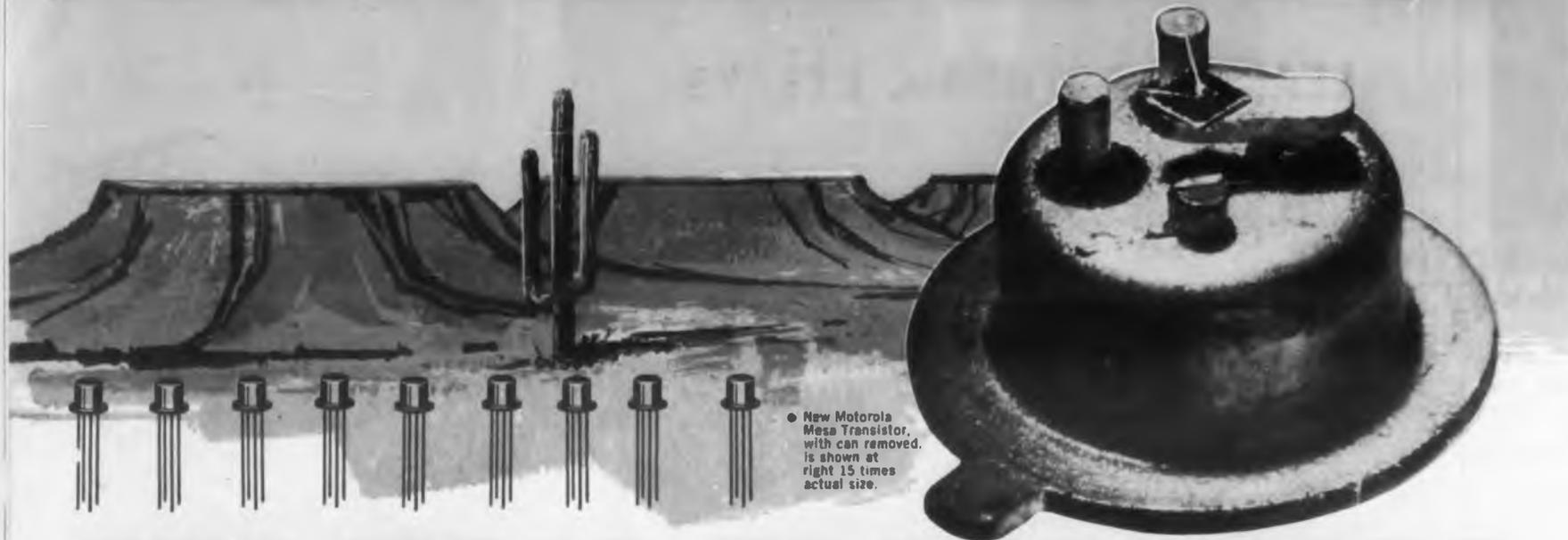
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# First From **MOTOROLA**

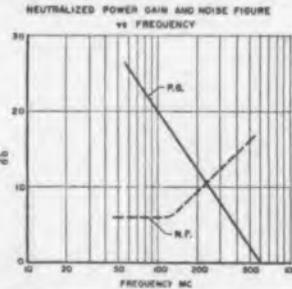


• New Motorola Mesa Transistor, with can removed, is shown at right 15 times actual size.

## UHF MESA TRANSISTORS

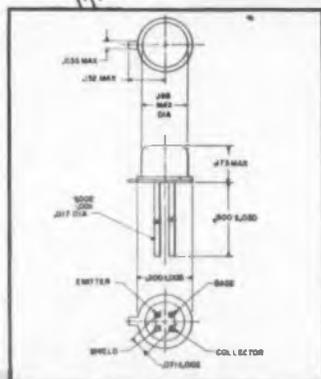
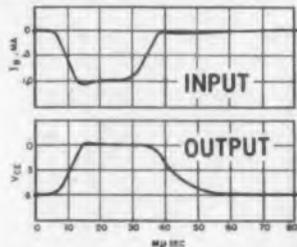
2N700 LOW-NOISE HIGH-FREQUENCY AMPLIFIER					
TYPICAL CHARACTERISTICS					
TYPE	$f_{max}$	Power Gain	$BV_{CB}$ @ 100 $\mu$ a	NF @ 200 mcs	Max Power
2N700	600 mcs	12 db @ 200 mcs	33 volts	9 db	50 mw

Operating Temperature  
100°C case temperature with  
12 mw dissipation  
Germanium PNP



2N695 ULTRA HIGH-SPEED SWITCH					
TYPICAL CHARACTERISTICS					
TYPE	$BV_{CB}$	$I_{CO}$ @ 5 volts	$\beta_{sat.}$ at 20 ma	$I_C$ max	$P_C$
2N695	20 volts	.8 $\mu$ a	30	20 ma	50 mw

Operating Temperature  
100°C case temperature with  
12 mw dissipation  
Switching Times  
in the order of 10  $\mu$ sec  
Germanium PNP



FOR COMPLETE TECHNICAL INFORMATION concerning Motorola Mesa Transistors contact the nearest Motorola regional office; or wire, write or phone  
**MOTOROLA, INC.,**  
5005 East McDowell Road, Phoenix, Ariz.  
BRidge 5-4411 Teletype PX80.

### the beginning of an exciting new transistor family

- Extreme reliability — only high temperature materials used, process carefully controlled.
- Higher operating temperatures.
- Rugged — withstands 50,000G acceleration.
- New header design provides effective interelectrode capacitance isolation . . . smaller inductance
- Low nuclear radiation susceptibility.
- Modified JETEC 20 case . . . hermetically sealed.
- Meets or exceeds mechanical and environmental requirements of MIL-T-19500A.
- High uniformity — "Normal" instead of "selected" distribution.
- A Revolutionary New Family**  
These are only the first of a wide variety of germanium Motorola Mesa Transistors coming your way soon.

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## MOTOROLA

## SEMICONDUCTORS

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## ENGINEERING REVIEW



### Silicon—Thin Sliced Loaves

Using a new diamond wheel Audio Devices' Rectifier Division, Santa Ana, Calif. recently revealed its silicon-saw-dust loss has been reduced 45 per cent.

At \$5,000 a pound, crystal silicon is not a material to be wasted. Conventional diamond wheels cut away 65 per cent or more of the substance during production of silicon wafers. The Diatronic wheel, manufactured as a standard product by Navan, Inc., Santa Monica, Calif., has cutting edge widths ranging from 0.006 in. with a tolerance of  $\pm 0.005$  in.,  $-0$  in.

The new wheels cut satisfactorily for 30 days or more. This compares with four hours to two days for conventional wheels. Silicon crystals cut by Audio are usually 0.10 in. sq and 0.13 in. thick. Clearly a diamond wheel with a maximum edge width of 0.0065 in. instead of the former 0.007 in.  $\pm 0.001$  results in substantial production savings.

### Unconventional Sources of Electrical Power Surveyed

Most practical unconventional power sources for converting solar, thermal, chemical, and mechanical energies into electricity, appear to be the oscillating electromagnetic generator, thermopile generator, ion exchange membrane, fuel cell, and photovoltaic battery. This was the conclusion of an Air Force-sponsored survey which has just been released to industry. The

◀ CIRCLE 8 ON READER-SERVICE CARD

study involved the theoretical and practical limitations and capabilities of power generation by means other than rotating machinery, conventional batteries, or radio activity. The data, drawn from the literature and limited laboratory work, was intended to determine where emphasis should be placed in a possible development program. A. L. Betts and P. A. McCollum of Oklahoma A & M College conducted the survey for Wright Air Development Center, U. S. Air Force. The report is *Unconventional Power Sources* divided into two parts (PB 131411 and PB 131218) each selling for two dollars from OTS, Dept. of Commerce, Washington 25, D.C.

### Largest Radio Multi-Channel Link Opened

The largest radio telecommunications system capable of providing an ultimate capacity of over 50,000 channel miles has recently been opened in Nigeria. Constructed by Marconi's Wireless Telegraph Co., the system uses Marconi vhf multi-channel equipment at all the 14 terminal and 25 repeater stations.

### Utilize Body Heat in Cold Weather Operation

Development of a battery vest, utilizing human body heat to keep dry cells warm and active for radio operators in extremely cold weather, was announced by the Department of the Army.

Developed by the U. S. Army Signal Research and Development Laboratory, Fort Monmouth, N. J., the idea is to place dry cell batteries in a vestlike garment worn beneath parkas to capture body heat. A cord is used to plug in standard Army radios. With the vest batteries developed for low-temperature use are expected to stay in service ten times longer in 40-degree-below-zero weather. Test models were built by Burgess Battery Co., Freeport, N.Y.

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# 1500 Volts 400 ma at 150°C!

## Transitron SILICON RECTIFIERS

Here for the first time is a 1500 volt rectifier proven in service at 150°C Case. Current levels up to 400 ma are handled by the TM155 . . . the latest to join Transitron's expanding family of high voltage silicon rectifiers. And now this entire high voltage series is priced more attractively than ever!

Hermetically sealed in the standard 1/8" hex package, these units are resistant to shock, vibration and environment changes. The new higher ratings make them useful in high voltage power supplies for magnetrons, klystrons, electronic precipitators and other applications requiring 600 volt output or higher.

Send for our rectifier brochure, TE-1351.

### FEATURES

- NO DERATING AT HIGH TEMPERATURE
- HIGH POWER HANDLING ABILITY
- SMALL SIZE
- HERMETICALLY SEALED

For still higher voltages at currents to 175 ma, Transitron makes rectifier assemblies in cartridges and in the convenient "2 W" axial lead package.



Type	Maximum Inverse Operating Voltage (volts)	Maximum Average Forward Current (ma)	Maximum Average Inverse Current @ Full Load (ma)
TM155	1500	400	.5
TM156	1500	200	.5
TM124	1200	1000	.5
TM125	1200	400	.5
TM126	1200	200	.5
TM104	1000	1000	.5
TM105	1000	400	.5
TM106	1000	200	.5

# Transitron

electronic corporation

wakefield, massachusetts



Transistors



Diodes



Regulators



Rectifiers



**New! Low cost! Fresh design approach!**

## Direct-Reading FREQUENCY METERS

### 8.2 to 40.0 KMC

A completely new engineering approach enables the new *-hp-* 532A series Frequency Meters to provide you with low cost, direct-reading convenience and dependability not previously available in a microwave frequency meter.

These new general-purpose test instruments avoid the out-moded and error-prone sliding contact design. Instead, the 532A series employs a high Q resonant cavity (TE<sub>111</sub> mode) tuned by a choke plunger. The cavity is mounted on a special wave-guide section designed so that a very small amount of power is reflected at resonance, while the major portion is transmitted. Reaction at resonance is virtually constant full range; there are no spurious modes or resonances; resonance is indicated by a dip of approximately 1.5 db in output. Scale divisions 5 MC apart insure a high order of resolution. Tuning is by a precision lead screw springloaded to eliminate backlash. Four separate models covering the X, P, K and R bands (see table) are offered.

#### HEWLETT-PACKARD COMPANY

4871K PAGE MILL ROAD • PALO ALTO, CALIFORNIA, U.S.A.  
CABLE "HEWPACK" • DAVENPORT 5-4451  
FIELD REPRESENTATIVES IN ALL PRINCIPAL AREAS



**Gevic computer**, for a typical fighter bomber application, will weigh only 45 pounds and occupy 0.8 cu ft. Arithmetic module is being inserted in package.

#### Lightweight Digital Computer Designed for Airborne Use

Weighing 45 pounds and occupying 0.8 cu ft. of space, a new airborne digital computer has sufficient speed and capacity to handle all computations required by an advance fighter-bomber. Developed by the Light Military Electronic Equipment Department of the General Electric Company, Utica, N.Y., the computer, called GEVIC, has been designed with high solution and iteration rates, so that it can be incorporated directly into control system loops.

Design engineers stated that the same technique could be applied to airborne multi-threat evaluation, pre-launch missile computation, or in-flight missile inertial guidance.

The GEVIC computer is based on a newly-developed variable increment type of variable difference mathematics. This special mechanization permits very fast slew operation, yet provides high accuracy digital resolution during normal operation. The computer can select any one of numerous increment values to accommodate rapidly changing parameters.

GEVIC uses magnetic logic and subminiature techniques throughout. The magnetic core-diode circuits are driven in parallel from a single sine-wave clock supply. The parallel connection enables the core units to operate over wide ranges of voltage and diode impedance values. Clock supply wave-shape is of minor importance. Components are mounted on only one side of the printed circuit boards to facilitate dip soldering techniques.

#### SPECIFICATIONS

	X532A	P532A	K532A	R532A
<b>Accuracy:</b>	0.08%	0.1%	0.1%	0.2%
<b>Frequency range, KMC:</b>	8.2 to 12.4	12.4 to 18.0	18.0 to 26.5	26.5 to 40.0
<b>Waveguide size, inches:</b>	1" x 1/2"	0.702" x 0.391"	0.5" x 0.25"	0.36" x 0.22"
<b>Resetability:</b>	0.01%	0.01%	0.01%	0.01%
<b>SWR at resonance (approximate):</b>	1.3:1	1.3:1	1.3:1	1.3:1
<b>Price:</b>	\$150.00	\$210.00	\$230.00	\$250.00

Data subject to change without notice. Prices f.o.b. factory



offers complete coverage in microwave measuring equipment

CIRCLE 10 ON READER-SERVICE CARD

## High-Purity Tantalum Produced Commercially

Achievement of commercial production of very high purity tantalum metal was announced by the Research Corp., Cambridge, Mass.

The new tantalum product is very low in oxygen, carbon and other impurities which adversely affect melting and fabrication. High purity gives the NRC tantalum ingot unusual ductility and low hardness (60-65 Brinell), permitting size reduction from 3-in. diam ingot to 0.0005-in. foil without intermediate annealing.

## Attack Simulator Trains Anti-aircraft Crews

Nike missile-men and other anti-aircraft crews are being trained in enemy interception and destruction by a new attack simulator. The device is housed in a 20-foot trailer since it is designed to be moved from one weapons site to another. It will be used at Nike guided missile centers and at 90-millimeter and 120-millimeter artillery sites both in the United States and overseas, for the continual training of fire-control and missile-guidance radar operators.

The device, developed by IT&T, New York, N.Y., can inject six synthetic aircraft targets into the control radars, with each of the simulated targets having the characteristics of extremely fast, maneuverable planes. As each of the planes is detected and appears on the radar scope, the instructor can order into the system "jamming" by the "enemy" to simulate various types of interference. The speed with which the operators can solve each of the problems is indicated by a time scoreboard.

Target speeds up to 2300 miles an hour, with a maximum target range of more than 100 miles can be simulated. It also can simulate target altitudes up to 80,000 feet; maneuvers, including climb rates, up to 40,000 ft a min and dive rates up to 80,000 ft a min.

# THE BIG LOOK

## IN GENERAL ELECTRIC'S NEW PANEL INSTRUMENTS

### DISTINCTIVE APPEARANCE

Clean-line design sparkles with functional new beauty—adds a distinctive touch to your finest switchboards and panels. Big border-to-border scale is framed in aluminum for better color blending. Design innovation creates the illusion of bigness, yet they fit into the same useable space as old style instruments.

### EXCELLENT READABILITY

BIG LOOK styling provides up to 28% increase in scale length over types replaced. Easy-to-read numerals cannot be obscured by the slim, tapered pointer. Clear raised window allows natural light to flood scale area, keeping shadows out.

### RELIABLE OPERATION

**Self-shielding:** Exclusive moving-magnet mechanism and the core-magnet mechanism can generally be mounted on magnetic or non-magnetic panels without special calibration.

**Completely Sealed:** All cases are sealed with neoprene gaskets to protect internal parts from dust, dirt, and water for extra-long, trouble-free operation. D-c movements and a-c iron-vane movement are accurate to within  $\pm 2\%$  of full scale value.

For complete information contact your nearby G-E Apparatus Sales Office or Distributor; or write for bulletin GEA-6678A, Section 582-31, General Electric Company, Schenectady 5, N. Y.

*Progress Is Our Most Important Product*

GENERAL  ELECTRIC



## ACTUAL SIZE

Although they look bigger, these a-c and d-c units are actually 2½- and 3½-inch sizes. Mounting is interchangeable with JAN, MIL, and ASA (round) specifications.



# ACHESON

dispersions  
digest

Reporting uses for



COLLOIDAL GRAPHITE, MOLY-SULFIDE,  
VERMICULITE, AND OTHER SOLIDS



Typical application of colloidal graphite is for the elimination of static charges on drive belts.

'dag' dispersions for static elimination are being used increasingly where accumulated charges prove hazardous or contribute to a high noise level. For years, cotton wicks impregnated with colloidal graphite in water have been installed along wing and fuselage surfaces of planes. These conductive wicks bleed off static charges into the airstream

## 'DAG' COLLOIDAL GRAPHITE... FOR BETTER PRODUCT DESIGN

High-purity, electric furnace graphite, colloiddally dispersed in a variety of liquid carriers — this is the product gaining increasing use in the electronics and electrical manufacturing industries.

Design Engineers acquainted with the unusual properties of 'dag' colloidal graphite are adapting this versatile material to solve design problems that heretofore were difficult to overcome in any other way.

Films formed with dispersions of colloidal graphite are chemically inert, non-fusible, electrically and thermally conductive, and resistant to electron bombardment. In addition, it is one of few conductive materials having excellent lubricity.

### Conductive coating for grids and plates in vacuum tubes

The excellent thermal-radiation properties of graphite help keep grids cool enough to prevent undesired primary emission. The low photo electric properties of graphite render properly coated parts practically free from the effects of such electromagnetic radiations as light, X-rays, etc. Applied to grids (and frequently to plates) of thermionic tubes, a graphite coating offers protection from the impact of primary particles since it is resistant to electron bombardment. This greatly reduces or entirely eliminates emission of so-called "secondary" electrons.

Colloidal graphite can be applied directly to parts which need not have undergone such preliminary treatments as acid etching, sand blasting, or oxidation. Where radiation effects are desired, it should be remembered that surfaces which are rough, as well as black, radiate more effectively. Graphite coatings can be applied by such convenient methods as dipping,



Colloidal graphite is spray-applied on grid plates to increase radiation, reduce secondary emission.

spraying and brushing. Continuous strip stock for plates, for example, may be coated by guiding the strip into a dip tank, then withdrawing past wiper blades and through a drying tower. Graphite coatings on grids or plates are used in various types of power-amplifier tubes to increase radiation or reduce secondary emission.

before they build up to the danger point. Dust-collector bags used on pulverizing, abrading and grinding equipment also are coated with colloidal graphite in alcohol to eliminate this same fire hazard. Graphite dispersions applied to the pulley side of high speed drive belts also hold static

electric charges in check. There are many more uses for 'dag' colloidal dispersions in electronic and electrical applications. Write for Bulletin No. 433 or call in your Acheson Service Engineer for his recommendations. They can prove profitable. Address Dept. ED-88.



## ACHESON Colloids Company

PORT HURON, MICHIGAN

A division of Acheson Industries, Inc.

Also Acheson Industries (Europe) Ltd. and affiliates, London, England



Offices in: Boston • Chicago • Cleveland • Dayton • Detroit • Los Angeles • Milwaukee  
New York • Philadelphia • Pittsburgh • Rochester • St. Louis • Toronto

CIRCLE 12 ON READER-SERVICE CARD

# WASHINGTON REPORT



Herbert H. Rosen

## SAGE Becomes Operational

A new era opened on electronic automation recently with the dedication of the first operational SAGE center at McGuire Air Force Base, New Jersey. While technologically not representative of the most advanced electronics, SAGE does function as the foundation of another area of specialization in the electronics industry. One that will revolve around the air defense of the nation with some application to civilian air traffic control.

SAGE has also provided eight organizations with a solid entry into this new field—an entry that leaves little room for other companies. Western Electric acted as the prime contractor for SAGE—gathering all the loose ends together to form this giant complex. Burroughs provided radar data links with its AN/FST-2 units. The Lincoln Lab of MIT was concerned with the overall design of the system. IBM's AN/FSQ-7 computer is the heart of SAGE. Bendix Radio supplied the FPS-20 long range radar, the gap filler radar FPS-14, and parts of the computer inputs. General Electric's power supplies feed the computers and other units. Lewyt has developed a transistorized display and read-cut printer for SAGE. And a newcomer to the team, Systems Development Corps—a Rand Inc. spin-off organization—worked on the programming of the data.

SAGE continues to be a very expensive and complex experiment. Its complexity dictated the selection of only large, deeply organized, well-financed principal contractors. Cost of SAGE has been reported to be between \$2.4 billion and \$7.2 billion. The latter figure includes everything in the Air Defense System associated with SAGE—radars, missiles, missile sites, control centers, observations posts, power, communications, etc. The \$2.4 billion represents the cost of bringing the radar link and the sample center to the point of dedication—as at McGuire.

Even spread over the six years spent in developing SAGE, the finances of this program are staggering. The huge black house—and everything in and around it—cost about \$132 million. A cost the Air Force anticipates will not be repeated at other centers. For the moment, however, about \$27 million bought the computer,

about \$10 million the brick and mortar in the building, and the rest for power, air conditioning, land lines, data links, radar link, office space, etc.

McGuire is the first of 29 major SAGE Direction Centers. Nine of these will have duplicate SAGE installations and will act as central control for regions consisting of four or more SAGE Centers. That brings the total up to 36 more—nearly another billion dollars of equipment.

By the time the tenth or so center is built, the Air Force expects the average cost of each one to be reduced considerably. Engineers on the project also predict that the newest electronic techniques will be more generally used—notably semiconductor technology.

Even then, the Air Force estimates that operations and maintenance costs of the 36 centers will be about \$489 million a year. Those costs should start in 1963, when all of the SAGE Centers are supposed to be operational.

An official estimate of the total bill the U.S. must pay annually for all of its air defense is \$4-1/2 billion. Of course, that includes both the manned and unmanned defensive forces being coordinated by NORAD—the North American Air Defense Command—at Colorado Springs.

Early next year, it is hoped, the first BOMARC squadron will be operational at McGuire. Part of the SAGE computer will be used to control and guide this medium range missile.

Meanwhile, a small-scale controversy rages over the relative roles of SAGE and Missile Master. The Air Force is more concerned with the long range intercept as typified by DEWline and the F-105. Missile Master and its 50-mile Nike-Hercules are considered the last ditch stands.

Still, the two systems must be linked together. Within the next two years the differences between the two systems must be resolved. SAGE is digital. Missile Master is analog. And the data link connecting them cannot be as large as either installation.

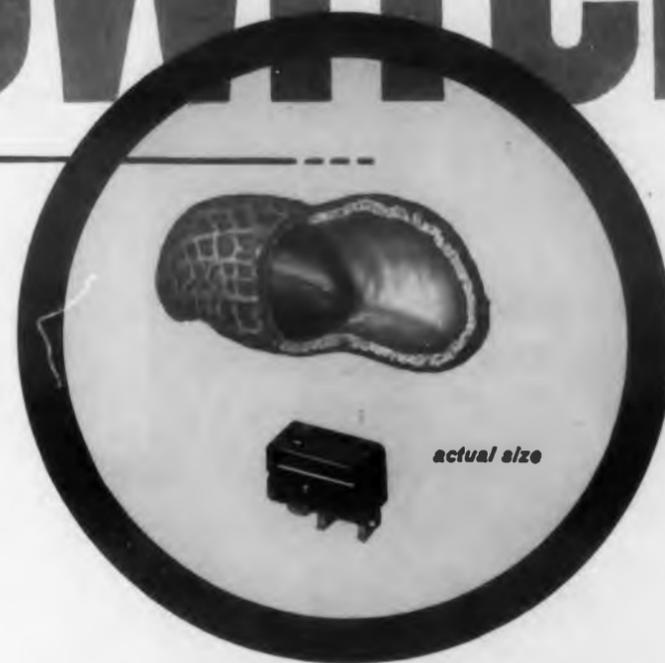
Still others comment on the number of missions SAGE can control—in the 40's. As an air control system for civilian traffic, this is an intolerably small rate. Moreover, SAGE requires people—it is semiautomatic.

As SAGE now stands it fits into the National Defense Plan against manned airplanes and air-breathing missiles—the subsonic kind. This is a condition the military planners expect to continue for a few years. After that what?

SAGE can be connected to BMEWS—the ballistic missile early warning system—just as it is now connected to the DEWline. And as it will be eventually to Missile Master. But there are grave doubts that unless there are some improvements, its ability to cope with supersonic ballistic missiles is weak.

# NEW "peanut" SWITCH

**Rugged, Reliable**  
**Long, Long life**  
**Higher capacity**  
**No dead break**



T3 series **sub-sub-miniature** basic switch

**extreme small size--may be ganged in minimum space**

**long, long mechanical life--  
2 1/2 million cycles**

**longer electrical life than switches  
twice its size**

**no dead break--perfect for super  
sensitive applications**

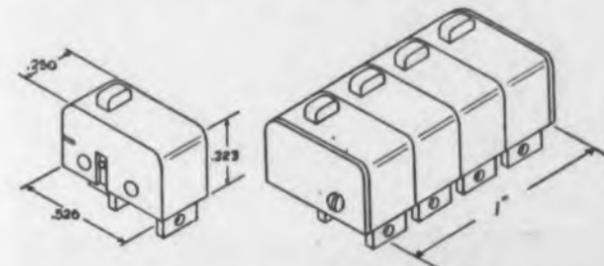
**high repeatability--only one moving  
part besides button**

**consistent, close-tolerance mounting--  
in single or ganged set-ups**

**rugged, durable high temperature and  
impact resistant case**

**wide range standard actuators available  
in leafs, toggles, pushbuttons, etc.**

**super long life model available with  
limited overtravel**



#### OPERATING CHARACTERISTICS

Base Size.....	.526" long, .250" wide, .323" high
Weight.....	1.7 grams (.060 oz.)
Contact.....	SPDT, fine silver std. (others to order)
Operating Force.....	approx. .200 grams (7.05 oz.) max.
Pretravel.....	approx. .010"
Contact Pressure.....	59 grams (1.76 oz.)
Overtravel.....	.005" min.
Movement Differential.....	.003" max.
Release Force.....	30 grams (1.06 oz.)
Mechanical Life.....	2,500,000 cycles, approx.
Ambient Temperature.....	-65° to +250°F. std. (350° to order)
Terminals.....	solder standard (spade type available)
Electrical Life Rating.....	6 amps, 125/250 VAC, 30 VDC resistive 3.5 amps, 30 VDC inductive sea level 3.0 amps, 30 VDC inductive 50,000 ft. 2.5 amps, 30 VDC inductive 100,000 ft.

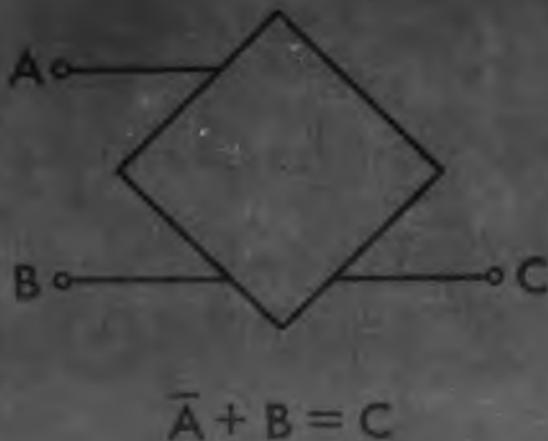
WRITE FOR MORE DETAILS



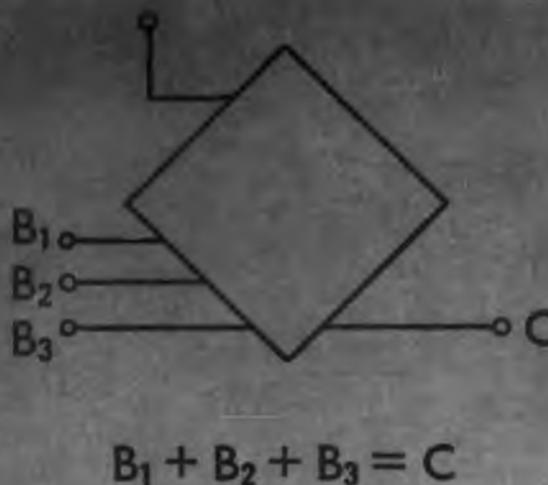
**ELECTROSNAP CORPORATION**  
SWITCH DIVISION

4216 W. Lake Street Chicago 24, Illinois  
TELEPHONE: VAN BUREN 6-3100  
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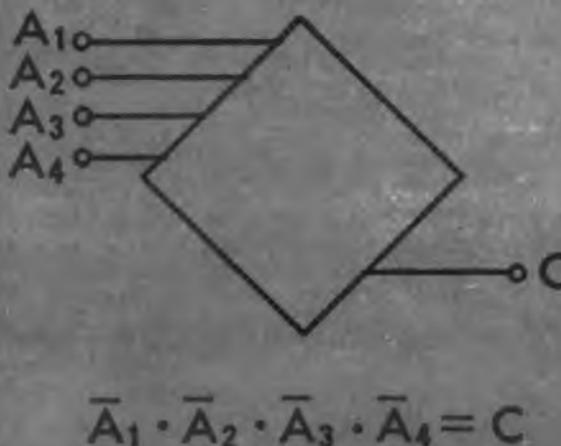
CIRCLE 13 ON READER-SERVICE CARD



**"BASIC MODULE" LOGIC**



**"OR" LOGIC**

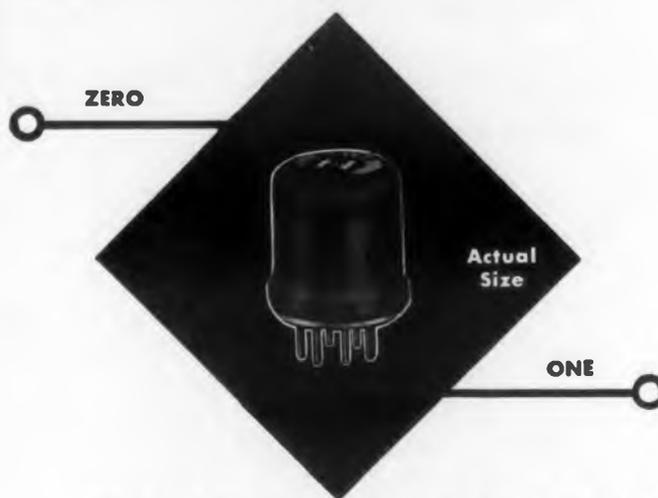


**"NOT-AND" LOGIC**

# NEW for Logic Design Hoffman Magnalog System

featuring

**ZENER MAGNETIC LOGIC MODULE**



\* Designed for miniaturization and simplicity of circuitry.

Typical applications include: bistable; binary half and full adder; shift register; binary counters; decimal counters; "one" generator; "AND", "OR", "NOT" functions.

**FEATURES:**

- 100 KC information rate
- High Temperature Operation
- Silicon Zener Diodes
- Miniature Size
- 7 pin, miniature plug-in cases
- Synchronous Operation
- All Static Components
- Low Cost
- Flexibility of Use
- Versatility of Application

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## MEETINGS

**Sept. 3-5: 1st National Conference on the Application of Insulation**

Cleveland, Ohio. Sponsored by AIEE and National Electrical Manufacturers Association. Sessions will be divided according to equipment category, as follows: rotating equipment, transformers, controls and instrumentation, and electronics. Morning sessions will consist of papers delivered by representatives of electrical insulating materials manufacturers; afternoon sessions presentations will be made by electrical equipment manufacturers. For information write George Bamberg, Cleveland Publicity Committee, c/o The Glastic Corp., 4321 Glenridge Road, Cleveland 21, Ohio.

**Sept. 12: Regional Technical Conference, Society of Plastics Engineers**

St. Clair Inn, St. Clair, Mich. Sponsored by Detroit Section of SPE. Arrangements have been made for papers on injection molding, compression molding, thermoforming, reinforced plastics, automotive lighting, and vacuum metallizing. For information write J. D. Young, E. I. du Pont de Nemours & Co., 13119 W. Seven Mile Rd., Detroit 35, Mich.

**Sept. 12-14: 7th Annual High Fidelity Show**

Palmer House, Chicago, Ill. Write to International Sight and Sound Exposition, Inc., 1 N. La Salle St., Chicago 2, Ill., for further details.

**Sept. 15-19: 13th Annual Instrument-Automation Conference and Exhibit**

Philadelphia Convention Hall, Philadelphia, Pa. Sponsored by ISA. Two technical sessions on the use of instruments in the nuclear field will highlight the 5-day conference. Ask Fred J. Tabery, Conference and Exhibit Manager, 3443 S. Hill St., Los Angeles, Calif., for further information.

**Sept. 22-24: National Symposium on Telemetering**

Americana Hotel, Miami Beach, Fla. Sponsored by PGTRC of IRE. Ken West, 1345 Indian River Dr., Eau Gallie, Fla., has additional information about the symposium.

**Sept. 24-25: 7th Annual Symposium on Industrial Electronics**

Rackham Memorial Auditorium, Detroit, Mich. Sponsored by PGIE and AIEE. Address queries

ELECTRONIC DESIGN • August 20, 1958

to William R. Thurston, General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

**Sept. 29-Oct. 3: ASTE Semi-Annual Meeting and Western Tool Show**

Shine Exposition Hall, Los Angeles, Calif. Sponsored by American Society of Tool Engineers. Theme will be "Tooling for the Space Age." For more information write ASTE, 10700 Puritan Ave., Detroit, Mich.

**Oct. 1-2: 2nd Annual Symposium on Engineering Writing and Speech**

New York City. Sponsored by the IRE PGEW.

**Oct. 13-15: National Electronics Conference**

Hotel Sherman, Chicago, Ill. Tentative program includes sessions on transistors, servomechanisms, antennas, audio, filter design, solid state, microwaves, instrumentation, network theory, engineering writing and speech, computers, radar and radio navigation, magnetic amplifiers, engineering management, industrial electronics, television and communications. More information can be obtained from National Electronics Conference, Inc., 84 East Randolph St., Chicago 1, Ill.

**Oct. 20-21: 4th National Aero-Com Symposium**

Hotel Utica, Utica, N.Y. Sponsored by the IRE Professional Group on Communications Systems. It will stress the requirements, progress and challenge of communications in all its phases.

**Oct. 20-22: URSI Fall Meeting**

Pennsylvania State University, University Park, Pa. Co-sponsors are IRE professional groups on information theory and antennas and propagation. Write U.S.A. National Committee, URSI, 2101 Constitution Ave., N. W., Washington 25, D. C., for more information.

**Oct. 22-24: Fifth National Symposium on Vacuum Technology**

Sir Francis Drake Hotel, San Francisco, Calif. Sponsored by American Vacuum Society. For more information write American Vacuum Society, Box 1282, Boston, Mass.

**Oct. 22-25: National Society of Professional Engineers Fall Meeting**

St. Francis Hotel, San Francisco, Calif. Sessions will be devoted to hearing committee reports on such issues as the effect of the accelerated activity in space travel on the future of the engineering profession; effective utilization of present engineering manpower; encouraging capable high school students to consider careers in engineering; and the role of the Federal government in engineering education. J. A. Sontheimer,

**201C**—designed for high quality audio tests. Covers 20 cps to 20 KC. Output 3 watts/42.5 volts. \$225.00

**200J**—extreme accuracy for interpolation and frequency measurements. Covers 6 cps to 6 KC, output 160 mw/10 volts; 20 volts open circuit. \$275.00

**202C**—replaces famous 202B for low frequency measurements 1 cps to 100 KC. Output 160 mw/10 volts; 20 volts open circuit. \$300.00

**202A**—for vibration analysis, servo tests, other vlf measurements. 0.008 to 1,200 cps. Output 20 mw/10 volts. \$465.00

**200CD**—popular precision instrument for audio and ultrasonic tests. 5 cps to 600 KC; output 160 mw/10 volts; 20 volts open circuit. \$160.00

**233A**—carrier test oscillator covering frequencies 50 cps to 500 KC. Output 3 watts/600 ohms. \$475.00

**650A**—highly stable, wide band; 10 cps to 10 MC. For audio, supersonic, video, rf measurements. Output 15 mw/3 volts. Frequency response flat  $\pm 1$  db. \$490.00

**200AB**—for audio tests, 20 cps to 40 KC. Output 1 watt/24.5 volts. Simple to use, compact, rugged. \$130.00

**205AG**—time-tested convenience for high power tests, gain measurements. 20 cps to 20 KC, 5 watts output. \$475.00

**206A**—widely used for high quality, high accuracy audio tests. Very low distortion. Covers 20 cps to 20 KC; output  $+15$  dbm. \$615.00

**200T**—custom-engineered for telemetry, carrier current tests. 250 cps to 100 KC, output 60 mw/10 volts; 20 volts open circuit. \$350.00

**207A**—low cost sweep oscillator, continuous output 20 cps to 20 KC, flat response, low distortion. May be motor driven, or coupled to recorder. \$275.00

# 12 different -hp- oscillators

highest quality, outstanding value  
complete coverage 0.008 cps to 10 MC  
each designed to do a specific job best  
stable RC circuit pioneered by -hp-

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Cable "HEWPACK" • DAVenport 5-4451

Field engineers in all principal areas

Complete details from your -hp- representative  
or write direct

complete coverage, outstanding value

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# NEW MOTOROLA ZENER REGULATORS

**10 and 50 WATT types  
up to 200 VOLTS**

Here's an entirely new Motorola product line . . . silicon junction Zener Regulator diodes produced under Motorola's extreme quality standards and offering ratings and characteristics not previously obtainable.

- Very high power ratings — both 10 and 50 watt types available.
- Wide voltage range — up to 200 volts in both 10 and 50 watt types.
- Very low Zener impedance limits.
- "Soft" or unstable Zener knees eliminated — by impedance limits at 5 mA for 50 watt type . . . at 1 mA for 10 watt types.
- Forward characteristics controlled — for applications requiring conduction in both directions.
- Available with either anode or cathode connected to case.
- Conservatively rated — excellent long-time stability.
- Designed for military usage — Operating and storage temperature range  $-65^{\circ}\text{C}$  to  $+175^{\circ}\text{C}$ .
- Standard packages —
  - 10 WATT TYPES welded, hermetically sealed, metal to glass, Jetec package.
  - 50 WATT TYPES plug-in or solder-in TO-3 package with series interlock construction for protection against overvoltage on load.

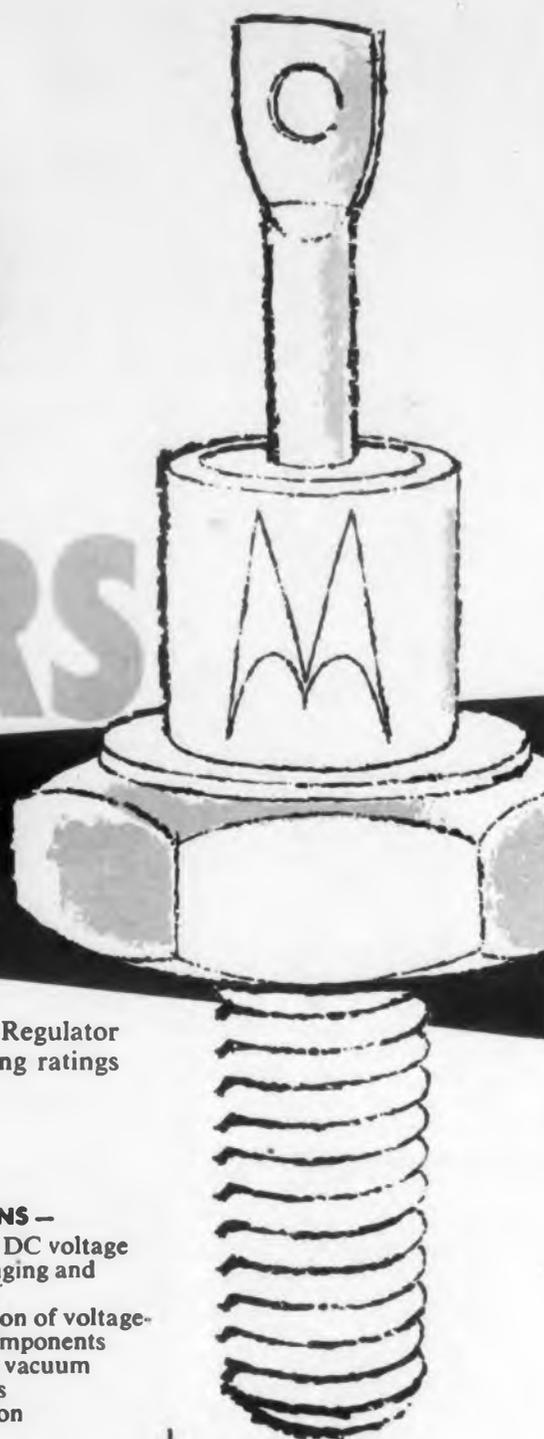
**TYPICAL APPLICATIONS —**  
 Regulation of DC voltage  
 DC level changing and coupling  
 Surge protection of voltage-sensitive components  
 Regulation of vacuum tube heaters  
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## MEETINGS

Secretary, California Society of Professional Engineers, c/o St. Francis Hotel, San Francisco, Calif., has more information.

### Oct. 27-28: East Coast Conference on Aeronautical and Navigational Electronics

Lord Baltimore Hotel, Baltimore, Md. Sponsored by IRE Professional Group on Aeronautical and Navigational Electronics and the Baltimore Section. Technical papers to be presented will concern such things as new techniques in air navigation, new systems for air traffic control and radar. There will also be exhibits of navigational systems and test equipment and components. For additional information contact Harry S. Rutstein, Publicity Chairman, Eastern Associates, Inc., Baltimore, Md.

### Nov. 19-20: Northeast Electronics Research and Engineering Meeting

Mechanics Hall, Boston, Mass. Sponsored jointly by the Boston, Connecticut, and Western Massachusetts Sections of the IRE. R. R. Leonard, Datamatic Div., Minneapolis Honeywell Regulator Co., Newton Highlands, Mass., has more information.

### Dec. 2-4: 3rd EIA Conference on Reliable Electrical Connections

Dallas, Tex. For information, write W. O. Richards, 224 Cedar St., Syracuse 3, N. Y.

### Paper Deadline

Oct. 1: Deadline for papers to be presented at the 1959 Western Joint Computer Conference, to be held at the Fairmont Hotel, San Francisco, Calif., March 3-5, 1959. Theme of this conference will be "New Horizons with Computer Technology." There is particular emphasis on factual papers dealing with the newer applications of computer techniques, such as information retrieval, operation control, pattern analysis, decision making, computer communications, learning concepts, as well as on papers dealing with advances in computer component and systems design. There will be two sessions of a speculative nature; one dealing with the extension of computer technology into areas not considered feasible at present, the other with the philosophis and/or social implications of the widespread application of automatic computer techniques. Papers should be prepared based on a 20-minute delivery time. There are no format requirements for submission drafts. Three copies of proposed paper should be submitted to M. L. Lesser, IBM Research Laboratory, San Jose, Calif.

# EDITORIAL

## DOD Must Linear Program

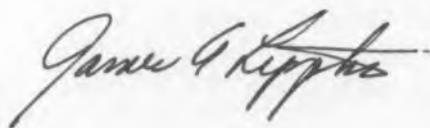
Previous comment on this space, June 25 and August 6, dealt with the possibility of standardizing some aspects of digital computer design for weapons systems. The Department of Defense asked for voluntary industry standardization. From a survey on this subject we learned that industry felt it was too premature to standardize such a fluid industry, but that some benefits could be gained if it were possible. The complexity of the problem points to the need for a summit view to see everything that is involved. This means that if the Department of Defense wants standardization they will have to say what the specific goals are. Since they control funds for weapons systems work they can "put up" accordingly. Ignoring the 50 per cent who were unsympathetic to any idea of standardization as being premature, here are some constructive ideas leading to standardization advanced by respondents to our survey.

**Overall Authority and Coordination.** Only the Department of Defense can provide these functions. John Brown of the U. of Michigan says ". . . [The DOD must make] available to a standardization group ALL of the detailed requirements of ALL the computer circuits and components to be included in the standardization." Brown feels promising circuits that might work into a flexible standardization program are dynamic flip-flops, half-adders, shift register units, delay units.

**Assigning Weight-Factors.** J. H. Bigelow of the Institute of Advanced Study, Princeton, says "contracts must clearly indicate the relative importance of various performance parameters and also the sort of interchangeability needed for that particular class." Bigelow illustrated examples of weight-factors: a high one—comparable to tires or ammunition; a low one—research to see if the complicated solution could be done within specified constraints. Mr. Bigelow called this concept of assigning weight factors a linear programming technique. A team within the procurement department specifies the relative importance of weight factors and follows up by evaluating the results.

**Start with Land-Based Computers.** Airborne and shipboard requirements impose severe unusual shape and size limitations. Any start at standardization should be aimed at land-based computers.

**Evaluation First.** We choose to list this item last as a closing thought. Study and evaluation of what is desirable and what can be done comes first. This is a Department of Defense job. They must show the way.



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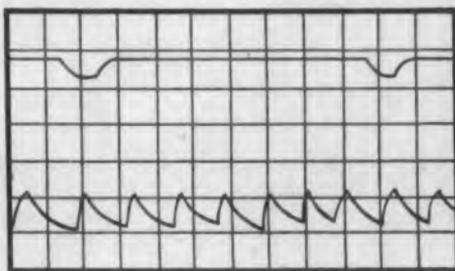
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# How To Design Pulse Magnetic Amplifiers

## Part 1—Design



**Richard L. White**  
Hoffman Semiconductor Div.  
Evanston, Ill.

Richard White has years of experience developing commercial and military electronic equipment. He feels the application of magnetic core logic will help the instrumentation field go more and more to digital techniques.

Here, in the first part of a two part series, he gives a direct approach to designing pulse magnetic amplifiers. He winds up with a practical design procedure and a sample problem.

The second part of his article discusses logic.

**YOU CAN** design pulse magnetic amplifiers with two basic equations and some characteristics of the magnetic material. The equations are here. The characteristics are supplied by manufacturers.

### Bobbin Cores

Pulse magnetic amplifier design centers around what is called a bobbin core. Physically, it resembles a small thread spool with an enlarged center hole. Several layers of ultra-thin magnetic material are wrapped where the thread would normally be. The bobbin, made of a ceramic material or stainless steel, gives rigid support to the fragile magnetic material.

### Core Material

Fig. 1 shows the hysteresis loop of a 4-79 Mo-Permalloy 1/8 mil bobbin core with important design parameters labelled. Three factors dictate the choice of material.

- High squareness ratio ( $B_r/B_m$  ratio approaches unity).
- Low coercive force  $NI_m$  (involves power loss per core, hence, power requirements of the high frequency driving circuit).

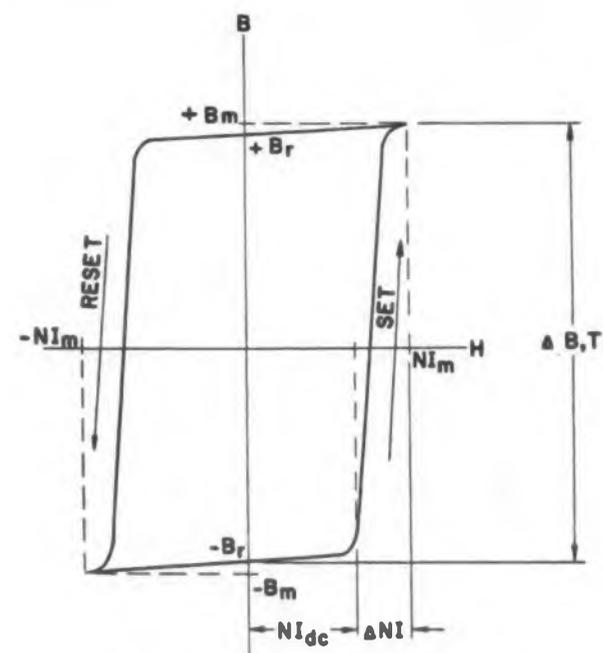


Fig. 1. A typical hysteresis loop.

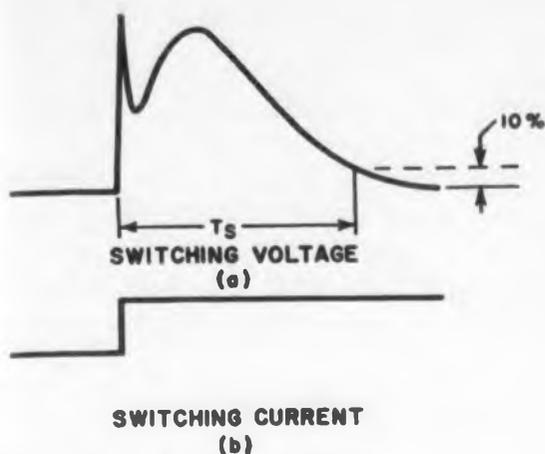


Fig. 2. A typical switching signal.

■ High flux change ( $\Delta B$  is large for a given cross-sectional area).

For these quantities, 4-79 Mo-Permalloy has the following approximate values: squareness ratio—0.98, coercive force ( $NI_{dc}$ )—0.24 ampere-turns, flux change ( $\Delta B$ )— $10^5$  lines per square inch.

#### Switching Time vs Coercive Force

Fig. 2 shows a typical switching signal. Switching time and coercive force are related by

$$NI_t = NI_{dc} + K_t/T_s \quad (1)$$

where  $NI_t$  has the units of ampere-turns per inch of mean length. The mean length  $L$ , is calculated from manufacturer's data on bobbin size. ( $L = \pi D$  where  $D$  is the average diameter of the magnetic material wrapped on the bobbin).  $K_t$  is a constant depending on the magnetic material. (For 4-79 Mo-Permalloy,  $K_t = 1$ ).  $T_s$  is the switching time in microseconds.

For 4-79 Mo-Permalloy, eq (1) becomes

$$NI_t = 0.24 + 1/T_s$$

A comparison of the data using this equation and experimental data using the circuit of Fig. 3 is plotted in Fig. 4. The curves agree closely.

#### Equivalent Resistance Concept

A saturable magnetic core presents a predominantly resistive impedance to an applied

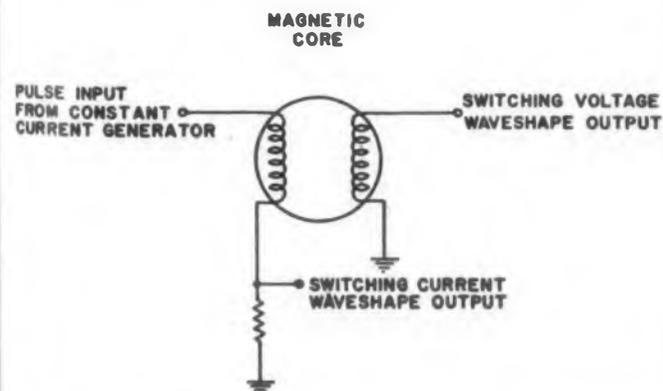
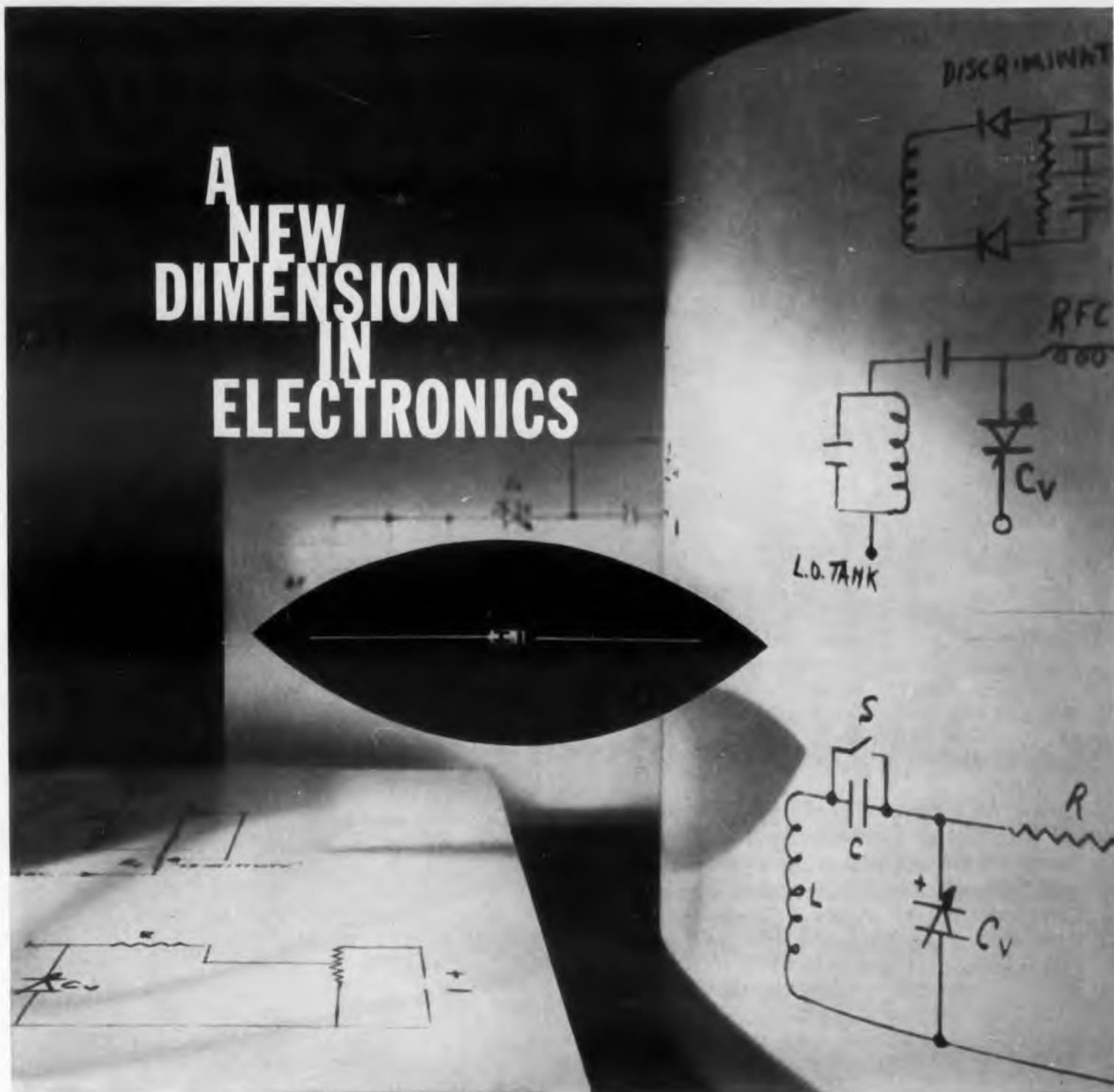


Fig. 3. This circuit was used to provide the switching data plotted in Fig. 4.



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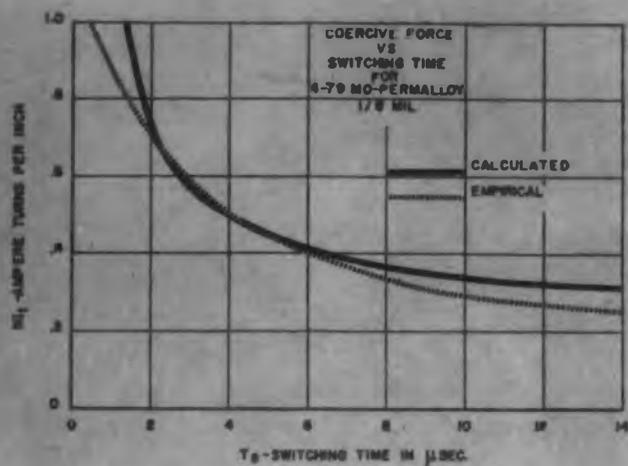


Fig. 4. Switching data for  $1/8$  mil 4-79 Mo-Permalloy.

voltage or current pulse. The equation relating the various physical and electrical parameters to this resistance is

$$\bar{R}_o = \frac{\Delta B A 10^{-2}}{NI_t L T_s} \text{ ohms/turn}^2 \quad (2)$$

where  $\Delta B$  is the number of lines per square inch,  $A$  is in inches of cross-sectional area,  $NI_t$  is in ampere-turns per inch,  $T_s$  is switching time in microseconds, and  $L$  is the mean length of the magnetic path in inches. This equation determines the power loss in the core and the voltage drop across the windings.

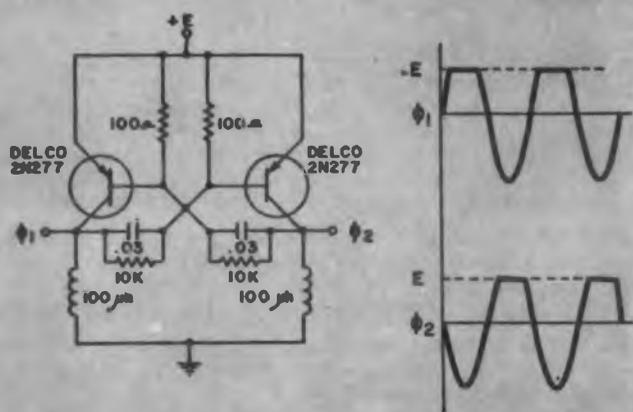


Fig. 5. The circuit and output wave-shapes of a 100 kc transistor oscillator. It can drive approximately 50 pulse magnetic amplifiers.

### Pulse Magnetic Amplifier Operation

Fig. 6 shows a basic complementing pulse magnetic amplifier. The power connection at  $\Phi_2$  is taken from the power oscillator in Fig. 5.

This amplifier is a binary device, capable of only two output conditions. The presence of a voltage pulse is called a "1" and the absence of a pulse is called "0." If the core is in the set condition, at  $+B_r$  in Fig. 1 when  $\Phi_2$  is applied, a "1" appears at the output. The total voltage appears across the load resistor  $R_L$ . No voltage appears across winding  $N_2$  because the core is saturated.

If the core is in the reset condition, at  $-B_r$  with  $\Phi_2$  applied, a "0" appears at the output. The total voltage appears across winding  $N_2$ . This condition exists because the core is being set. The hysteresis loop is being traced from  $-B_r$  to  $+B_m$ .

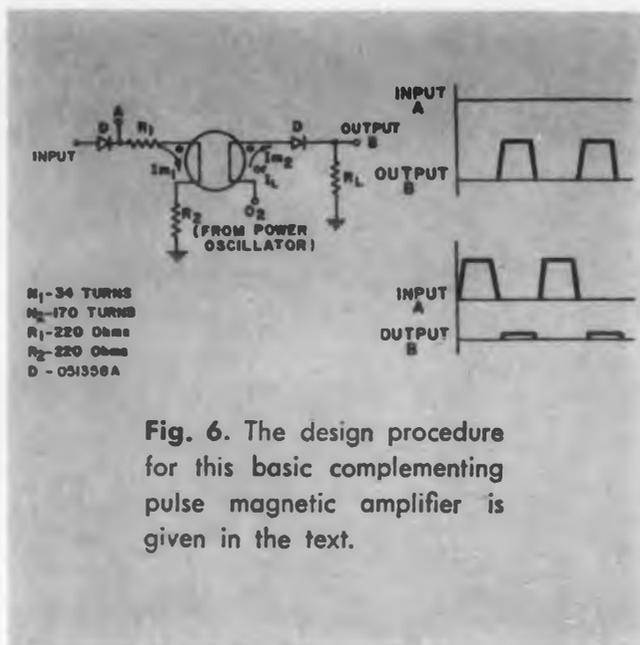


Fig. 6. The design procedure for this basic complementing pulse magnetic amplifier is given in the text.

A small voltage does appear across the load resistor  $R_L$  of the amplifier (Fig. 6) due to the magnetizing current  $I_{m2}$ .

The desired output is determined by the binary signal fed to the input. This input signal has a 180 deg phase relationship to the output signal. The input signal is in phase  $\Phi_1$ , while the output is in phase  $\Phi_2$ . Hence, the input places the core in a state that determines what the output will be one half cycle later. If there is no input during  $\Phi_1$  positive, one half cycle later an output occurs during the positive excursion of  $\Phi_2$ . An input during  $\Phi_1$  positive resets the magnetic core so no output is present in the following positive  $\Phi_2$  period.

This illustrates three important characteristics of the pulse magnetic amplifier.

- The amplifier is complimentary. When the in-

put is a "1" the next output is a "0," and vice versa.

- The amplifier has intrinsic time delay. The output dictated by a given input occurs 180 degrees later.

- Power is not transferred through the core by transformer action. It is gated by controlled saturation. When the core is saturated, winding  $N_2$  offers only the resistance of the wire to  $\Phi_2$ . When the core is not saturated,  $N_2$  offers the impedance determined by eq (2).

### Design Considerations

Three factors must be determined first:

1. Switching time;
2. Pulse voltage amplitude;
3. Zero to one ratio.

Switching time is determined by the desired operating frequency.

Maximum pulse voltage is determined by the physical limitation of the number of wraps of magnetic material on the bobbin and the maximum turns of wire that can be wound on the bobbin. The amplifier is designed to have its output connected to the input of at least one identical amplifier. Also, the ampere-turn requirement for complete saturation is constant (for a given switching time) regardless of the number of turns on a given winding. Hence,  $N_1 I_{m1} = N_2 I_{m2}$ . Zero to one ratio is the ratio of the voltage pulses at the output for a "1" and a "0". Since the output is a constant resistance, this voltage ratio can be expressed as a current ratio, and the ampere-turn relationship can be re-written

$$I_{m1}/I_{m2} = N_2/N_1.$$

Thus the minimum zero to one ratio can be expressed in terms of the windings on the bobbin core.

When the switching time, pulse voltage amplitude, and minimum zero to one ratio have been established, the design can proceed.

### Design Procedure

**Step 1.** Select a bobbin size and number of wraps of 1/8 mil 4-79 Mo-Permalloy. The maximum number of wraps for a given bobbin is given in the manufacturer's data sheet.

**Step 2.** Calculate  $NI_t$  using eq (1). Multiply this figure by  $L$  to obtain the ampere-turns for the selected bobbin.

**Step 3.** Calculate the equivalent winding resistance using eq (2).

**Step 4.** Select a desired magnetizing current  $I_{m2}$ , keeping in mind that  $I_{m1}$  will be at least the zero to one ratio times as great as  $I_{m2}$ .

**Step 5.** Calculate  $N_2$  (using Ohm's law) and  $N_1$ . Select a wire size compatible with the window

area of the bobbin and the output current requirements.

**Step 6.** Calculate the series resistance ( $R_1 + R_2$ ). Use a current value of  $1.5 I_{m1}$  to assure complete resetting of the core during the switching time regardless of slight variations in manufacture.

**Step 7.** Calculate the power loss in the core and its associated components for a complete power cycle.

### Sample Design

Given data:

Operating frequency = 100 kc

Switching time = 5  $\mu$ sec (selected primarily because of the frequency limitations on the power transistors in the power oscillator).

Pulse voltage amplitude = 9 v

Zero to one ratio = 5 (A compromise. A larger ratio requires a higher  $I_{m1}$ . A smaller ratio might enter an ambiguous area where partial setting of the following core could take place).

**Step 1.** Pick the bobbin size on the basis of the pulse voltage, wire size, number of wraps of magnetic material, and hole area to accommodate the wire. Good choice is Arnold Engineering #17 with ID = .210 in., OD = .312 in.

Number of wraps = 15

Mean length of magnetic path ( $L$ ) = .79 in.

Cross-sectional area ( $A$ ) =  $2.34 (10)^{-4}$  sq in.

**Step 2.**  $NI_t = .24 + 1/5 = .44$  ampere-turns/in.  
 $NI_t L = (.44) (.79) = .35$  ampere-turns

**Step 3.**  $\bar{R}_o = \frac{2.34 \times 10}{(.35) 5} = .134$  ohms/turn<sup>2</sup>

**Step 4.** Let  $I_{m2} = 2$  ma  
 $I_{m1} = 5 I_{m2} = 10$  ma

**Step 5.**  $E = \frac{NI_t L}{N_2} \bar{R}_o N_2^2 = NI_t L \bar{R}_o N_2$

and  $N_2 = \frac{E}{NI_t L \bar{R}_o} = \frac{8}{(.35) (.134)} = 170$  turns

$N_1 = N_2/5 = 34$  turns

$N_1^2 \bar{R}_o = 150$  ohms

$N_2^2 \bar{R}_o = 4000$  ohms

Wire size = #36 heavy Solderize

**Step 6.**  $R_s + N_1^2 \bar{R}_o = \frac{E}{1.5 I_{m1}} = \frac{9}{15} 10^3 = 600$  ohms

$R_s = 600 - 150 = 450$  ohms

$R_1 = R_2 = 220$  ohms

**Step 7.**  $2.25 I_{m1}^2 N_1^2 \bar{R}_o = 34$  mw

$2.25 I_{m1}^2 \bar{R}_o = 100$  mw

$I_{m2}^2 N_2^2 \bar{R}_o = 16$  mw

Power loss per stage = 150 mw

Results of this design are summarized in Fig. 6.



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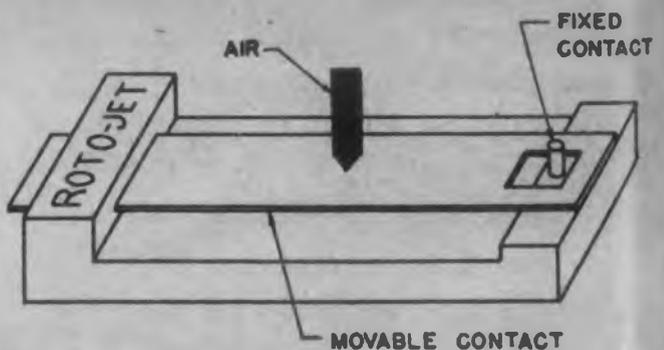
Contact wear is a minimum, resulting in a service free life of 2000 hours at 20 rps. Noise is practically eliminated; at least, none can be observed on a scope with 1 mv/cm sensitivity using an input signal of 10 mv at 50  $\mu$ a.

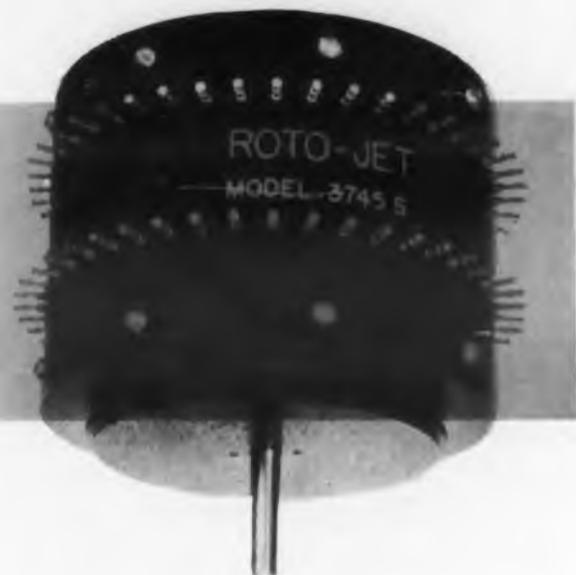
The sampling switch, called the Roto-

Jet, is being made available by Norman Hardy Assoc., P.O. Box 97, Wyncote, Pa. The standard arrangement of 45 contact pairs can be easily adapted to other configurations. For instance, by tying all the output terminals together, the switch becomes single pole, 45 contacts per pole.

The structure of one contact-pair module is illustrated. The impact of a high velocity air causes the reed-like movable contact to deflect, drawing the free end into contact with a fixed pin. The arrangement provides good mechanical advantage, permitting a tiny jet of air to hold the contacts together with

**A jet of air strikes the movable contact, causing it to deflect and be drawn into contact with the fixed contact pin.**





more than satisfactory force. Closure time is fast, being in the order of 40  $\mu$ sec. Contact is broken in about 20  $\mu$ sec. These times represent the leading and trailing edge duration of the typical square wave pattern. Duty cycle (ratio of closed contact time to total time between successive contacts) can be adjusted from 30 to 90 per cent.

The Roto-Jet sampling switch has a contact resistance of 0.5 ohm. An air supply of 2-1/2 cfm at 40 psi is needed for operation. Diameter of the switch is approximately 3-3/4 in.

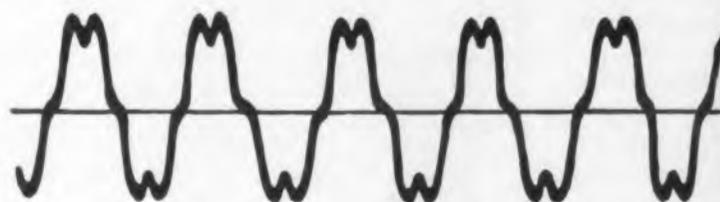
For more information, turn to the Reader-Service card and circle 100.



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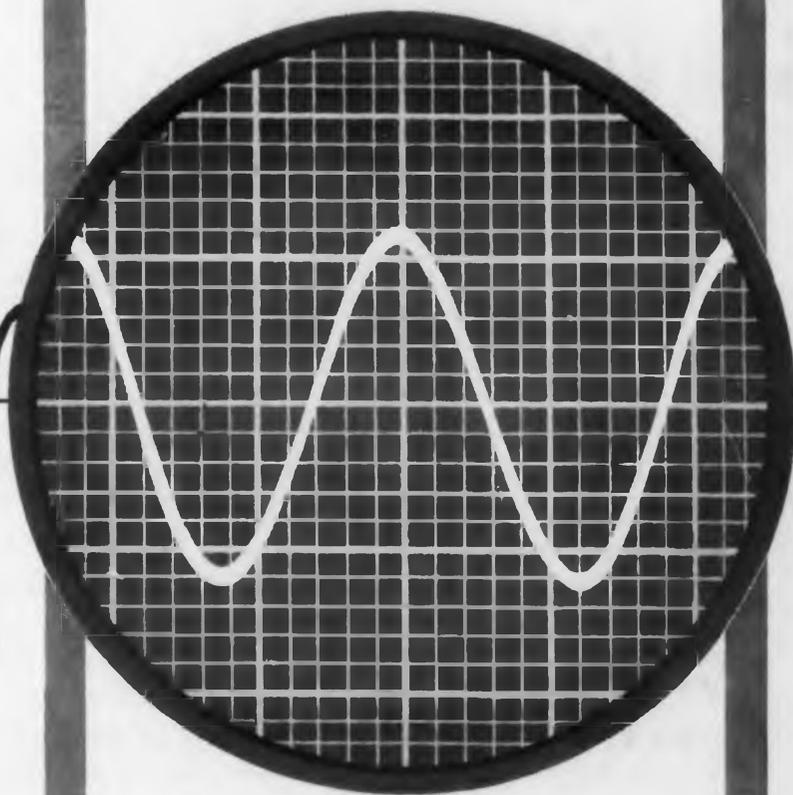
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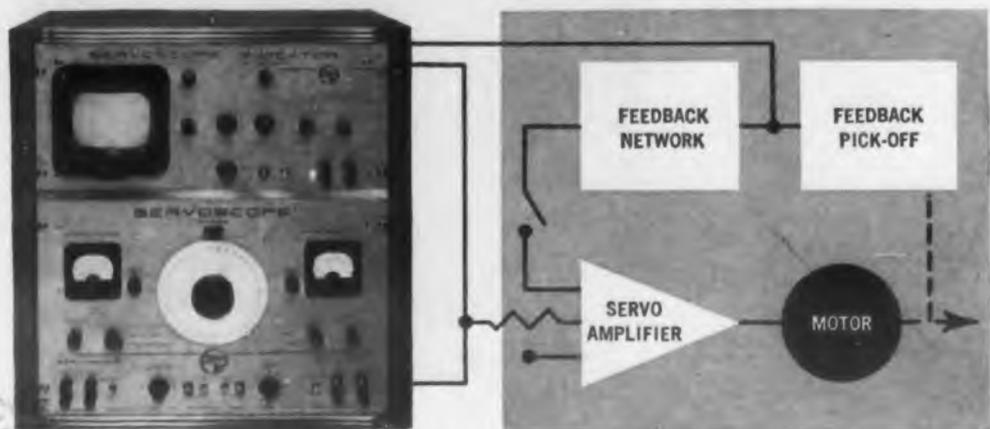
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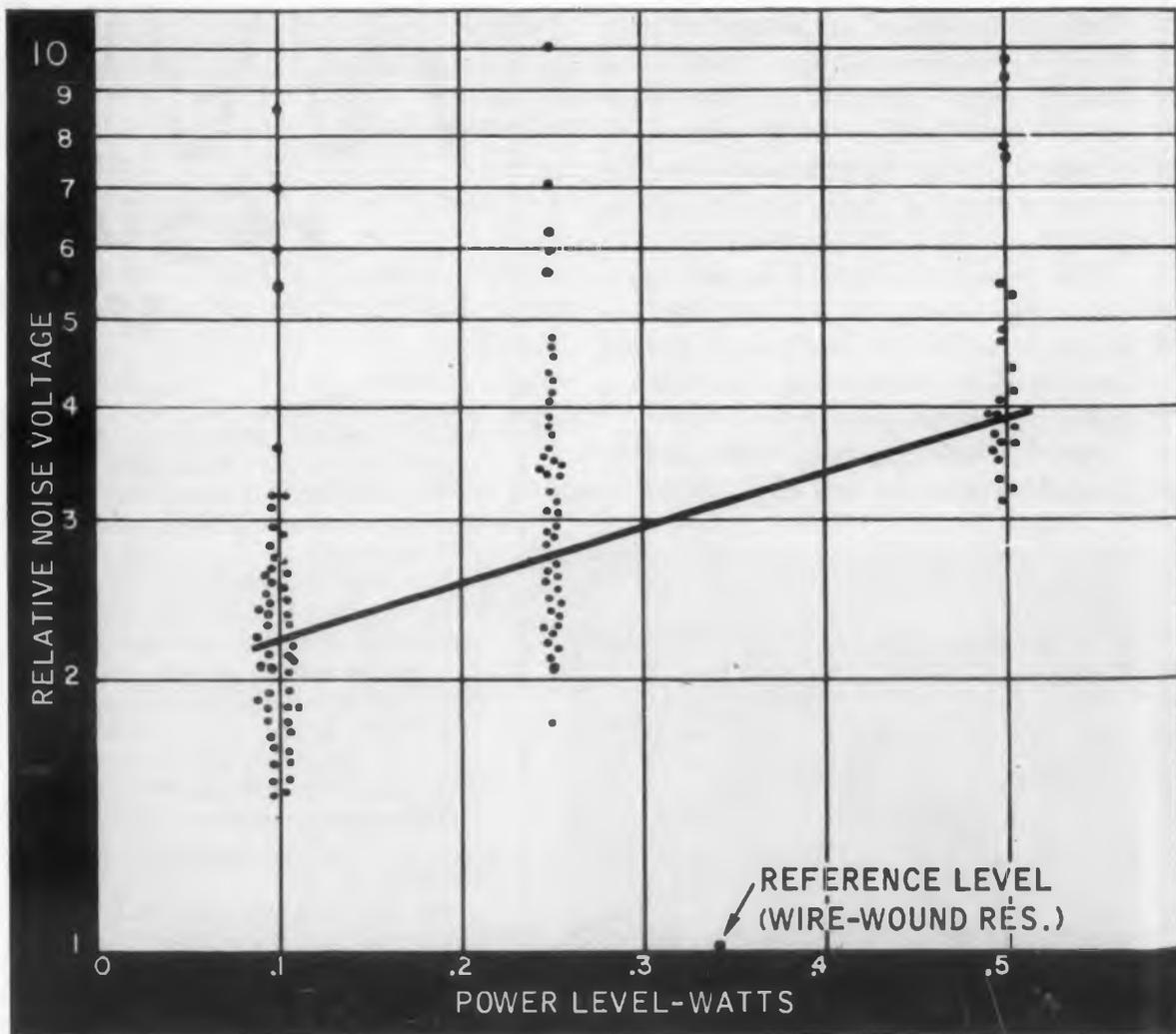
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CIRCLE 22 ON READER-SERVICE CARD

# Resistor Noise Testing

**Edmund Osterland**  
EO Electronics, Inc.  
Mountain Lakes, N.J.



**Fig. 2.** Noise vs load characteristics for a typical lot of 80-1/2-watt 50 K deposited carbon resistors. Some samples too noisy to be shown on the graph.

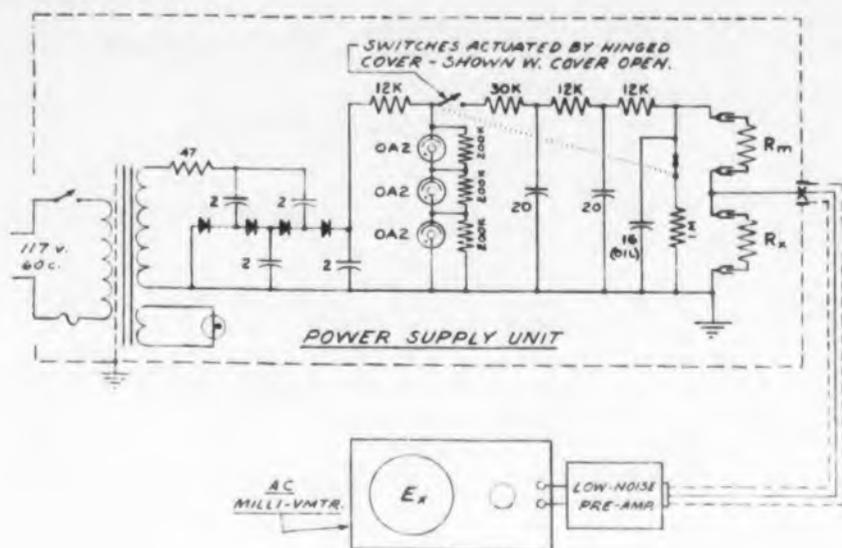


Fig. 1. (left) Circuit diagram of the system for measuring noise value.



Fig. 3. (right) Actual instruments used in the noise tests.

**O**BSERVATION of the wide variation of noise level in resistors from a given lot suggests that full incoming inspection is advisable. Described is a method which permits such inspection with minimum time and equipment.

Noise values for different types of resistors are detailed in Table 1. Note the high noise values found in groups which have a generally acceptable average noise figure.

The circuit diagram, Fig. 1, illustrates a system for measuring noise value. Direct current equal or near to the rated maximum for a particular resistor is passed through a matching resistor,  $R_m$  and the test resistor  $R_x$ . The matching resistor  $R_m$  should have approximately the same resistance as  $R_x$  for optimum sensitivity of measurement, and it must be a wirewound unit with welded or soldered end terminations so that it

will not contribute measurable noise currents. The extent of current fluctuations in  $R_x$  is then directly noted by measuring the ac voltage from the junction of  $R_m$  and  $R_x$  to ground.

The variation of noise currents as a function of dc load is shown in Fig. 2. This also illustrates the irregularity of individual units in a representative lot taken from new stock supplies.

The combination of an instrument pre-amplifier and a sensitive rms voltmeter serves as indicator. The response of the indicator should be limited to the low audio range, since current noise predominates in this region. The Min-Amp pre-amplifier in Fig. 3 incorporates filter circuits which aid in the delineation of resistor noise against a background of extraneous noise.

The inherent noise voltage generated by the resistor is given as

$$E_n = E_x \times R_x \left[ \frac{1}{R_x} + \frac{1}{R_m} + \frac{1}{R_g} \right]$$

Where:

$E_x$  is the indicated noise voltage,

$R_x$  is the resistance of the test resistor,

$R_m$  is the resistance of the matching resistor,

$R_g$  is the pre-amplifier input resistance.

Dividing  $E_n$  by the dc voltage across  $R_x$  yields the familiar figure of  $\mu v/v$ . Since for any group of resistors the test voltage and the circuit parameters remain constant, it is only necessary to choose acceptable values of  $E_x$  for production test limits.

For shielding purposes, the test resistor is clipped into a fixture recessed in the power supply unit and enclosed by a hinged lid. Closing the lid also closes switches in the dc supply circuit so that the apparatus is operative only when the resistor is properly enclosed in this shielding structure. Shielded connectors and connecting leads are also required for satisfactory results.

A laboratory-type regulated power supply of conventional design may be used as a dc source but will probably require additional filter sections to attain an adequately low hum level. The simple dc supply illustrated is useful for testing 1/4 to 1/2 watt resistors in the range of 10 K to about 75 K. Finally, the input noise level of the pre-amplifier must remain consistently low for accurate noise analysis. The unit pictured has a rated noise level of  $2 \mu v$  for the restricted range of 200 to 2000 cps or  $6 \mu v$  for a 5 to 500,000 cps response band. It provides a maximum gain of 100 which enables the measurement of signals down to  $10 \mu v$  with the millivoltmeter shown.

#### References

JAN-R-11 Specification, May 31, 1944.  
Noise in Composition Resistors, George T. Conrad, Jr., National Bureau of Standards.

Tabulation of Resistor Types and Associated Noise Levels.

Resistor Type	R ohms	Load Level	Inherent Noise in microvolts/volt			Remarks
			Low	High	Average	
1/2w. composition slug type	22K	1/3w.	0.31	0.37	0.34	10 samples
1w. composition slug type	22K	1/3w.	0.15	0.61	0.19	10 samples
1/2w. dep. carbon Mfr. (A)	20K	1/3w.	0.15	1.10	0.29	10 samples
1/2w. composition slug type	51K	1/3w.	0.20	2.30	0.56	10 samples
1/2w. composition film type	47K	1/3w.	0.46	0.90	0.62	10 samples
1/2w. dep. carbon Mfr. (A)	50K	1/3w.	0.09	9.20	0.30	80 samples
1/2w. dep. carbon Mfr. (B)	65K	1/2w.	0.11	3.80	0.51	20 samples
Wire-wound std. (1 sample)	50K	1/3w.	0.08	0.08	0.08	Nearly equiv. to thermal noise

Table 1. Noise values for different types of resistors are shown. Note how far the extreme values may differ from the average value for a given resistor type. Bandwidth of measurement is 5 to 250,000 cps.

# Pulse Oscilloscope List

HERE IS a list of 47 scopes having high frequency responses, fast rise times, sweep generators calibrated in real time, and which are dc coupled to avoid low frequency distortion. All are commercially available standard models from among 13 manufacturers.

The oscilloscopes are arranged in ascending order of hf response (Column 3) from 1 mc up to 1 kmc. Within any group having the same upper frequency limit, the order is determined by the sensitivity (Column 5) with the most sensitive placed first. Within any such group where the sensitivities are the same, the order is determined by the sweep speed (Column 6) with the smallest minimum time placed first.

Sensitivities are peak-to-peak values. Figures separated by a dash show the range of sensitivity for the vertical channel. Where no dash appears, the second number is the sensitivity of the horizontal channel. Wherever specifications are given for the horizontal amplifier, this input is available externally. The scopes shown use 5-in. cathode ray tubes, unless otherwise noted. All may be used on commercial single phase 60 cps input power of 105-125 v.

List is abstracted from Volume 3, *Scalars*, of the *Directory of Technical Specifications, Electronic Test Instruments*,<sup>®</sup> published by Technical Information Corp., 41 Union Square, New York 3, N. Y.

A 30-page list of oscilloscopes covering 146 items by 39 manufacturers in 21 columns of specifications and including manufactures' names and addresses is available for a limited time at \$10. A complete electronic test instrument service, which includes a four volume Directory, up-dating, and consultation on any instrument location problem, is available from the company for an annual subscription of \$270. For more information about the Directory service and the oscilloscope list, turn to the Reader-Service card and circle 305.

Manufacturer	Model	Amplifier 1	Frequency		Rise Time μ sec 4	Sens. mv/in 5	Sweep Speed 6	Special Notes
			Min. cps 2	Max. mc 3				
SOLARTRON	AD557-A	b	dc	1	ina	3mv -100V /cm	* 1μs- 1sec /cm	6. Expansion 10X. CRT: 4 inch.
ELECTRONIC TUBE	H-23 a	Vert Horz	dc dc	1 250kc	ina ina	28 700	* 2μs- 0.1sec /in	6. Dual independent sweep generators.
RADIOMETER	OSG-42	Vert Horz	dc dc	1 1	ina ina	0.2mm 0.15mm /mv	*20mm /μs max	6. Expansion 3X. CRT: 3 inch.
RADIOMETER	OSG-41	Vert Horz	dc dc	3 800kc	ina ina	0.7mm 0.3mm /mv	*50mm /μs max	6. Expansion 3X.
TEKTRONIX	310	Vert Horz	dc ina	4 ina	.09 ina	10 1.2V /div	* 0.5μs -200ms /div	6. Expansion 5X. CRT: 3 inch, 4 div/in.
DU MONT	331	Vert Horz	dc dc	4 400kc	.08 ina	400mv 1V fs	* 0.5μs -500ms /div	6. Expansion 3X. CRT: 3 inch.
ADVANCED ELECTRONICS	200HP 200HR	Vert Horz	dc dc	4 500kc	0.1 5	50 30 /div	* 0.5μs -150ms /div	6. Expansion 5X. CRT: 3 inch, 5 div/in.
COSSOR	1058	Vert Horz	dc 20	4 200kc	.09 ina	250 500 /cm	* 25μs -250ms	6. Expansion 5X. CRT: 4 inch.
TEKTRONIX	532-53/54B c	Vert Horz	dc dc	5 300kc	.07 ina	* 5mv -20V /cm	* 1μs- 12sec /cm	5. AC 5-50 mv, AC/DC 50 mv 20V/cm, vernier to 50V/cm. 6. Expansion 5X.
TEKTRONIX	532-53/54L c	Vert Horz	dc dc	5 300kc	.07 ina	* 5mv -20V /cm	* 1μs- 12sec /cm	5. AC 5-50 mv, AC/DC 50 mv- 20V/cm, vernier to 50V/cm. 6. Expansion 5X.
TEKTRONIX	532-53/54A c	Vert Horz	dc dc	5 300kc	.07 ina	* 50mv -20V /cm	* 1μs- 12sec /cm	5. Vernier to 50V/cm. 6. Expansion 5X.
DU MONT	327	Vert	dc	5	.07	500 fs	* 1μs- 1sec /in	6. Signal delay 0.4μs; expansion 2, 3, 4 or 5X.
THE SCOPES CO.	301	Vert	dc	6	.06	100 /cm	* 1μs- 0.5sec /cm	6. Expansion 10X. CRT: 3 inch.
SOLARTRON	CD523-A	Vert	dc	10	ina	1mv -10V /cm	* 0.1μs -1sec /cm	6. Expansion 5X. CRT: 4 inch.
TEKTRONIX	531-53/54B c	Vert Horz	dc dc	10 240kc	.035 ina	* 5mv -20V /cm	* 0.1μs -12sec /cm	5. AC 5-50 mv, AC/DC 50 mv- 20 V/cm, vernier to 50V/cm. 6. Expansion 5X.
HEWLETT-PACKARD	150A-151A c	Vert Horz	dc dc	10 500kc	.035 ina	* 5mv -20V /cm	* 0.1μs -15sec /cm	5. Vernier to 50V/cm. 6. Expansion X5, 10, 50 and 100, max. .02μs/cm.
TEKTRONIX	536-53/54B c	b	dc	10	.035	* 5mv -20V /div	* 0.2μs -2sec /div	5. AC 5-50 mv, AC/DC 50 mv- 20V/cm, vernier to 50V/cm. 6. With extra plug-in.
TEKTRONIX	524AD	Vert	dc	10	.035	* 15mv -50V /cm	* 0.1μs -10ms /cm	5. AC 15-150 mv, DC 150 mv-50V/cm. 6. 0-25 ms delay; exp. 3 or 10X.
TEKTRONIX	316 RM16	Vert Horz	dc dc	10 500kc	.035 ina	* 10 1.4V /div	* 0.2μs -2sec /div	5. AC 10-100 mv, AC/DC 100 mv- 125V/div. 6. Exp. 5X. CRT: 3 inch, 4 div/in.
LABORATORY FOR ELECTRONICS	411A	Vert Horz	dc dc	10 400kc	.035 ina	20 4V /cm	0.1μs -100ms /cm	
DU MONT	329-A	Vert	dc	10	.035	*200mv -400V fs	* 0.1μs -1sec /div	5. 100 mv, 5 mc by switch. 6. Expansion by 50% notch, cal X10, uncal to X100.
DU MONT	323-A	Vert	dc	10	.035	200mv -400V fs	* 0.1μs -1sec /div	6. Expansion by 50% notch, cal X10, uncal to X100.
TEKTRONIX	531-53/54A c	Vert Horz	dc dc	10 240kc	.035 ina	* 50mv -20V /cm	* 0.1μs -12sec /cm	5. Vernier to 50V/cm. 6. Expansion 5X, delay available.
HEWLETT-PACKARD	150A-152A c a	Vert Horz	dc dc	10 500kc	.035 ina	* 50mv -20V /div	* 0.1μs -15sec /cm	5. Vernier to 50V/cm. 6. Expansion X5, 10, 50 and 100, max. .02μs/cm.

## List of Pulse Oscilloscope Manufacturers

Manufacturer	Model	Amplifier 1	Frequency		Rise Time μ sec 4	Sens. mv/in 5	Sweep Speed 6	Special Notes
			Min. cps 2	Max. mc 3				
TEKTRONIX	536-53/54A c	b	dc	10	.035	* 50mv -20V /div	* 0.2μs -2sec /div	5. Vernier to 50V/div. 6. With extra plug-in.
ELECTRONIC TUBE	H-25 a	Vert Horz	dc dc	10 500kc	.05 ina	* 300 4V	* 0.2μs -20ms /in	5. DC; .05V/in. AC. 6. Dual independent sweep generators; 2nd sweep delayed from 1st.
TEKTRONIX	531-53/54L c	Vert Horz	dc dc	11 240kc	.031 ina	* 5mv -20V /cm	* 0.1μs -12sec /cm	5. AC 5 mv-2V, DC 50 mv-20V, vernier to 4 or 40V/cm. 6. Expansion 5X, delay available.
TEKTRONIX	536-53/54L c	b	dc	11	.031	* 5mv -20V /div	* 0.2μs -2sec /div	5. AC 5 mv-2V, DC 50 mv-20V, vernier to 4 or 40V/cm. 6. With extra plug-in.
COSSOR	1065	Vert Horz	dc 50	11 300kc	.04 ina	250 /cm	10μs- 250ms *	6. Expansion variable to 5X.
TEKTRONIX	551-53/54H a c	Vert Horz	dc dc	14 240kc	.025 ina	* 5mv -20V /cm	* 0.1μs -12sec /cm	5. Vernier to 50V/cm. 6. Expansion 5X.
LAVOIE	LA-260-S60 c	Vert Horz	dc 10	15 750kc	.02 ina	* 10 1V /cm	* 0.1μs -5sec /cm	5. Vert to 25V/cm. 6. Vernier to 15 sec/cm; exp. 10X. Dual trace plug-in available.
LAVOIE	LA-259D	Vert Horz	dc 10	15 750kc	.02 ina	* 10 2V /cm	* .07μs 100ms /cm	5. Vert to 25V/cm. 6. Expansion 10X; 0.2μs delay.
ELECTRONIC TUBE	K-215 a	Vert Horz	dc dc	15 2	.025 ina	* 50 1V /cm	* 0.1μs -1sec /cm	5. To 20V/cm vert. 6. Dual independent sweep generators.
TEKTRONIX	515A RM15	Vert Horz	dc dc	15 500kc	.023 ina	* 50 1.4V /cm	* 0.2μs -2sec /cm	5. Vernier to 50V/cm. 6. Vernier to 6 sec/cm; expansion 5X.
TEKTRONIX	551-53/54B a c	Vert Horz	dc dc	* 18 240kc	.02 ina	* 5mv -20V /cm	* 0.1μs -12sec /cm	3. AC 2cps-10mc, .035μs rise. 5. AC 5-50 mv, AC/DC 50 mv-20V/cm, vernier to 50V/cm. 6 Exp. 5X.
TEKTRONIX	551-53/54A a c	Vert Horz	dc dc	18 240kc	.02 ina	* 50mv -20V /cm	* 0.1μs -12sec /cm	5. Vernier to 50V/cm. 6. Expansion 5X.
DU MONT	336-A	Vert	dc	18	.02	2V- 500V fs	* 0.1μs -1sec /div	6. Delay 0.2μs; exp. by 50% notch, cal X10, uncal to X100.
TEKTRONIX	541-53/54B c	Vert Horz	dc dc	* 20 240kc	.018 ina	* 5mv -20V /cm	* 0.1μs -12sec /cm	3. AC 5 cps-12 mc, .03μs rise. 5. AC 5-50 mv, AC/DC 50 mv-20V/cm, vernier to 50V/cm. 6. Exp. 5X.
ROHDE & SCHWARZ	OMF BN 1912	Vert	dc	20	ina	250 mm/v	0.1μs -110ms /cm	
TEKTRONIX	541-53/54A c	Vert Horz	dc dc	20 240kc	.018 ina	* 50mv -20V /cm	* 0.1μs -12sec /cm	5. Vernier to 50V/cm. 6. Expansion 5X.
TEKTRONIX	551-53/54C a c	Vert Horz 4 chan	dc dc	22 240kc	.016 ina	* 50mv -20V /cm	* 0.1μs -12sec /cm	5. Vernier to 50V/cm. 6. Expansion 5X.
TEKTRONIX	551-53/54L a c	Vert Horz	dc dc	* 25 240kc	.014 ina	* 50mv -20V /cm	* 0.1μs -12sec /cm	3. AC 3cps-15 mc, .023 rise. 5. AC 5 mv-2V, DC 50 mv-20V, vernier to 4 or 40V/cm. 6. Exp. 5X.
TEKTRONIX	541-53/54L c	Vert Horz	dc dc	* 30 240kc	.012 ina	* 5mv -20V /cm	* 0.1μs -12sec /cm	3. AC 3cps-24 mc, .015 rise. 5. AC 5 mv-2V, DC 50 mv-20V, vernier to 4 or 40V/cm. 6. Exp. 5X.
TEKTRONIX	541-53/54K c	Vert Horz	dc dc	30 240kc	.012 ina	* 50mv -20V /cm	* 0.1μs -12sec /cm	5. Vernier to 40V/cm. 6. Expansion 5X.
DU MONT	410	Vert	dc	50	7mμs	200mv -200V fs	.01μs -20ms /cm	
TEKTRONIX	517A	Vert	dc	ina	7mμs	50 /cm	.01μs -20μs /cm	
EDGERTON, GERMESHUSEN & GRIER	2236	Vert	200kc	1kmc	0.1 mμs	30V	25mμs -5μs	CRT: TW Tube, 0.4 in. vert by 0.6 in. horz. scan.

Advanced Electronics Mfg. Corp.,  
2025 Pontius Ave.,  
Los Angeles 25, Calif.

Cossor (Canada) Limited  
301-303 Windsor St.,  
Halifax, Nova Scotia

Allen B. DuMont Labs., Inc.,  
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Boston 15, Mass.

Electronic Tube Corp.,  
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Philadelphia 18, Pa.

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Laboratory for Electronics, Inc.,  
75 Pitts St.,  
Boston 14, Mass.

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Welwyn International, Inc.,  
3355 Edgecliff Terrace,  
Cleveland 11, Ohio

Rohde & Schwarz,  
Federal Instruments,  
250 Garibaldi Ave.,  
Lodi, N. J.

The Scopes Company, Inc.,  
P. O. Box 56,  
Monsey, N. Y.

Solartron, Inc.,  
530-532 Cooper St.,  
Camden 2, N. J.

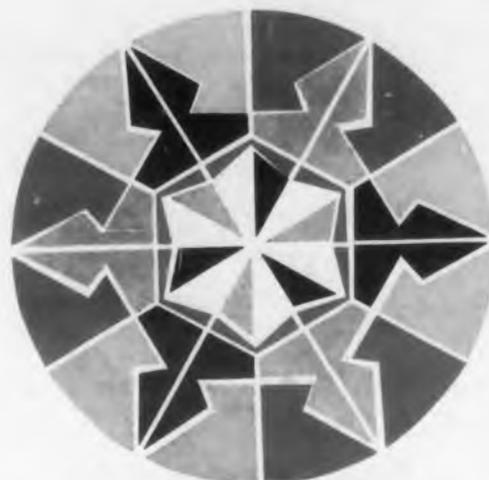
Tektronix, Inc.,  
P. O. Box 831,  
Portland 7, Ore.

## Footnotes

- a. Dual channel scope.  
b. Identical vertical and horizontal amplifiers.  
c. Scope with plug-in amplifiers; model numbers are scope dash plug-in unit.

- Abbreviations: \* —refers to Special Note following column number.  
x —refers to lettered Footnote.  
ina —information not available.  
CRT —cathode ray tube.  
exp —expansion.  
cal —calibrated.  
fs —full scale.  
chan —channel

# Concentrated Filter



# Passbands

Frederick A. Schaner  
The Daven Company  
Livingston, N. J.

## Part 2 Crystal Filters

Crystal filters have been used commercially for about 25 years. Here, in the second part of Mr. Schaner's article, he describes their important properties.

In the first part, he discussed Mechanical Filters. In the concluding part, he will discuss the important qualities and applications of the Electrical or LC Filter.

**T**HE NARROW passband characteristics of crystal filters make them ideal for telephone work and for data converter circuits in data link receivers. The reasonably wide passband characteristics which can be achieved with careful design also make them useful for single side band and am/fm communication receivers. One can sometimes simplify communication receiver circuitry from double to single conversion by using a crystal filter ahead of the i-f amplifier if image and spurious rejection requirements are not too rigorous.

Crystal filters have been used commercially for about 25 years. They are manufactured with center frequencies ranging from 1.0 kc to 30 mc, and with passbands from 0.01 to 10 per cent of the center frequency. They are said to have excellent phase linearity across the passband.

Crystal filters are essentially electro-mechanical devices. Consequently, in airborne and mobile applications, care must be taken in design and fabrication so externally induced mechanical vibrations will not affect the electrically transduced vibrations and thereby degrade the com-

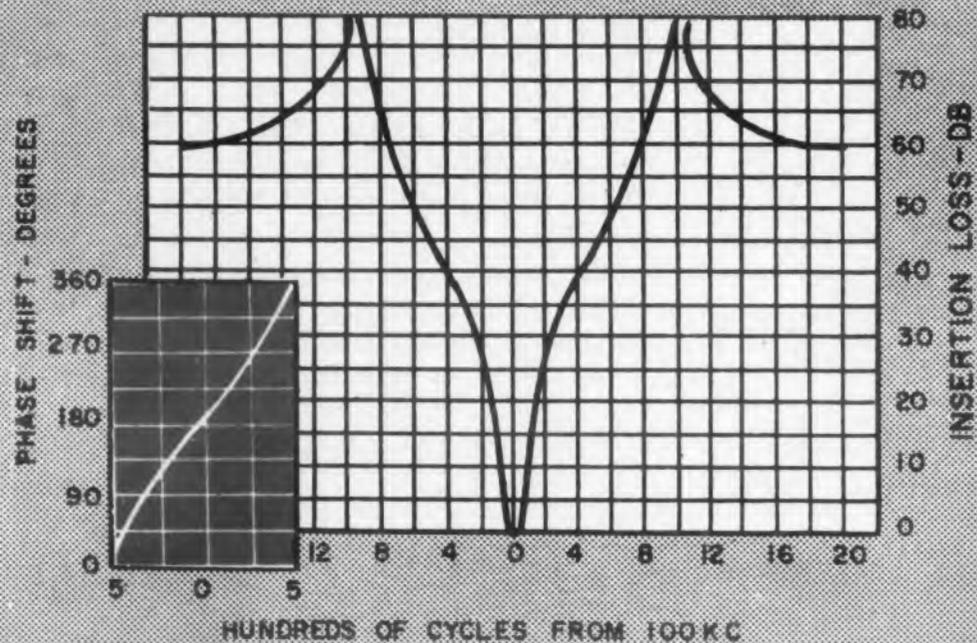


Fig. 1. Characteristics of the "needle nose" narrow band crystal filter.

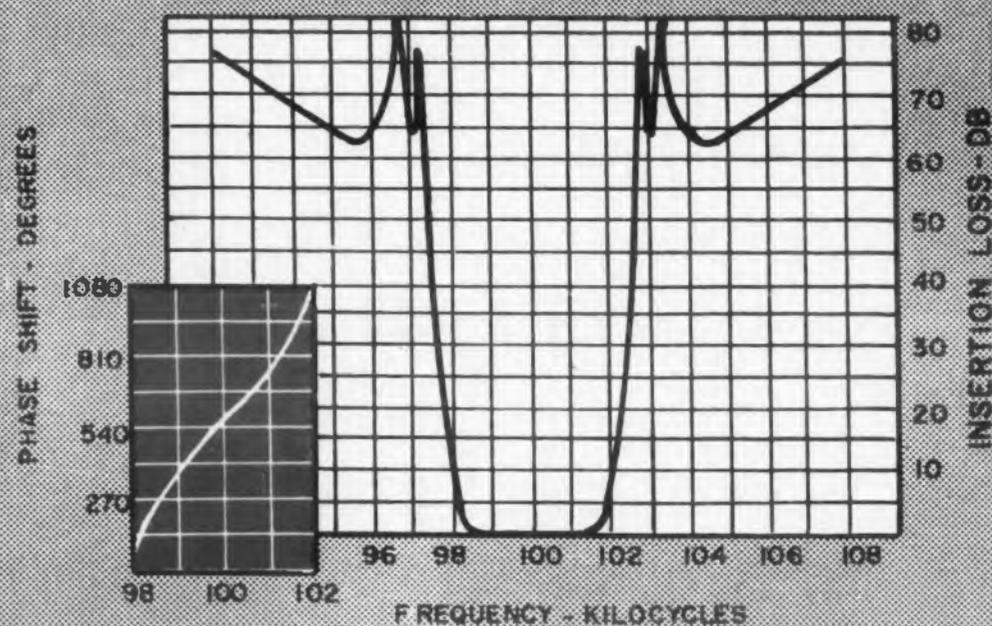


Fig. 2. Medium bandpass crystal filter characteristics.

# ALLEN-BRADLEY electronic components

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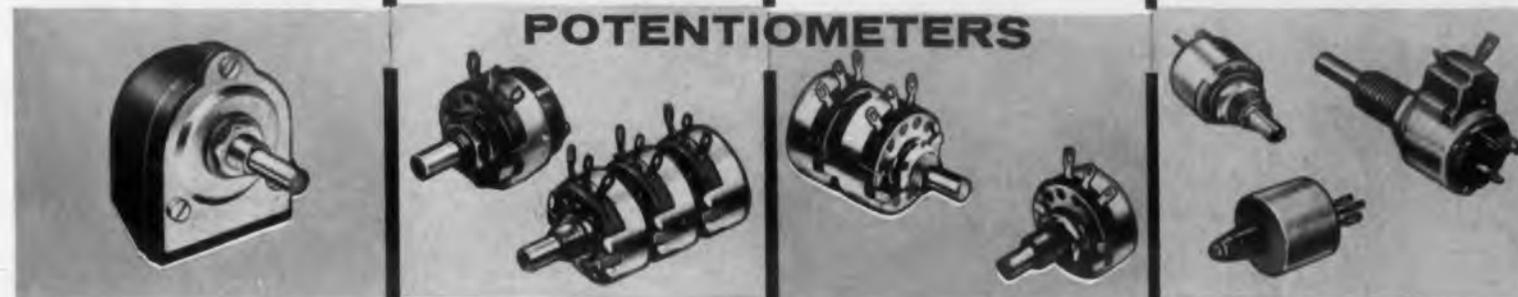


**HOT MOLDED COMPOSITION RESISTORS**—Quality standard of the industry. Rated at 70°C, in 2, 1, 1/2, 1/4, and 1/10 watts. Res. to 22 meg. Tol: 5, 10, and 20%.

**HERMETICALLY SEALED** in ceramic tubes. Solid, hot molded resistor. Less than 1% resistance change after 250 hr, 95% rel. hum., 40°C. Resistance values to 22 megohms.

**METAL GRID PRECISION RESISTORS**—Hermetically sealed. Non-inductive. 1, 1/2, and 1/4 watts at 100°C. Tolerances 0.1% to 1.0%. Temp. coef.  $\pm 25$  PPM/°C.

**COPPER CLAD**—Metal panel mounting, insulated composition resistor supplied in two ratings: 3 and 4 watts at 70°C, and 4 and 5 watts respectively at 40°C.

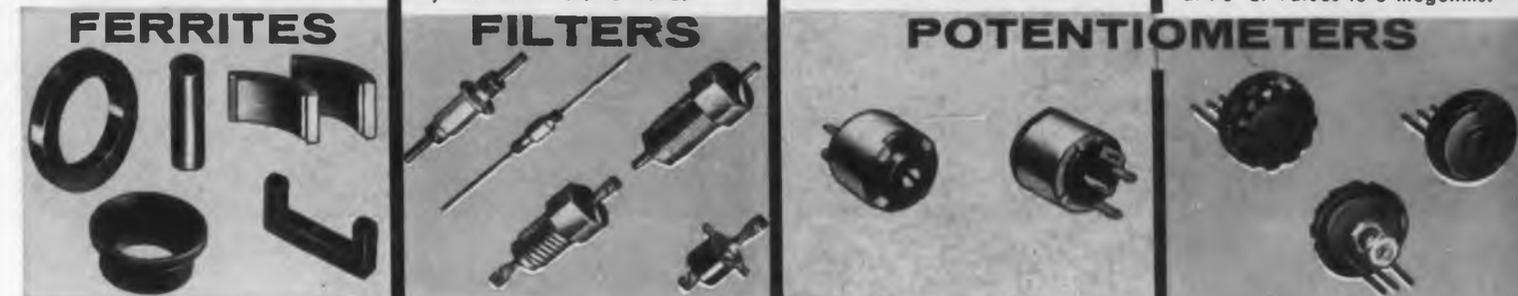


**INDUSTRIAL**—Type H with solid, hot molded resistor element. Quiet, improves with use. Life over 100,000 cycles. Rated 5 watts, 40°C; and 3 watts, 70°C.

**STANDARD**—Type J. Solid molded element. Quiet, reliable. Rated 2 watts, 70°C. Values to 5 meg.—less than 10% change in 100,000 cycles. Exceeds MIL-R-94B.

**HIGH TEMPERATURE**—Type K. Similar to Type J but rated 3 watts, 70°C; 2 watts, 100°C; and 1 watt, 125°C—derate to zero at 150°C. Many types and tapers.

**MINIATURE**—Type G. Solid molded element. Only 1/2" in diam. Plain or lock bushing; also with line switch. Rated 0.5 watt at 70°C. Values to 5 megohms.



**CORES**, including lightweight ferrite yokes; U, L, and O cores for color convergence; U and E flyback cores; and others. All have uniform magnetic properties.

**HIGH FREQUENCY** low pass cascaded ceramic filters for elimination of radiation. Max ratings: 500 v DC at 125°C; RF current 0.25 amp; DC or LF current 5 amp.

**PRINTED CIRCUIT TYPE**—Solid molded element. Rated 1/4 watt at 70°C. Type F is only 1/2" in diam. Screwdriver adjustment. Total resistance values to 5 meg.

**THIN TYPE**—Uses molded cover as actuator. Type T has solid molded element. Rated 1/2 watt at 70°C. Life in excess of 50,000 cycles. Total values to 5 megohms.



**CERAMIC DIELECTRIC** capacitors of superior quality, in a wide variety of types—GP (single and dual)—with no "rundown" on leads. Also, as TC and stable.

**CERAMIC ENCASED** capacitors for use where reliability and superior performance at high temp are important. Rated 500 v DC at 150°C. Tol: 5%, 10%, and 20%.

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**BARE DISC** ceramic capacitors for direct mounting in printed circuit boards. Mechanically strong to avoid breakage in handling, installing, and soldering.

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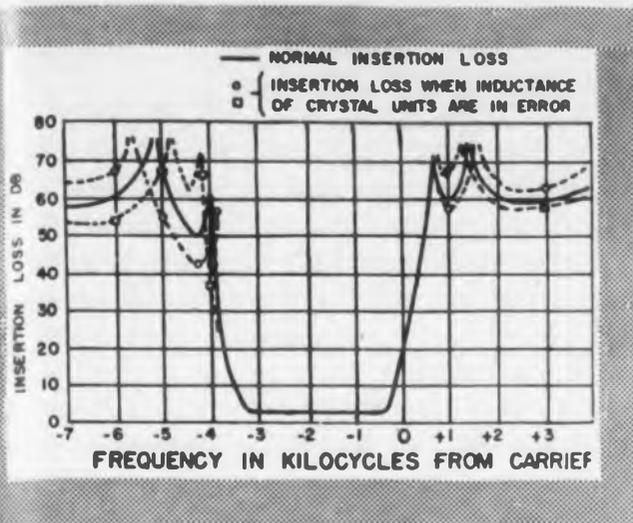
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**ALLEN-BRADLEY**  
QUALITY

**ELECTRONIC COMPONENTS**

CIRCLE 25 ON READER-SERVICE CARD



**Fig. 3.** Insertion loss of a crystal bandpass filter. The dotted curves show the effects of a one per cent change of the inductance of one of the crystal units in either lattice branch.

paratively low frequency intelligence in the received signal.

## Crystal Properties

A crystal filter usually consists of a lattice network of carefully selected piezoelectric crystals. These crystals have a mechanical resonant frequency which depends on certain physical dimensions. Because of their very high equivalent  $Q$  (10,000 to 30,000 unloaded), one can make very narrow band filters and filters in which the attenuation rises very rapidly at cutoff. Curves for two bandpass filters are shown in Figs. 1 and 2.

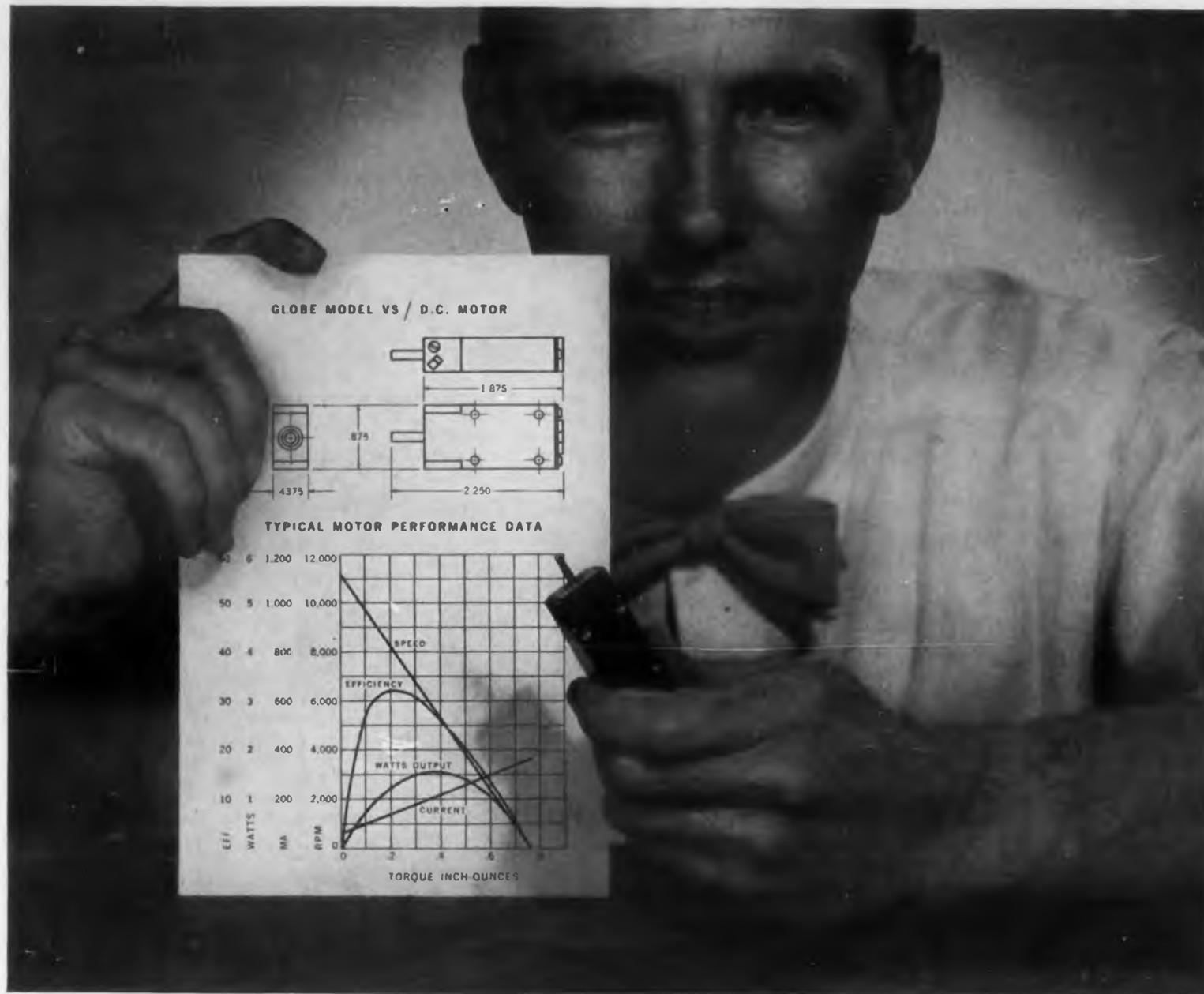
While filter crystal units are like oscillator crystal units, in that they must have low internal dissipation and a close control of resonant frequency, they are different in that many additional characteristics of the filter crystal units must also be accurately controlled.

## Characteristics Affect Performance

**Impedance.** Two typical illustrations show how characteristics other than resonant frequency and  $Q$  may react on filter performance. One of the major characteristics is the slope of the reactance vs frequency curve near series resonance. This slope is sometimes referred to as the impedance level of the crystal unit.

A convenient measure is the inductance of the equivalent electrical circuit. When this inductance departs from its nominal value, filter performance may undergo appreciable change. This is particularly true of filters in which the circuit has a lattice with crystal units in all bridge arms.

For example, in Fig. 3, the solid curve shows the transmission characteristic obtained with a lattice type filter in which both the series and



## NEW FLAT MOTOR / SMALLEST YET

Globe Industries announces a new precision miniature d.c. motor, the smallest we have made. Like all Globe motors, it can be modified easily and quickly to meet your electrical and mechanical requirements. It is called the VS, and takes its place with the SS, MM and LL in Globe's family of superb quality motors.

The VS weighs  $1\frac{3}{4}$  ozs., is  $\frac{7}{16}$  in. thick. A breakthrough in miniaturization, it can deliver .2 oz. in. of torque at 10,000 rpm and is the first precision motor of its size available. Multiple units can be gang-mounted in modules.

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CIRCLE 26 ON READER-SERVICE CARD



diagonal branches have two balanced crystal units. A close impedance balance between the lattice branches provides high attenuation.

When the inductance of any of the units departs from its nominal value, the bridge balance is disturbed and the filter's transmission characteristic is changed. The two dotted curves of Fig. 3 show the characteristics that result when the inductance of the crystal units in either branch depart from their nominal values by about one per cent.

A negative departure in one branch has about the same effect on performance as a positive departure in the other branch. The two dotted curves differ in that one assumes a positive departure and the other a negative departure for the inductance of one branch.

**Resonant Frequency.** A typical lattice filter has two double plated crystals. One crystal is used in the two series branches, while the other is used in the two diagonal branches. Due to the close balance required, the effect of small departures from resonant frequency produce large variations in the transmission characteristic. For example, departures of about 10 cps in the crystal units of either branch can vary the discrimination as do departures of inductance, to about the same extent.

On the other hand, if the units of both branches exhibit equal departures, the entire transmission characteristic is shifted by the frequency departure of the crystals and there is no loss in discrimination.

**Resistance.** Another way deviations in crystal properties can react on filter performance is shown in Fig. 4. Here, the schematic is the equivalent electrical circuit of a narrow band filter using two balanced quartz crystal units. This filter provides a passband of about 10 cps with distortion less than 0.2 db. The insertion loss characteristic show that the desired transmission can be obtained for various magnitudes of effective

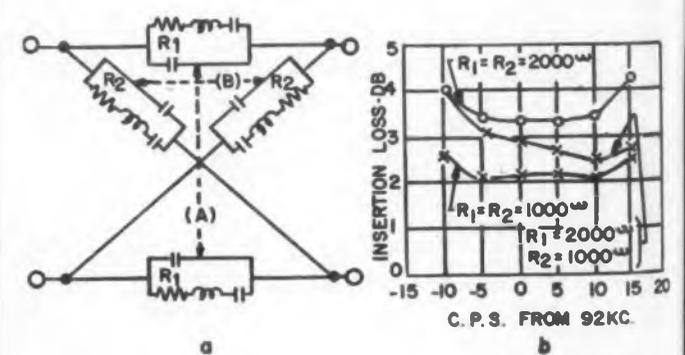


Fig. 4. Parameters of a narrow band crystal filter with two balanced quartz units.

a. The equivalent circuit.

b. The effects of variation in effective resistance.

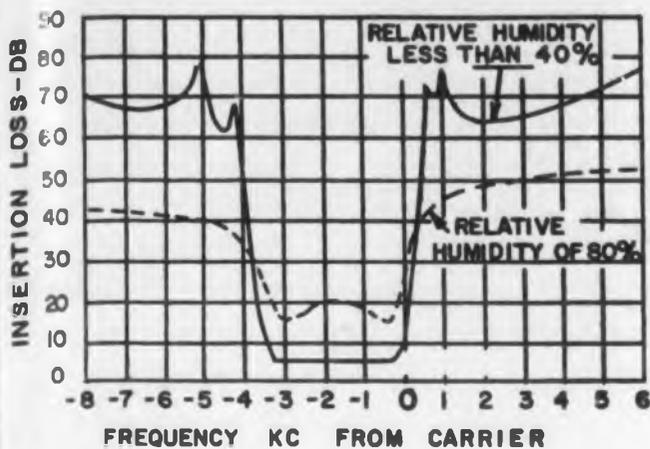


Fig. 5. A high relative humidity can ruin the discrimination of a crystal filter.

tive resistance as long as resistances in the series and diagonal branches are equal.

However, if the effective resistance in one branch is twice as large as that in the other branch, a highly distorted characteristic results, as shown by the middle curve of Fig. 4 b.

**Temperature Coefficient.** Just as unequal branch departures from nominal values of effective resistance, resonant frequency and impedance can degrade filter performance, so can unequal temperature coefficients of resonant frequency.

Other deviations in a single unit can affect filter performance. Such deviations include the presence of unwanted resonances, even weak ones, inadequate insulation resistance between the metalized coatings, or unbalance between the halves of plates on which the plating has been divided.

#### Manufacture of Crystals

High humidity and lack of cleanliness during manufacture can wreck the performance of crystal filters. The crystals must have extremely high impedances at their anti-resonant frequencies. These impedances can be as high as 100 megohms with crystal plates in a relatively dry atmosphere. Such values can be maintained up to fairly high frequencies.

For example, Fig. 5 shows the result of high relative humidity on the transmission characteristic of a typical crystal filter. The discrimination almost disappears for a relative humidity of 80 per cent. If the crystal plates are contaminated by solder flux, dirt, or some other foreign substance, bad discrimination may result from much lower humidity values.

It is impractical to manufacture crystal filters in an atmosphere with a relative humidity greater than 40 per cent. In all cases, the filters must be hermetically sealed. The housing must be evacuated, or filled with an inert gas, preferably under pressure.

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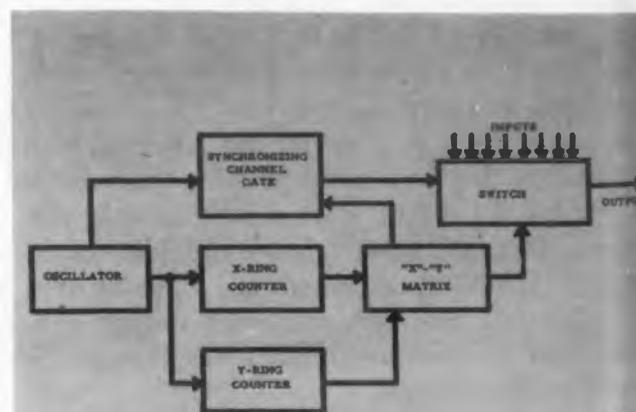
## No Moving Parts in High Electronic

**A**N ELECTRONIC solid state commutator with no moving parts is available from the Applied Science Corp. of Princeton, N.J. It can handle up to 1000 samples per sec with an input-to-output accuracy of 1 per cent or better for any mixed source impedance up to 25 kohms. This accuracy figure includes linearity and offset factors.

The multichannel sampling switch develops a back current of less than 1  $\mu$ amp during the time a channel is “off.” This negligible back current eliminates the problem of transducer “loading.”

Both the accuracy and non-loading features have been engineered as inherent parts of the ring counter actuated diode gating circuitry which forms the heart of the commutator.

The electronic commutator is designed for long-life applications in data handling systems using time-division multiplexing. The device will handle 0 to 5 v input signals in all IRIG



Functional block diagram of electronic commutator.

# Accuracy Commutator

standard pulse amplitude (pam) and pulse duration (pdm) sampling rates. Standard channel configurations are 30 and 45, including synchronization pulses.

ASCOP's commutator retains all the conventional advantages of solid state switching. Power consumption is less than 3 w. Design life expectancy is 5000 hours, without maintenance. Operating temperature range is -60 to +80 C with special packaging available for extreme intermittent temperatures. The commutator's size is approximately 45 cu in., and the weight is approximately 2 lb, making it feasible for airborne applications. In addition, the unit offers better vibration resistance than mechanical switches. It is expected that this ASCOP design will replace some mechanical commutators now in operation.

For more information, turn to the Reader-Service card and circle 101.



Electronic commutator has no moving parts and can handle 1000 samples per sec.



# Take Teflon!

- ★ Working Temperatures —65°C to +250°C
- ★ Maximum Insulation — Least O.D.
- ★ High Corrosion, Abrasion and Chemical Resistance
- ★ Flexible at Low Temperatures
- ★ Low Loss Applications

Plastoid Part Number	Imp. Ohms	Conductor	Diel.	Braid	Jacket* O.D.	Jacket Type	Cap. Mmfd. /ft.	V.P. %
12,270	50	1x.0385 SC	.109	Silver Copper Double	.167	Glass Braid, Silicone Saturant	29.0	70
15,251	50	1x.011 SCW	.035	Silver Copper	.063	Nylon	29.0	70
15,252	50	7x.010 SCW	.095	Silver Copper	.125	Nylon	29.0	70
15,253	50	1x.012 SCW	.036	Silver Copper	.064	Nylon	29.0	70
12,310	70	7x.004 SCW	.060	Silver Copper	.095	Glass Braid, Silicone Saturant	21.0	70
15,254	70	7x.0063 SCW	.095	Silver Copper	.125	Nylon	21.0	70
4,692	70	7x.004 SCW	.070	Silver Copper	.105	Glass Braid, Teflon Saturant	21.0	70
15,255	70	1x.011 SCW	.056	Silver Copper	.084	Nylon	21.0	70
12,221	93	7x.004 SCW	.103	Silver Copper	.131	Nylon	16.0	70
12,341	93	7x.004 SB	.104	Silver Copper	.138	Fused Teflon Tape	16.0	70
15,256	93	7x.004 SCW	.095	Silver Copper	.125	Nylon	16.0	70
12,279	94	1x.011 NCW	.096	Silver Copper	.118	Nylon	15.3	70
12,282	94	1x.011 SCW	.096	Silver Copper	.122	Nylon	15.3	70
12,280	94	1x.011 SCW	.095	Silver Copper	.140	Nylon Braid over PVC	15.3	70
15,257	94	1x.011 SCW	.095	Silver Copper	.140	Nylon over PVC	15.3	70

#### LEGEND Center Conductor:

SCW — Silver Coated Copperweld SB — Silver Coated Beryllium  
SC — Silver Coated Copper NCW — Nickel Coated Copperweld

\*Jacket may be altered to meet any special requirements.

## TEFLON\* MINIATURE COAXIAL CABLE

Plastoid "Teflon" miniature coaxial cables are only about 1/4 the outside diameter of comparable RG types, yet provide the same impedance characteristics as standard types. Manufactured in three widely used impedance ranges (50, 70 and 93 ohms) these "Teflon" miniature cables exhibit stable characteristics when operated up to 200°C temperature and can be used successfully in confined areas and where high ambient temperatures are present. They may be applied with any desired outer coating, and will withstand temperatures up to 250°C, when supplied with an impregnated fiber glass jacket.

**CONSTRUCTION:** Both the conductor and braid usually employ silver plated wire. The standard jacket material is "Teflon". Any desired jacketing materials such as Nylon, Fiberglass, Teflon Coated Fiberglass, KEL-F or any other suitable jacket are available to meet unique conditions and specifications.

**APPLICATIONS:** The ultimate in space conservation as compared to standard RG types. Rugged construction represents an important contribution to such varied applications as aircraft and guided missiles, plants or laboratories where instrument hook-ups are subjected to chemical corrosion or abrasive treatment.

#### TYPICAL CONSTRUCTIONS



\*duPont's trade name for Polytetrafluoroethylene

## HOOK-UP WIRE — EXTRUDED TEFLON INSULATION

### MIL-W-16878B (Navy) Type E

Voltage Rating: 600  
Temperature Rating: +200°C

1. Silver coated copper conductor.
2. Extruded teflon insulation — ten solid colors per spec. Also with contrasting helical color coding in single and double combinations.
3. May be supplied in single or multiple conductor cables with or without shields — consisting of silver coated, tinned or bare copper as required.

Plastoid Part	Spec. Designation	AWG Size & Stranding	Max. O.D.	Approx. Wt. #/M'
PP12003	E-26	26/7x34	.043"	2.0
PP12004	E-24	24/7x32	.048"	3.0
PP12024	E-24	24/19x36	.048"	3.0
PP12005	E-22	22/7x30	.054"	4.0
PP12025	E-22	22/19x34	.054"	4.0
PP12006	E-20	20/7x28	.062"	5.5
PP12026	E-20	20/10x32	.062"	5.5
PP12027	E-18	18/19x30	.074"	8.0
PP12008	E-16	16/19x29	.087"	11.0
PP12009	E-14	14/19x27	.101"	15.0

### MIL-W-16878B (Navy) Type EE

Voltage Rating: 1000  
Temperature Rating: +200°C

1. Silver coated copper conductor.
2. Extruded teflon insulation — ten solid colors per spec. Also with contrasting helical color coding in single and double combinations.
3. May be supplied in single or multiple conductor cables with or without shields — consisting of silver coated, tinned or bare copper as required.

Plastoid Part	Spec. Designation	AWG Size & Stranding	Max. O.D.	Approx. Wt. #/M'
PP12015	EE-26	26/7x34	.053"	2.5
PP12016	EE-24	24/7x32	.058"	3.5
PP12028	EE-24	24/19x36	.058"	3.5
PP12017	EE-22	22/7x30	.064"	5.0
PP12029	EE-22	22/19x34	.064"	5.0
PP12018	EE-20	20/7x28	.072"	6.5
PP12030	EE-20	20/19x32	.072"	6.5
PP12031	EE-18	18/19x30	.084"	10.0
PP12020	EE-16	16/19x29	.095"	13.5
PP12021	EE-14	14/19x27	.113"	18.0

### MIL-W-7139A

Voltage Rating: 600  
Temperature Rating: 400°F

Conforms to Dept. of Navy Bureau of Aeronautics requirements.

1. Silver Coated Copper Conductor
2. Teflon Insulation
3. Glass Braid
4. Dacron Braid

Mil. Part No.	Plastoid Part No.	AWG Size & Stranding	Diel. O.D.	Nom. O.D.
RM-22	PP12.051	22/19x.0063	.059	.088
RM-20	PP12.052	20/19x.0079	.068	.098
RM-18	PP12.053	18/19x.0100	.080	.110
RM-16	PP12.054	16/19x.0113	.088	.118
RM-14	PP12.055	14/19x.0142	.108	.138
RM-12	PP12.056	12/19x.0179	.132	.162

Outer Covering Conforms with Para. 3.2.3 MIL-W-7139A

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# NEW PRODUCTS

*Covering all new products that might generally be specified by an electronics engineer engaged in the design of original equipment.*



## TANTALUM CAPACITORS

**Withstand temperatures to 150 C** and vibrations of 2000 cps, per MIL-C-3965B. Series M2 tantalum capacitors is hermetically sealed and measures 1/2 in. long. At 85 C, ratings are available from 11  $\mu\text{f}$  90 v to 140  $\mu\text{f}$  6 v. At 150 C, ratings are 11  $\mu\text{f}$  75 v to 140  $\mu\text{f}$  4 v.

P. R. Mallory & Co., Inc., Dept. ED, 28 S. Gray St., Indianapolis, Ind.

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## MASER AMPLIFIER

**Extremely low noise figures** can be achieved by using the Versitron solid-state maser amplifier. Operating in either the S-band or X-band, the Versitron has a noise temperature equivalent of approximately 25 Kelvin. Gain bandwidth products are 3 mc in the S-band and 10 mc in the X-band. The unit employs a regenerative type cavity amplifier and a nondestructible ruby crystal. Circulator input and output, liquid helium operating temperature and a stabilized magnetic field are other characteristics.

Advance Industries, Inc., Dept. ED, 640 Memorial Dr., Cambridge 39, Mass.

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### DC AMPLIFIER

A high current dc amplifier for driving recording galvanometers, model 1411 features output of  $\pm 100$  ma up to 30 kc, electrical offset control, output metering, damping resistance selector, dummy loads with substitution by relay, and continuously variable voltage gains from 1 to 3000. Other specifications include 100 K input impedance,  $\pm 2 \mu\text{v}$  drift limits, and less than 0.1 per cent non-linearity for the usual galvanometer frequency ranges.

Dynamics Instrumentation Co., Div. of Alberhill Corp., Dept. ED, 1118 Mission St., S. Pasadena, Calif.

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### HYSTERESIS MOTOR

The stator of this hysteresis motor is made of a continuous steel silicon strip, punched and coiled. Designed for the instrumentation and tape recorder field, model 6-10.20 runs at 360 and 720 rpm giving direct drive for 3-3/4 and 7-1/2 ips. Starting and running torques are 4 and 5 in.-oz for 360 rpm and 5 and 6 in.-oz for 720 rpm. A three speed motor is also available with speeds of 450-900-1800 rpm.

Charles B. Stegman Assoc., Dept. ED, 5757 Tobias Ave., Van Nuys, Calif.

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MODEL	OUTPUT VOLTS DC	OUTPUT AMPERES DC	OUTPUT IMPEDANCE		SIZE		
			DC-1KC	1KC-100KC	W	H	D
SC-18-0.5	0-18	0-0.5	.04	.4	8 1/4"	4 1/2"	13 5/8"
SC-18-1	0-18	0-1	.02	.2	8 1/4"	4 1/2"	13 5/8"
SC-18-2	0-18	0-2	.01	.1	8 1/4"	4 1/2"	13 5/8"
SC-18-4	0-18	0-4	.005	.05	19"	3 1/2"	13"
SC-36-0.5	0-36	0-0.5	.08	.8	8 1/4"	4 1/2"	13 5/8"
SC-36-1	0-36	0-1	.04	.4	8 1/4"	4 1/2"	13 5/8"
SC-36-2	0-36	0-2	.02	.2	19"	3 1/2"	13"
SC-3672-0.5	36-72	0-0.5	.15	1.0	8 1/4"	4 1/2"	13 5/8"
SC-3672-1	36-72	0-1	.08	.8	19"	3 1/2"	13"

Patent Pending

## (TUBELESS) TRANSISTORIZED SHORT CIRCUIT PROTECTED

- REGULATION: 0.1% for line changes 105-125 volts at any output voltage in the range minimum to maximum.

0.1% or 0.003 volt for load changes 0 to maximum (whichever is greater) at any output voltage in the range minimum to maximum.

- RIPPLE: 1 mv. RMS.
- RECOVERY TIME: 50 microseconds.
- STABILITY: (for 8 hours) 0.1% or 0.003 volt (whichever is greater).
- AMBIENT OPERATING TEMPERATURE: 50°C maximum. Over-temperature protection provided. Unit turns off when over-temperature occurs. Power-on-off switch on front panel resets unit.
- TEMPERATURE COEFFICIENT: Output voltage changes less than 0.05% per °C.
- SHORT CIRCUIT PROTECTION: No fuses, circuit breakers or relays! Designed to operate continuously into a short circuit. Returns instantly to operating voltage when overload is removed. Ideal for lighting lamps and charging capacitive loads.
- OVER-CURRENT CONTROL: Can be set from 0 to 120% of full load. Current is limited to preset value for any load including short circuit.

# KEPCO

## LABORATORIES, INC.

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



Model SC-18-2-M



\*Two units mounted in Rack Adapter RA-2



Model SC-18-4-M

- REMOTE PROGRAMMING at 1000 ohms per volt is provided. Remote programming allows mounting a voltage control at a remote point.
- REMOTE ERROR SIGNAL SENSING is provided to maintain stated regulation directly at load.
- CONSTANT CURRENT OPERATION: These units can be set up for constant current operation without internal modification.
- POWER REQUIREMENTS: 105-125 volts, 50-65 cycles. 400 cycle units available.
- OUTPUT TERMINATIONS: DC terminals are clearly marked on the front panel. All terminals are isolated from the chassis. Either positive or negative terminal of each DC output may be grounded. A terminal is provided for connecting to the chassis. The DC terminals, the remote programming terminals and the remote error signal sensing terminals are brought out at the rear of the unit.
- CONTROLS: Power-on-off switch, one turn voltage control, on front panel. Over-current control on rear of unit. Ten turn voltage control available on special order.
- Continuously Variable Output Voltage. No voltage switching.
- Suitable for square wave pulsed loading.
- Either positive or negative can be grounded.
- Units can be series connected.
- High efficiency
- Low heat dissipation.
- Compact, light weight
- For bench or rack use.
- Color: Gray hammertone. (Special finishes available).

#### ORDERING INFORMATION:

Units without meters use model numbers indicated in table. To include meters add M to the Model No. (e.g. SC-18-1-M).

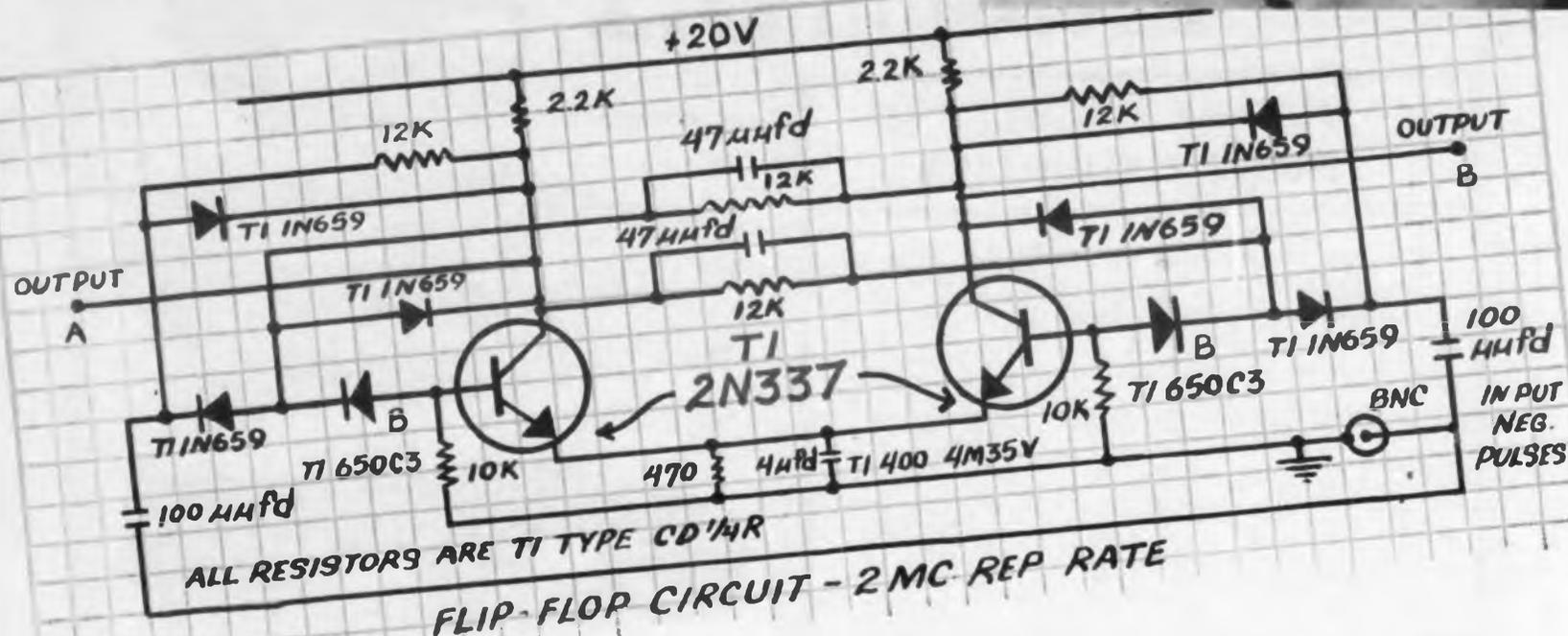
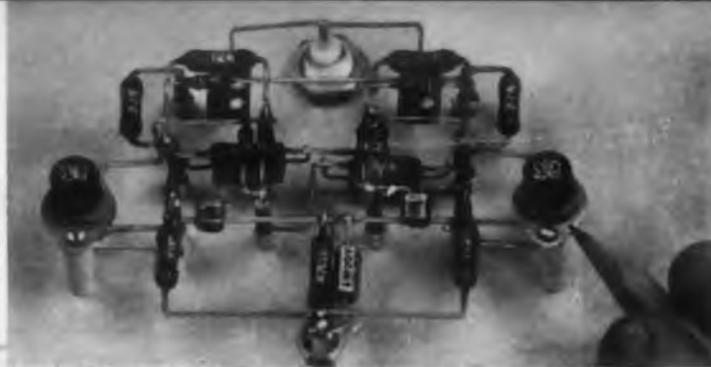
\*Rack adapter for mounting any two 8 1/4" x 4 1/2" units is available. Model No. RA2 is 5 1/4" high 19" wide.

\*Rack adapter for mounting any one 8 1/4" x 4 1/2" unit is available. Model No. RA3 is 5 1/4" high 19" wide.

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# HIGH SPEED SWITCHING



## ... with reliable TI silicon transistors

New improved TI 2N337 and 2N338 specifications provide greater design flexibility for your switching circuits . . . nuclear counters . . . pre-amplifiers . . . RF amplifiers . . . 455 KC IF amplifiers . . . and many other high frequency applications.

You get high gain at low current levels with TI diffused silicon transistors. High alpha cutoff . . . 10 mc min for 2N337, 20 mc min for 2N338 . . . and extremely low collector capacitance assure optimum performance in your switching and high frequency amplifier applications.

design characteristics at 25° C ambient (except where advanced temperatures are indicated)

	test conditions	2N337			2N338			unit
		min	design center	max	min	design center	max	
$I_{CBO}$	Collector Cutoff Current at 150°C	—	—	1	—	—	1	µA
$BV_{CBO}$	Breakdown Voltage	—	—	100	—	—	100	µA
$BV_{EBO}$	Breakdown Voltage	45	—	—	45	—	—	V
$h_{ib}$	Input Impedance	1	—	—	1	—	—	Ohm
$h_{ob}$	Output Admittance	30	50	80	30	50	80	µmho
$h_{fb}$	Feedback Voltage Ratio	—	0.2	1	—	0.2	1	X10 <sup>-6</sup>
$h_{fb}$	Current Transfer Ratio	0.95	0.985	—	0.975	0.99	—	—
$h_{FE}$	DC Beta	20	35	55	45	80	150	—
$f_{\alpha b}$	Frequency Cutoff	10	20	—	20	30	—	mc
$C_{ob}$	Collector Capacitance*	—	1.2	3	—	1.2	3	µµf
$R_{cs}$	Saturation Resistance†	—	75	150	—	75	150	Ohm
$h_{fe}$	Current Transfer Ratio	14	22	—	20	24	—	db
$t_r$	Rise time‡	—	0.05	—	—	0.06	—	µsec
$t_s$	Storage Time	—	0.02	—	—	0.02	—	µsec
$t_f$	Fall time	—	0.08	—	—	0.14	—	µsec

\* Measured at 1 mc

† Common Emitter

‡  $I_B = 1mA$  for 2N337, 0.5mA for 2N338

§ Includes delay time ( $t_d$ )

### NEW IMPROVED SPECIFICATIONS FOR 2N337 AND 2N338

	from	to
$BV_{CBO}$	40 V max	45 V max
$R_{CS}$	300 Ω max	150 Ω max
$h_{ib}$	90 Ω max	80 Ω max

Consider TI's guaranteed specifications when you select semiconductor devices for your next transistor circuit.

## NEW PRODUCTS

### Manual Spectrometer

0.15 per cent linearity



A manual scintillation spectrometer for analysis of energy spectra of gamma emitting isotopes, model N-1260M has stability of 0.25 per cent per day. Linearity is 0.15 per cent, and background count is 25 cpm.

Hamner Electronics Co., Inc., Dept. ED, P.O. Box 531, Princeton, N.J.

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### Recording System

Rectilinear readout and thermal writing



The 8-channel model RD 1684 00 ultralinear recording system has rectilinear readout and thermal writing. Frequency response is dc to 100 cps. The system features a choice of two individual plug-in amplifiers: one with sensitivity of 10 mv per chart line and stability of 1/2 chart line per hour, the other with sensitivity of 50 mv per line, and stability of 1/10 line per hour. Eight standard chart speeds from 0.4 to 100 mm per sec.

Brush Instruments, Dept. ED, 3405 Perkins Ave., Cleveland 14, Ohio.

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DALLAS, TEXAS

## Programming System

Has removable pre-patched boards



Removable, pre-patched boards allow fast reprogramming in the A-MP 240 patchcord programming system. Designed for shock and vibration resistance, the system has 240 contact holes. A patented wiping action assures pre-cleaning of contact springs and taper pins.

Amp Inc., Dept. ED, 2100 Paxton St., Harrisburg, Pa.

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## DC Insulation Tester

5 ma output at 100 kv

The VON 100 kv dc insulation tester checks and evaluates insulation of large motors, generators, transformers, cables and high voltage assemblies. Output is 5 ma at 100 kv.

The Hewson Co., Inc., Dept. ED, 443 Broad St., Newark 2, N.J.

CIRCLE 39 ON READER-SERVICE CARD

## Frequency Standard

Crystal controlled



Transistorized, crystal controlled model 381 frequency standard has a frequency stability of  $\pm 0.0002$  per cent from  $-55$  to  $+90$  C ambient. It withstands shock of 100 g, acceleration of 20 g, and vibration of 10 g to 2000 cps. Total volume of standard at 50 cps pulse output is less than 13 cu in.

Gibbs Mfg. and Research Corp., Dept. ED, 450 N. Main St., Janesville, Wis.

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## how large is small?

DAVEN'S NEW MINIATURE WIRE WOUND RESISTORS PROVIDE AS MUCH AS 400K RESISTANCE IN  $\frac{1}{4}$ " X  $\frac{5}{16}$ " SPACE

DAVEN's fully encapsulated, miniature, precision wire wound resistors offer the design and development engineer the solution to critical space limitation problems. DAVEN's advanced techniques provide the needed resistance value in a minimum of space, without sacrificing reliability. Where space conservation is a prime factor in your design, specify DAVEN miniature wire wounds.

### Types and Specifications

Type	Dia.	Length	Max. Ohms	Max. Watts
1274	3/16	3/8	100K	0.25
1273	1/4	5/16	400K	0.25
1283	1/4	5/16	400K	0.25
1284	1/4	27/64	.5 Meg.	0.25
1250	1/4	1/2	900K	0.33
1170A	7/16	1/2	1.2 Meg.	0.50
1170	1/2	1/2	1.8 Meg.	0.50

• Fully encapsulated • Meet and exceed all humidity, salt water immersion and cycling tests as specified in MIL-R-93A, Amendment 3 • Operate at 125°C continuous power without de-rating • Can be obtained in tolerances as close as  $\pm 0.02\%$  • Standard temperature coefficient is  $\pm 20\text{PPM}/^\circ\text{C}$ .

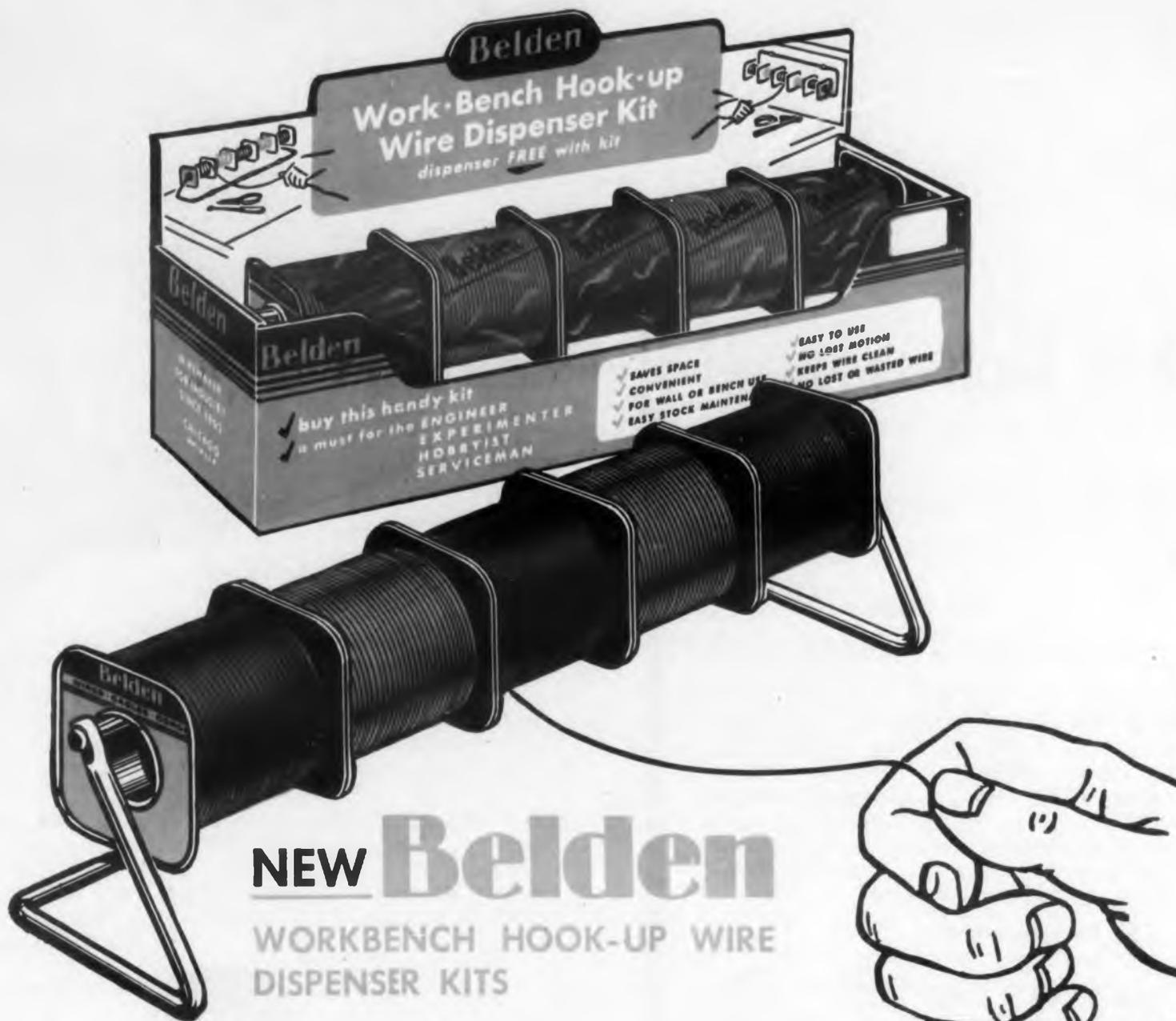


THE **DAVEN** CO.  
Livingston, N. J.

Special temperature coefficients can be supplied on request.

Write for our new resistor catalog.

R and D Labs  
Engineers...  
Servicemen...  
Hobbyists...



## NEW Belden

### WORKBENCH HOOK-UP WIRE DISPENSER KITS

Belden Dispenser Kits solve the problems of waste and inconvenience for all users of Hook-Up Wire and are available in the 14 most popular assortments of Vinyl, Vinyl-Nylon, Textile, and Teflon<sup>®</sup> insulated wire for every requirement.

Each kit contains an assortment of Hook-Up Wire colors and types plus a portable metal dispenser rack for workbench or wall mounting. The dispenser rack provides a complete, compact, and convenient wire department for every working area at the user's finger tips, simplifies user Hook-Up Wire stock maintenance, and helps keep wire clean and orderly while keeping the workbench neat and efficient. Available at all Belden jobbers.

\* Du Pont trademark

One Wire Source for Everything Electrical and Electronic

Magnet Wire • Lead Wire • Power Supply Cords,  
Cord Sets and Portable Cord • Aircraft Wires  
Electrical Household Cords • Electronic Wires  
Welding Cable • Automotive Wire and Cable



08A01G8

CIRCLE 42 ON READER-SERVICE CARD

## NEW PRODUCTS

### Transistors

Germanium p-n-p alloy type

Germanium p-n-p alloy type transistors for various uses. Drift transistors 2N373 and 2N374 are for i-f amplifier and converter service respectively. Junction transistor 2N591 is for large-signal of driver service. Audio power transistors 2N301 and 2N301-A provide outputs to 5 w.

Radio Corporation of America, Semiconductor Div., Dept. ED, Somerville, N.J.

CIRCLE 470 ON READER-SERVICE CARD

### Strobed Readout Amplifier

Transistorized



Designed as a readout amplifier for type S-3 ferrite magnetic matrix memory cores, the AI-600 is a two-transistor regenerative pulse amplifier. Signals above 18 mv cause the amplifier to generate a 10 v positive-going output pulse which has about 0.3  $\mu$ sec rise, 1.5  $\mu$ sec length, and 0.4  $\mu$ sec fall across 2.2 K output load impedance. Recovery is within 6  $\mu$ sec. A strobe input terminal is provided to permit control of the amplifier on time.

Airtronics, Inc., Dept. ED, 5522 Dorsey Lane, Washington 16, D.C.

CIRCLE 44 ON READER-SERVICE CARD

### Polystyrene Capacitors

No derating from -60 to 85 C

HD&K Syncap polystyrene capacitors include these types: glass encapsulated, upright rectangular in metal cans, bath tub fixed or adjustable, metal tubular, bakelite encased, and uncased. Maximum dielectric absorption is 0.05 per cent; stability and retrace, 0.05 per cent. The units operate from -60 to +85 C with no derating. Capacitances range from 0.01 to 10  $\mu$ f.

Wesco Electrical and Mfg. Co., Dept. ED, 27 Olive St., Greenfield, Mass.

CIRCLE 45 ON READER-SERVICE CARD

## DC Coupling Preamp

Single-ended or push-pull input



In model 450-1300 dc coupling preamplifier input is single-ended or push-pull, impedance 5 meg each input side to ground; 50 mv input produces 1 v at output jack. Frequency response is 0 to 10 kc; linearity, 0.25 per cent.

Sanborn Co., Dept. ED, 175 Wyman St., Waltham 54, Mass.

CIRCLE 46 ON READER-SERVICE CARD

## Isolation System

For shock and vibration problems

While steady loads to 50 g are applied, this isolation system isolates 50 g shocks and stands 20 g vibration from 5 to 2000 cps. It permits insensitive responses to temperatures from -85 to +500 F.

Litton Industries, Maryland Div., Dept. ED, 4900 Calvert Rd., College Park, Md.

CIRCLE 47 ON READER-SERVICE CARD

## Multicoupler

Covers 2 to 32 mc



TRAK multicoupler model 21 couples one antenna to ten receivers and operates between 2 and 32 mc. It features 60 db isolation between outputs, 60 db attenuation of intermodulation components, and a 6 db noise figure.

CGS Labs, Inc., Dept. ED, Ridgefield, Conn.

CIRCLE 48 ON READER-SERVICE CARD

CIRCLE 49 ON READER-SERVICE CARD



Two Type 7191's receive special "D.C. hold-off" vibration test. All Tung-Sol/Chatham miniature hydrogen thyratrons — 7190, 7191, 7192 — must "hold off" while subject to 15G

vibration, swept from 50 to 2,000 cps in 4 minutes. Tubes also are shocked at 48° hammer angle in Navy high-impact flyweight shock machine, equal to 720G/1 millisecond shock.

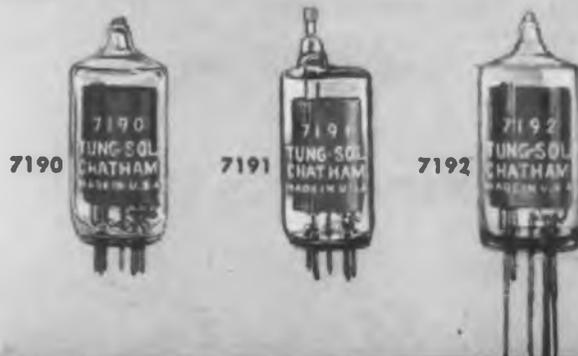
# Tung-Sol/Chatham miniature hydrogen thyratrons supply test-proved ruggedness for missile use!

Extensive in-factory tests assure designers Tung-Sol/Chatham miniature hydrogen thyratrons — 7190, 7191, 7192 — can withstand the severe shock and vibration met in missile flight. Performance of these tubes in several operational missiles gives in-use proof of their ruggedness.

In radar modulators and tracking beacons, these compact tough tubes supply 10 KW, replace bulkier types. Broad range of pulse repetition rates widens design choice . . . zero bias simplifies circuitry and

triggering requirements. Tubes hold off high voltage, pass high peak current with low tube voltage drop. Three types available: 7190 — pin base, 7191 — top anode connector, 7192 — flexible leads.

Tung-Sol, only producer of miniature hydrogen thyratrons for missiles, can supply you immediately. For complete data on these types . . . on special-purpose tubes of all types, phone or write. Tung-Sol Electric Inc., Newark 4, New Jersey. Commercial Engineering Offices: Bloomfield and Livingston, New Jersey; Culver City, California; Melrose Park, Illinois.



**ts TUNG-SOL®**

## THE STANDARD FOR MICROWAVE COMPONENTS



Because of a unique combination of engineering and production skills, you can expect microwave components from Frequency Standards, Inc. that offer a dependability and accuracy ( $\pm 0.01\%$ ) unmatched in the field.

For here you will find the highly specialized engineering experience and the intricate tooling and production facilities needed to produce such sensitive microwave components as the two pictured on this page.

These two Tunable Band Pass Filters, both passive frequency selective devices, are capable of providing large amounts of selectivity in the stop band consistent with low dissipation losses in the pass band. Our standard line includes 2-, 3- and 4-section filters with a ganged tuning control feature, over a wide frequency range, assuring you of an accuracy of  $\pm 0.01\%$ .

For details, contact Frequency Standards, Inc., and we will furnish information on our standard products, our custom products and our facilities for meeting all requirements, no matter how exacting, in the microwave components field.

Please address inquiries to Frequency Standards, Inc., Box 504A, Asbury Park, N. J., Prospect 4-0500, or your nearest representative in all principal cities.

BOOTHS 1255 & 1256, WESCON SHOW

### FREQUENCY STANDARDS, INC.



A DIVISION OF  
NATIONAL ELECTRIC PRODUCTS CORP.

CIRCLE 50 ON READER-SERVICE CARD

## NEW PRODUCTS

### DC Amplifier

Delivers up to 6 w



Rack-mounted and transistorized, Model B-1 dc amplifier delivers up to 6 w, at an output impedance of less than 0.1 ohm, over the frequency range from dc to 20 kc.

Southwestern Industrial Electronics Co., Dept. ED, 2831 S. Post Oak Rd., Houston 19, Tex.

CIRCLE 51 ON READER-SERVICE CARD

### Electronic Counter

Measures frequencies from 10 cps to 1.1 mc



The model 13-20 counter measures frequencies from 10 cps to 1.1 mc, periods from 0 to 10 kc, time intervals from 3  $\mu$ sec to 100,000 sec, and 1 to 999,999 total events. The instrument also measures time and frequency ratios, frequency drift, and similar quantities, and will count and totalize discrete electrical impulses. Power input is 115 v  $\pm 10$  per cent, 60 cps, 280 w.

Northeastern Engineering, Inc., Dept. ED, 25 S. Bedford St., Manchester, N.H.

CIRCLE 52 ON READER-SERVICE CARD

### Bridge Balance

For strain gauges



This miniature strain gage balance box interconnects a power supply and 18 strain gage bridges to a multi-channel recorder. Means for balancing the bridges are included.

Datran Electronics, Dept. ED, 1836 Rosecrans Ave., Manhattan Beach, Calif.

CIRCLE 53 ON READER-SERVICE CARD

## Tape Recorder

For telemetering

Start and stop time is under 30 msec in model 707 tape recorder for ground station telemetering instrumentation. The unit has a frequency response to 130 kc and an output of 4 v rms into 180 ohms. Plug in modules provide direct analog, pdm, and fm recording. Models for 1/2-in. tape have 7 tracks; 1-in. models have 14 tracks.

Midwestern Instruments, Dept. ED, P.O. Box 7186, Tulsa, Okla.

CIRCLE 54 ON READER-SERVICE CARD

## Transducers

Pressure to frequency



Series P300 pressure to frequency transducers have infinite resolution and provide 1 per cent repeatability. Units can be supplied on any RDB standard subcarrier telemetering frequency between 1.7 and 70 kc.

Datran Electronics, Dept. ED, 1836 Rosecrans Ave., Manhattan Beach, Calif.

CIRCLE 55 ON READER-SERVICE CARD

## Nuclear Battery

Safer to use



The model K nuclear battery delivers higher currents than Strontium-90 models, but is much safer to use. It uses krypton-85, a low cost radioisotope that diffuses quickly upon contact with air. A miniature unit has a current rating of 10 to 1000  $\mu$ ma, an open circuit potential of several thousand volts, and a linear charging rate to several hundred volts.

Universal Winding Co., Inc., Patterson, Moos Div., Dept. ED, 90-28 Van Wyck Expressway, Jamaica 18, N.Y.

CIRCLE 56 ON READER-SERVICE CARD

# The FIRST and ONLY standard line of tunable Microwave Filters

### S BAND FILTERS

Characteristics	Two (2) Section Resonator	Three (3) Section Resonator	Four (4) Section Resonator
Model No.	27-BW	27-CW	27-DW
Type of Resonator	TE <sub>101</sub> mode rectangular	TE <sub>101</sub> mode rectangular	TE <sub>101</sub> mode rectangular
Tuning Range	2700-3150 MCS	2700-2950 MCS	2700-2900 MCS
3 db Bandwidth	4.5-6.5 MCS	4.5-5.5 MCS	4.5-5.5 MCS
Max 30 db Bandwidth	36 MCS	18 MCS	13 MCS
Max Insertion Loss	.9 db	1.3 db	1.8 db
Price	\$400.00	\$535.00	\$670.00
Model No.	27-BC	27-CC	27-DC
Type of Resonant Cavity	$\lambda/4$ coax	$\lambda/4$ coax	$\lambda/4$ coax
Tuning Range	2700-3200 MCS	2700-3100 MCS	2700-2950 MCS
3 db Bandwidth	8-11 MCS	8-10 MCS	8-9 MCS
Max 30 db Bandwidth	60 MCS	32 MCS	21 MCS
Max Insertion Loss	1.6 db	2.4 db	3.2 db
Price	\$350.00	\$475.00	\$600.00

### C BAND FILTERS

Characteristics	Two (2) Section Resonator	Three (3) Section Resonator	Four (4) Section Resonator
Model No.	54-BC	54-CC	54-DC
Type of Resonator	$\lambda/4$ coax	$\lambda/4$ coax	$\lambda/4$ coax
Tuning Range	5400-5950 MCS	5400-5950 MCS	5400-5750 MCS
3 db Bandwidth	8-11 MCS	8-10 MCS	8-9 MCS
Max 30 db Bandwidth	60 MCS	32 MCS	21 MCS
Max Insertion Loss	2 db	3 db	4 db
Price	\$360.00	\$485.00	\$610.00

### L BAND FILTERS

Characteristics	Two (2) Section Resonator	Three (3) Section Resonator	Four (4) Section Resonator
Model No.	96-BC	96-CC	96-DC
Type of Resonant Cavity	$\lambda/4$ coax	$\lambda/4$ coax	$\lambda/4$ coax
Tuning Range	960-1150 MCS	960-1100 MCS	960-1050 MCS
3 db Bandwidth	8-11 MCS	8-10 MCS	8-9 MCS
Max 30 db Bandwidth	60 MCS	32 MCS	21 MCS
Max Insertion Loss	1.2 db	1.8 db	2.5 db
Price	\$370.00	\$495.00	\$620.00

### X BAND FILTERS

Characteristics	Two (2) Section Resonator	Three (3) Section Resonator	Four (4) Section Resonator
Model No.	75-BW	75-CW	75-DW
Type of Resonant Cavity	TE <sub>111</sub> mode cylindrical	TE <sub>111</sub> mode cylindrical	TE <sub>111</sub> mode cylindrical
Tuning Range	7500-8500 MCS	7500-8250 MCS	7500-8000 MCS
3 db Bandwidth	8-11 MCS	8-10 MCS	8-9 MCS
Max 30 db Bandwidth	60 MCS	32 MCS	21 MCS
Max Insertion Loss	1.5 db	2.5 db	3.5 db
Price	\$475.00	\$625.00	\$775.00
Model No.	85-BW	85-CW	85-DW
Type of Resonant Cavity	TE <sub>111</sub> mode cylindrical	TE <sub>111</sub> mode cylindrical	TE <sub>111</sub> mode cylindrical
Tuning Range	8500-9600 MCS	8500-9300 MCS	8500-9000 MCS
3 db Bandwidth	8-11 MCS	8-10 MCS	8-9 MCS
Max 30 db Bandwidth	60 MCS	32 MCS	21 MCS
Max Insertion Loss	1.5 db	2.5 db	3.5 db
Price	\$475.00	\$625.00	\$775.00

All of the above filters have Max VSWR of 1.5, and either a single shaft or counter dial for Tuning Control. Depending upon mode of operation, units are supplied with either Type N Connectors or Waveguide flanges.

DELIVERY IN 90 DAYS

BOOTHS #1255 & 1256, WESCON SHOW

## FREQUENCY STANDARDS, INC.

A DIVISION OF

NATIONAL ELECTRIC PRODUCTS CORP.

P. O. BOX 504, ASBURY PARK, N. J.

Telephone: PRospect 4-0500

TWX A PK 588

CIRCLE 57 ON READER-SERVICE CARD

*One pot's  
answer to  
tough requirements*



**5,000,000**  
cycle life

**2,000**  
cycle vibration  
at 30 g's



*just two characteristics  
resulting from patented*

# dynamic balance"

Precision potentiometers capable of living up to toughest circuitry demands! Built-in immunity to extremes of vibration, shock and acceleration... and finest quality materials assure maximum precision, exceptionally long life. A new concept proved in both military and commercial applications. Available from 7/8" to 3".

#### THIS IS KINTRONIC'S DYNAMIC BALANCE

arm is dynamically balanced on shaft

contact assembly is dynamically balanced on arm



#### Precision single turn potentiometers featuring:

- Linear or functional windings — 0.1% standard linearity
- Rotational speeds to 3,500 R.P.M.
- 165°C standard... 225°C special
- Ball bearings, class 7 stainless
- No hygroscopic... no fungus supporting materials
- NAS 710, procedure III

*Write for complete specifications of the "1,000 Series" Apply the inimitable performance of Dynamic Balance precision potentiometers to your project.*



Division of  
Chicago Aerial Industries, Inc

10265 Franklin Avenue • Franklin Park, Illinois

CIRCLE 119 ON READER-SERVICE CARD

## NEW PRODUCTS

### Voltage Regulated Power Supply Range of 0 to 18 v, 0 to 0.5 amp.



The transistorized Model SC-18-0.5 delivers 0 to 18 v, 0 to 0.5 amp. Regulation for line or load is less than 0.1 per cent or 0.003 v, whichever is greater. Ripple is less than 1 mv rms. Recovery time is less than 50  $\mu$ sec. Stability for 8 hr is less than 0.1 per cent of 0.003 v, whichever is greater.

Kepeco Labs, Inc., Dept. ED, 131-38 Sanford Ave., Flushing 55, N.Y.

CIRCLE 120 ON READER-SERVICE CARD

### Decade Amplifier Permits ac and dc coupling

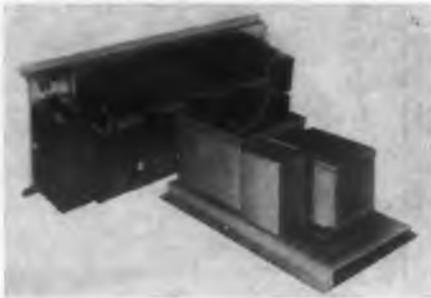


The frequency response of the Model 201 decade amplifier is flat within  $\pm 2$  per cent dc to 100 kc, and 1 db to 500 kc. Its input impedance dc-coupled is 400 K shunted by 30  $\mu$ f; output impedance is nominally less than 100 ohms. It is a gain of 10, and its equivalent noise level is less than 20  $\mu$ v.

Quan-Tech Labs., Dept. ED, Morristown, N.J.

CIRCLE 121 ON READER-SERVICE CARD

### Line Voltage Regulators Recovery time of 35 msec



The eight standard models range from 0.5 kva to 2 kva and are available in two grades of

## NEW GENERAL ELECTRIC BEAD SIZE THERMISTORS



New G-E "Bead Size" Thermistors —  
D-054 (1000 ohms at 25° C) and  
D-051 (20,000 ohms at 25° C)

### BETTER TOLERANCES ... FOR LESS COST

G.E.'s new "bead size" D-050 series thermistors are available with resistances from 1,000-20,000 ohms at 25° C. These .05-inch diameter disc thermistors provide lower thermal time constants and are available for 250° C maximum operating temperature (standard, 150° C). You can buy them economically with resistance tolerances of only  $\pm 5\%$  (standard,  $\pm 10\%$ ).

### NEW THERMISTOR MATERIALS

Extensive research has added many new thermistor materials to the G-E line. These can now be used in a wide variety of design applications not previously covered by grade 1 and 2 materials.

### COMPLETE RESISTANCE RANGE

G-E thermistors can be supplied in sizes from .05 up to 3 inches with resistance values from 1 to 10,000,000 ohms, and temperature coefficients of resistance from  $-1\%$  to  $-5\%$  at 25° C. For more technical information or the assistance of a G-E engineer, write: *Magnetic Materials Section, General Electric Company, 7820 N. Neff Street, Edmore, Michigan.*

*Progress Is Our Most Important Product*

**GENERAL ELECTRIC**

CIRCLE 122 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 20, 1958

MIL-T-27A. The output is kept within  $\pm 1$  per cent of 115 v, 60 cps, with an input range of 100 to 150 v, 60 cps, and load variations of 0 to 100 per cent. The recovery time to the  $\pm 1$  per cent region after a 10 per cent line step or a 25 per cent load step is less than 35 msec.

NJE Corp., Dept. ED, 345 Carnegie Ave., Kenilworth, N.J.

CIRCLE 123 ON READER-SERVICE CARD

### Ferrite Load Isolator

Gives 15 db isolation



Used to provide isolation between a microwave source and its load, model XL157 ferrite isolator removes the reactive loading effect caused by long transmission lines or the frequency pulling of magnetron or klystron. Operable over the band 8.5 to 9.6 kmc, it gives 15 db isolation with an insertion loss of 0.5 db.

Cascade Research, Div. of Monogram Precision Industries, Inc., Dept. ED, Los Gatos, Calif.

CIRCLE 124 ON READER-SERVICE CARD

### Metal Bellows

Wall thinness down to 0.0008 in.



These flexible metal bellows range from 1 to 0.125 in. O.D. and come in any wall thinness down to 0.0008 in. The metal is a nickel alloy of high tensile strength and low hysteresis with resistance to corrosion and temperature.

Servometer Corp., Dept. ED, P.O. Box 42, Clifton, N.J.

CIRCLE 125 ON READER-SERVICE CARD



capillary tubing



platinum wire



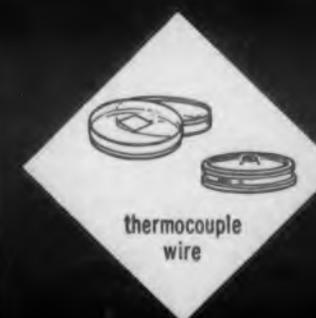
clad metals

*Build Quality  
in Your Line  
with*

**BISHOP  
TUBING  
AND  
PLATINUM  
PRODUCTS**



glass-to-metal  
sealing  
alloys



thermocouple  
wire



tubing



tubular  
fabricated  
parts



composite  
wires



platinum  
contacts,  
discs

Quality begets quality — it's an established axiom that premium products must begin with quality components. BISHOP has been producing platinum and precious metal products since 1842 . . . precision stainless steel tubing since 1931. The BISHOP family of metal products includes a broad variety of components for the designer, engineer . . . just to mention a few:

**Capillary Tubing**—standard and special sizes

**Platinum & Platinum Alloy Wire**—#50 to #3 B&S Gauge

**Clad Metals**—base and precious metals in various combinations

**Glass-To-Metal Sealing Alloys**—low expansion alloys

**Thermocouples**—noble metal and noble metal alloys

**Tubing**—nickel, stainless, platinum, special alloys

**Tubular Fabricated Parts**—all varieties

**Composite Wires**—base and precious metals in various combinations

**Platinum Tubing, Contacts, Discs**

CATALOGS, DATA SHEETS SENT PROMPTLY ON REQUEST

Begin your next design with *unexcelled* quality BISHOP component materials. Write, wire or phone Malvern 3100.

"Metals for Precision  
and Performance"



**J. BISHOP & CO.**

*platinum works*

MALVERN, PENNSYLVANIA

CIRCLE 126 ON READER-SERVICE CARD

From General Electric . . .

## PLAIN TALK ON TANTALYTIC\* CAPACITOR AVAILABILITY

It's time for plain talk on the facts of tantalum electrolytic capacitor availability. There is no "availability" problem as far as General Electric is concerned.

Here's why:

- No metal shortage—Stocks of capacitor-grade tantalum have doubled within the past year.
- No production capability shortage—General Electric's production facilities have tripled in the past year.
- No delivery bottlenecks—General Electric's improved manufacturing processes and techniques have virtually eliminated production rescheduling.
- Few military directive priorities—Since the supply of Tantalitic capacitors has met demand, the military requirements can be met without directive priorities.

This is why we say—now and in the future, General Electric will continue to provide Tantalitic capacitors in the types and ratings you want—when you want them.

For specific information on Tantalitic capacitor ratings, prices, deliveries, contact your nearest General Electric Apparatus Sales Office or write to General Electric Co., Section 449-4, Schenectady 5, N. Y.

\*Registered trade-mark  
of General Electric Co.

\*\*Trade-mark of  
General Electric Co.

**SOLID TANTALYTIC CAPACITORS**  
—for transistorized circuit applications—rated up to 60 volts, polar units only—sizes down to 0.125 inches by 0.250 inches.

**125C TANTALYTIC CAPACITORS**—for aircraft electronic systems—ratings 10-180 mfd, 30 to 100 volts. Sizes 1/2 to 1 1/8 inches in height. Also tubular, double-cased units.

**KSR\*\* TANTALYTIC CAPACITORS**—for missiles, radar, airborne electronic equipment applications—ratings up to 3500 mfd—three case sizes 1.375, 2, 2.5 inches in height.

**85C TANTALYTIC CAPACITORS**  
—for applications requiring high quality but where temperatures are less severe.

GENERAL  ELECTRIC

CIRCLE 86 ON READER-SERVICE CARD

## NEW PRODUCTS

### Cable Tester Self-programming



The SPACE self-programming automatic cable evaluator checks for leakage and continuity between wire ends of a cable harness. Using a computer type memory, it performs up to 10 tests per second and can generate its own tape program.

James Cunningham, Son & Co., Inc., Dept. ED,  
P.O. Box 516, Zone 2, Rochester 8, N.Y.

CIRCLE 87 ON READER-SERVICE CARD

### Rotator

Actuates large stabilized platforms

Torquer model ARTQ-1 actuates large stabilized platforms mounting heavy aerial cameras, infrared devices, and radar antennas. It is capable of high altitude continuous performance in ambient temperature of 130 C. The rotator develops torques up to 15 in. lb at a torquer weight of 6 lb.

The Aeroflex Corp., Aeroflex Labs Div., Dept. ED, 34-06 Skillman Ave., Long Island City 1, N.Y.

CIRCLE 88 ON READER-SERVICE CARD



### Potentiometer

Low torque

Model HP-151 is a miniature, low torque 15-turn unit with standard resistance values from 50 ohms to 150 K. Linearity can be held to 0.05 per cent. The unit dissipates 4 w at 40 C and stands shock, vibration, acceleration, and temperatures from -65 to +85 C.

Hub-Pot Inc., Dept. ED, 1242 E. Transit St., Pomona, Calif.

CIRCLE 89 ON READER-SERVICE CARD

Two-coil miniature  
interlock relay  
reduced  
in size...



to meet  
tough  
size limitations!

TYPE 117

Designed to meet rigid space requirements, this compact two-coil interlock relay takes less space than any previously available models. A single impulse to one coil will mechanically latch it into a closed position holding until the second coil is energized and mechanically locked into position. Only 1 3/8" x 1 1/8" x 2 1/8" high . . . available up to DPDT. Contacts are .090" diameter silver, palladium, or gold alloy rated up to 3 amps. Coil: tested for 1,000 V RMS Breakdown. +85°C maximum temperature insulation standard. Insulation: NEMA grade XXXP Phenolic or Melamine. High temperature insulation available on special order. For complete information on this Miniature two-coil interlock relay write for descriptive data sheet.

Need relays?  
ask



AEMCO offers a complete line of relays in a wide choice of spring and coil combinations, operating potentials, and contact ratings. If one of hundreds of standard AEMCO relay types does not exactly meet your requirements, we will be happy to design and manufacture a unit to meet or exceed your requirements.

AEMCO also manufactures a complete line of Sequence and Automatic Re-Set Timers, Time Switches and Sign Flashers.

WRITE TODAY

Your inquiries are invited. Ask for your free copy of Relay Catalog describing all standard relays in the AEMCO line.



INCORPORATED

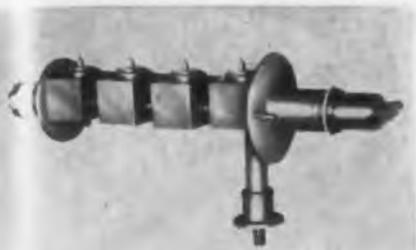
State St. • Menkato, Minn.

CIRCLE 90 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 20, 1958

## Amplifier Klystron

Delivers 10 kw



The VA-833A Klystron delivers in excess of 10 kw over a 1.4/1 range of frequencies from 685 to 985 mc. The conversion efficiency ranges up to 50 per cent and power gain ranges from 40 to 60 db.

Varian Associates, Tube Div., Dept. ED, 611 Hansen Way, Palo Alto, Calif.

CIRCLE 91 ON READER-SERVICE CARD

## Servomotor

Full speed in 0.004 sec

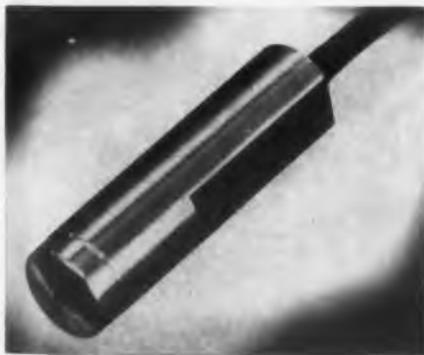
Model M-100 servomotor reaches full speed of 1450 rpm in 0.004 sec. Can be wound for Class H for transistor operation.

Dynamic Instrument Corp., Dept. ED, 59 New York Ave., Westbury, New York.

CIRCLE 93 ON READER-SERVICE CARD

## Magnetic Memory Drums

200 bits per in.



The OL-12-E features balanced low impedance windings, low record current, and high playback voltage for use with transistorized circuits. Bit densities of up to 200 bits per in., at 1 mil spacing, read and record information at high frequencies.

Midwestern Instruments, Data Storage Devices Div., Dept. ED, P.O. Box 7186, Tulsa, Okla.

CIRCLE 92 ON READER-SERVICE CARD



GUARANTEED FOR FIVE YEARS



# New LAMBDA L-T TRANSISTORIZED POWER SUPPLIES

## CONVECTION COOLED

No internal blowers • No moving parts

0-32 VDC 0-2 AMP

Introduced at the 1958 I.R.E. Show

Model LT 2095 \$365  
Model LT 2095M (metered) \$395

- Ambient 50° C at full rating.
- High efficiency radiator heat sinks.
- Silicon rectifier.
- 50-400 cycles input.
- Special, high-purity foil, long-life electrolytics.
- Compact. Only 3½" panel height.
- Short-circuit proof.
- Protected by magnetic circuit breakers.
- Hermetically-sealed transformer. Designed to MIL-T27A.
- All transistor. No tubes.
- Fast transient response.
- Excess ambient thermal protection.
- Excellent regulation. Low output impedance. Low ripple.
- Remote sensing and DC vernier.

### CONDENSED DATA\*

Voltage Bands . . . 0-8, 8-16, 16-24, 24-32 VDC

Line Regulation . . . Better than 0.15 per cent or 20 millivolts (whichever is greater). For input variations from 105-125 VAC.

Load Regulation . . . Better than 0.15 per cent or 20 millivolts (whichever is greater). For load variations from 0 to full load.

AC Input . . . . . 105-125 VAC, 50-400 CPS

\* Preliminary and tentative specifications

Electrical Overload Protection . . . Magnetic circuit breaker, front panel mounted. Unit cannot be injured by short circuit or overload.

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

Size . . . . . 3½" H x 19" W x 14⅝" D.

Send for complete LAMBDA L-T data.

See us at Booths 842-843  
WESCON Show



## LAMBDA Electronics Corp.

11-11 131 STREET • COLLEGE POINT 56, NEW YORK  
INDEPENDENCE 1-8500 Cable Address: Lambdatron, New York

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**new and unique!**



**Eliminate  
Breadboard Layout!  
SPEED DESIGN OF TRANSISTOR CIRCUITS  
With the SPRAGUE TRANSIMULATOR**

Bring transistor circuits to life in a matter of minutes with the Sprague LF-1 Transimulator. This new instrument lets you simulate any amplifier stage, a-c or direct-coupled, short of high power audio output; also multivibrator, switching, phasing, push-pull, Class A and B, and many others using cross-coupled Transimulators . . . whether the circuit is common or grounded emitter, base, or collector . . . whether the transistors are PNP, NPN, or Surface Barrier. You can simulate circuits stage-by-stage for cascade operation . . . or use a separate Transimulator for each stage to get simultaneous multi-stage operation.

**Bring Circuit Diagrams To Life In Minutes**

Everything you need for RC amplifier circuits is built right into the LF-1, including coupling capacitors . . . bias and load resistors . . . battery voltage supplies . . . Base Collector—Voltage Divider stabilization circuits . . . 5-way binding posts for transformer coupling and metering.

Whether you're designing audio circuits or switching circuits, you'll get a true picture of operating parameters minutes after you've drawn the circuit diagram . . . without wasting valuable time with breadboard and soldering gun.

**Pays For Itself In A Matter Of Weeks**

An ideal laboratory instrument, Transimulators are inexpensive enough to justify several on every bench. You can even use the LF-1 to test transistors *in the circuit* . . . the only real proof of design parameters. And a complete step-by-step instruction manual makes operation fast, simple, and easy.

**FEATURES OF THE LF-1 TRANSIMULATOR**

- TRANSISTORS—PNP and NPN Junction, and Surface Barrier.
- CIRCUITS—Common or Grounded Emitter, Base, Collector.
- RANGE—Audio, up to 100 kc.
- TRANSISTOR POWER—Through medium power audio output.
- BATTERY SUPPLY—Separate bias and load. 1.5, 3, 4.5, 6 volts d-c. Polarity Reversing Switch.
- COUPLING—2  $\mu$ f and 20  $\mu$ f Direct, and Ext. C. posts, on both Input and Output.
- BIAS RESISTANCE—Up to 555,000 ohms continuously variable.
- LOAD RESISTANCE—Up to 277,500 ohms continuously variable.
- EMITTER RESISTANCE—Up to 2,500 ohms variable. Series resistor and bypass capacitor can be added.
- BASE COLLECTOR STABILITY—Up to 250,000 ohms variable. Series resistor and bypass capacitor can be added.
- VOLTAGE DIVIDER STABILITY—Up to 50,000 ohms variable.
- 5-WAY BINDING POSTS—For meters, transformer coupling, external supply voltage, degeneration, bypass, coupling, signal input and output, almost any connection required.

**only \$79.50  
NET**

**SPRAGUE**

SPRAGUE PRODUCTS COMPANY, NORTH ADAMS, MASSACHUSETTS

CIRCLE 73 ON READER-SERVICE CARD

**NEW PRODUCTS**

**Transistorized Preamplifiers**

Provide 20 db gain



Light, rugged, waterproof, and easily connected, N-110 and N-120 transistorized preamplifiers provide 20 db gain. Input impedance is 1 meg; output impedance, 600 ohms; equivalent input noise, 10  $\mu$ v. Frequency response is 100 cps to 80 kc.

Chesapeake Instrument Corp., Dept. ED, Shadyside, Md.

CIRCLE 74 ON READER-SERVICE CARD

**Silicon Diode Package**

Forward currents to 400 ma



This single silicon diode package offers protection against extremes and is qualified per MIL-T-5422C. It has forward current ratings up to 400 ma, and inverse voltage ratings up to 600 v.

Master Specialties Co., Dept. ED, 956 E. 108th St., Los Angeles 59, Calif.

CIRCLE 75 ON READER-SERVICE CARD

**Explosive Bolts**

For missile use



Explosive bolts and bolt cartridges, both fragmenting and non-fragmenting. They consist of special or standard bolts with provisions for integral or separately installed high explosive charge. Applications include multi-stage sepa-

ELECTRONIC DESIGN • August 20, 1958

ration, nose cone separation, missile launcher release, rocket sled release, and jettisoning of special devices.

McCormick Selph Associates, Dept. ED, Hollister, Calif.

CIRCLE 76 ON READER-SERVICE CARD

## Germanium Diodes

0.9 and 0.6  $\mu$ sec switching



Germanium diode S570G has a 0.9  $\mu$ sec switching time. It has a stored charge, after a 10 ma forward current, smaller than that of a 3  $\mu$ f capacitor at 6 v. The S555G diode is specified at 6  $\mu$ sec and offers better dc characteristics.

Transitron Electronic Corp., Dept. ED, Wakefield, Mass.

CIRCLE 77 ON READER-SERVICE CARD

## Transistorized Power Supplies

Have microsecond transient response



A line of transistorized, precision laboratory power supplies with microsecond transient response. Shown is model 0-50-2 for 115 v ac, 60 cps input. In this model output is 0 to 50 v dc, continuously variable with resolution of 2 mv; voltage regulation is better than 1 mv for input variations. Other models range from 300 ma to 20 amp. All have constant current short protection and external sensing.

Transistor Applications Co., Dept. ED, 859 E. Alosta, Glendora, Calif.

CIRCLE 78 ON READER-SERVICE CARD

NOW.. CLEVITE brings you:

A NEW HIGH in  
POWER TRANSISTORS..  
65 WATT - 13 AMP



Available now in the proposed JETEC power transistor package, new Clevite germanium PNP high power transistors introduce new design concepts into switching, power conversion, voltage regulation and similar high-current applications.

### FACTS TO REMEMBER

- Four new numbers: CTP 1511, 1512, 1513, 1514
- Tested to eliminate transient voltage breakdown
- Current gain: 60-120 at 5 amps; 50 at 10 amps
- Collector to base breakdown voltage: 40, 60, 80, 100 v
- 13 amps switching
- Design: ring emitter
- Standard package: plug in, diamond outline, hermetic seal
- Thermal resistance: less than 1° C/watt
- Controlled beta range: 2:1 at 5 amps

**CLEVITE**  
**TRANSISTOR PRODUCTS**

241 Crescent St., Waltham 54, Mass. TWinbrook 4-9339

A DIVISION OF



OTHER CLEVITE DIVISIONS: Cleveland Graphite Bronze • Brush Instruments • Clevite Electronic Components • Clevite Harris Products • Clevite Ltd • Clevite Ordnance • Clevite Research Center • Intermetall G.m.b.H.

### Technical Data

CTP - 1511, CTP - 1512, CTP - 1513, CTP - 1514

Absolute Maximum Ratings

Collector Current = 13 amps

Junction Temperature = 90° C

Total Power Dissipation @ 70° Mounting Base Temp. = 20 watts

### ELECTRICAL CHARACTERISTICS @ 25° C

Test	Conditions	Symbol	CTP 1511	CTP 1512	CTP 1513	CTP 1514
Collector to Base Voltage (IE = 0)	ICBO = 15 mA	BVCBO	100 V (min)	80 V (min)	60 V (min)	40 V (min)
Collector to Emitter Breakdown Voltage	VBE = 0V IC = 1000 mA	BVCES	75 V (min)	60 V (min)	40 V (min)	30 V (min)
DC Current Gain	IC = 5.0 A VCE = -2.0 V	hFE	80-120	60-120	60-120	60-120
Saturation Voltage	IC = 12 A IB = 2000 mA	VCE(sat)	1.5 V (max)	1.5 V (max)	1.5 V (max)	1.5 V (max)
DC Current Gain	IC = 10.0 A VCE = -2.0 V	hFE	35 (min)	35 (min)	35 (min)	35 (min)
DC Transconductance	IC = 10.0 A VCE = -2.0 V	GFE	5.0mbos (min)	5.0mbos (min)	5.0mbos (min)	5.0mbos (min)

CIRCLE 79 ON READER-SERVICE CARD

# Vitramon<sup>®</sup> CAPACITORS PROVED

Up To 12 Times  
More Reliable Than  
Mil Specifications

*all*

"VITRAMON" Capacitors ordered under HIGH RELIABILITY SPECIFICATION S-1002 have a proven A.Q.L. 12 times higher than Mil Specifications. Every six weeks, very stringent qualification tests are performed — ENCOMPASSING 300,000 UNIT HOURS OF LIFE AT 125°C. Every shipment against an S-1002 order is accompanied by tabulated results to verify extreme reliability.

Capacitors are processed only after lot-by-lot tests confirm highest quality. Each item under S-1002 receives final measurement of all critical parameters just before shipment and this data also is enclosed with the packing slip.

The high reliability of "VITRAMON" Capacitors is achieved by building inherent characteristics into the piece through the fusing of quality porcelain enamel and fine silver to produce a dense, homogeneous, truly monolithic unit that requires no case or hermetic seal. Quality control, including a LIFE TEST ON EVERY LOT, and rigid testing during and after manufacture assure near-perfect dependability.

"VITRAMON'S" High Reliability Specification S-1002, describing materials used, manufacturing process, as well as all tests and failure rates, is now available on request.

See Us at WESCON—Booth #1339

Vitramon<sup>®</sup>  
INCORPORATED

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NEW RADIAL SERIES

NEW PARALLEL SERIES

NEW CO AXIAL SERIES

Standard Axial Series and Axial Radial Series

CIRCLE 80 ON READER-SERVICE CARD

## NEW PRODUCTS

### Selenium Rectifier

Grain oriented



The selenium in these rectifiers has parallel grains. This structure allows higher current ratings for a given cell size. The rectifier is available in cell ratings of 18 to 36 v.

Vickers Inc., Electric Products Div., Dept. ED, 1815 Locust St., St. Louis, Mo.

CIRCLE 81 ON READER-SERVICE CARD

### L-C Tuners

Metallized glass



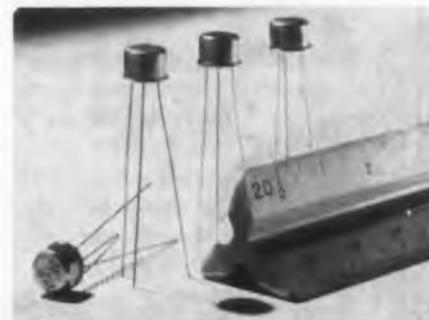
L-C tuners combine a variable inductance and a capacitor. The inductor winding, which doubles as capacitor plates, is metallized on a stable glass cylinder. A piston in the cylinder changes both inductance and capacitance.

JFD Electronics Corp., Dept. ED, 6101 16th Ave., Brooklyn 4, N.Y.

CIRCLE 82 ON READER-SERVICE CARD

### Switching Transistors

High frequency



Germanium high frequency switching transistors 2N425 through 2N428 feature the TO-9 package and are designed to MIL-T-19500A requirements.

Motorola Inc., Dept. ED, 4545 W. Augusta Blvd., Chicago 51, Ill.

CIRCLE 83 ON READER-SERVICE CARD

## TERMINAL BOARD RIVETER



HOPPER  
FEED!

VERSATILE!

TIMER  
CONTROL!

ADJUSTABLE  
IMPACT!

## NEW HILL SPIN RIVETER

CONSISTENT RESULTS!  
LOW MAINTENANCE!  
INCREASED PRODUCTION!



Turret terminals of various types and configurations may be hopper fed into the boards from the underside, thus allowing the operator a clear view of the riveting operation. The utilization of the spin rivet feature coupled with adjustable impact and timer control give consistent results. Cracking and splitting of terminals, particularly the stand-off and feed-thru types, has been virtually eliminated.

SEND SAMPLES FOR RIVETING  
HILL MACHINE COMPANY

1309 EDDY AVE., ROCKFORD, ILL.

Representatives in Principal Cities

CIRCLE 84 ON READER-SERVICE CARD

## Vought Vocabulary

# re-lent'less: *a missile that pierces hostile sky to pinpoint its nuclear strike*

When a target's latitude and longitude are marked on this missile's brain, an appointment has been made.

To keep its rendezvous, the Chance Vought *Regulus II* performs miracles of navigation: it will launch stealthily from submarines — nuclear and conventional — from surface craft and mobile shore launchers. It will compensate automatically for wind and weather and for the earth's rotation. It will detour enemy strongpoints, outfox known counterweapons. Closing in on its quarry, it can plummet from over 60,000 feet to smokestack height to escape radar detection.

In minutes, *Regulus II* can pierce over 1,000 miles of hostile sky to score a nuclear bull's-eye.

The first of the Navy's nuclear-driven subs, designed to roam the seas as unseen *Regulus II* bases, is now in construction. The missile itself has made over 25 successful flights. Under Navy leash in key locations, it will be a relentless watchdog for peace.

**Scientists and engineers: pioneer with Vought in new missile, manned aircraft, and electronics programs. For details on select openings write to: C. A. Besio, Supervisor, Engineering Personnel, Dept. W-2.**

CHANCE  
**VOUGHT AIRCRAFT**  
INCORPORATED DALLAS, TEXAS



## KEY ENGINEERING OPENINGS AT VOUGHT

### ELECTRONICS

Projects involve advanced guidance and control and fire control systems for missiles and high-performance manned aircraft. They begin with investigations and theory and progress through systemization and packaging to detailed hardware design. Key responsibilities await additional men who are qualified in these areas. Advanced degrees preferred.

**Stability and Control Engineer.** E.E., M.E., or A.E., with emphasis on flight stability and control problems or dynamics. (Special consideration given graduate study or extensive experience in transients or closed loop stability analysis.) To assist in design of autopilot and control systems for high-performance missiles and aircraft.

**Antenna Design Engineer.** E.E., or Physics Degree with demonstrated aptitude for antenna design. To join active projects involving design of flush-mounted, recessed and external antennas at all frequencies for very high-performance aircraft and missiles.

**Fire Control and Microwave Systems Engineer.** Requires E.E., or Physics Degree; at least 2 years experience in radar, data link, or fire control systems; and strong ability in this work.

**Test Equipment Engineer.** Requires E.E., or Physics Degree and at least 2 years experience in this or related field. (Desirable: broad background in electronics design with emphasis on digital computers or microwave systems.) To join in the design of complete checkout systems for missiles and associated subsystems.

**Reliability Analyst.** Requires M.E., Physics, E.E., or Math Degree; broad knowledge of electronic and mechanical systems; experience in operations research or reliability. Helpful: statistical methods experience.

**To arrange for a personal interview, or for a prompt report on these or other current openings, return coupon to:**

C. A. Besio  
Supervisor, Engineering Personnel  
CHANCE VOUGHT AIRCRAFT,  
Dallas, Texas Dept. W-2

I am a \_\_\_\_\_ Engineer,

interested in the opening for \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

CIRCLE 554 ON READER-SERVICE CARD

CIRCLE 85 ON READER-SERVICE CARD

# Westinghouse Roberts Test Technique Frees Reject-Strangled Production...

*Perfectly paired Hipermag cores  
boost magnetic amplifier output*



Mr. Cliff Horstman checks performance readings for Hipermag cores using the Roberts Dynamic Tester. This production-line test eliminates costly and complicated testing at your plant. After the Roberts test, Hipermag cores are "pegged" here according to their performance characteristics. This practice assures perfect performance-matching every time.

A very high reject ratio was strangling magnetic amplifier production at the plant of a large eastern manufacturer. Analyzed by the company's own engineers, the problem was found to be a case of inadequate core matching. A core-matching specification based on sine current dynamic testing was attempted. However, since the application was a voltage regulator using voltage reset, the problem of matching maximum permeability to the required tolerances was practically insurmountable for production-line testing.

After Westinghouse engineers analyzed the problem, it was decided that matching cores at zero control point with the Roberts tester would help obtain the desired high yields.

Production-run cores matched by this procedure were flown to the manufacturer from the Westinghouse Greenville plant. These cores resulted in an immediate improvement in production-line performance.

The Roberts core-matching technique provides the closest approach to magnetic amplifier design for commercial testing of cores that exists today. This testing technique on standard Hipermag cores provides performance tailored to your magnetic amplifier application.

Let our engineers help you with your magnetic amplifier production problems. Call your Westinghouse representative . . . or write Specialty Transformer Department, Westinghouse Electric Corporation, P.O. Box 231, Greenville, Pa.

<sup>®</sup>Trade-Mark

J-70873

YOU CAN BE SURE... IF IT'S **Westinghouse** 

CIRCLE 66 ON READER-SERVICE CARD

## NEW PRODUCTS

### Power Supply

28 v dc output



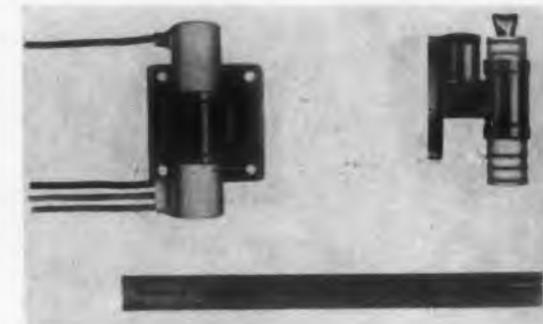
Power supply model M-1188 operates from an ac input of 120 v  $\pm$ 10 per cent, single phase, 60 cps and provides a regulated dc output of 28 v, adjustable 27.5 to 28.5 v. It has a current capacity of 0 to 5 amp, and voltage regulation accuracy is  $\pm$ 0.5 per cent for any combination of line and load changes within the foregoing range. Ripple is 1 per cent rms at room temperature, 2 per cent rms at  $-65$  F. Ambient temperature ranges of  $-65$  to  $+130$  F.

Perkin Engineering Corp., Dept. ED, 345 Kansas St., El Segundo, Calif.

CIRCLE 67 ON READER-SERVICE CARD

### Reflex Klystrons

For X, K, and C band



Two series of ceramic-metal reflex klystrons. The 1K20 models cover the 8500 to 11,700 mc range at output power levels to 50 mw. They withstand 15 g vibration with less than 100 kc frequency deviation. For use at any altitude, they are rated at 250 C seal temperature.

The 1K125C series cover the 3700 to 5000 mc frequency range, are capable of output powers to 2.3 w. They are tuned by an adjustable dielectric slug to minimize shock and vibration sensitivity.

Eitel-McCullough, Inc., Dept. ED, San Bruno, Calif.

CIRCLE 68 ON READER-SERVICE CARD



### Indicator

Calibrates transducers

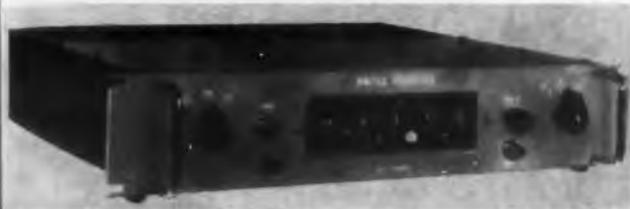
The ElectroSyn model 850 precision indicator offers a fast, accurate way to calibrate pressure instruments. Its two dials provide 1000 calibration marks about 0.1 in. apart.

Norwood Controls, Dept. ED, Norwood, Mass.

CIRCLE 69 ON READER-SERVICE CARD

### Digital Voltmeter

For ac or dc operation



Model 406 digital voltmeter measures ac voltages to 0.1 per cent. It also provides dc measurements within  $\pm 1$  digit. A switch selects ac or dc operation. Rack mounted and portable models available.

Zinn Instruments, Dept. ED, P.O. Box 733, Lomita, Calif.

CIRCLE 70 ON READER-SERVICE CARD



### Accelerometers

Single- and two-axis types

These accelerometers come in single- and two-axis units. Measurement range is  $\pm 10$  g adjustable upward within amplifier limits. Output scale factor is 5 ma per g of applied acceleration, linearity is within  $\pm 0.01$  per cent of applied acceleration, and the threshold is less than 0.00001 g.

Kearfott Co., Inc., Dept. ED, 1378 Main Ave., Clifton, N.J.

CIRCLE 71 ON READER-SERVICE CARD



## NEW HERMETICALLY SEALED HIPERMAG CORE PERMITS ENCAPSULATING, IMPREGNATING, OTHER PROCESSING ... WITH NO CHANGE IN MAGNETIC VALUES

Newest development in cores for magnetic amplifier applications is the Westinghouse Polyclad hermetically sealed Hipermag core.\* Polyclad insulation is applied over a new specially designed aluminum box housing the core. This hermetically seals the core and allows encapsulating, casting or impregnating—without altering magnetic properties . . . Eliminates magnetic amplifier rejects caused by changed magnetic values.

Tested for all environmental conditions, Polyclad insulation is suitable for high temperatures, protects against humidity and high-voltage stress, provides high insulation strength, with breakdown values up to 3000 volts.

Polyclad coating eliminates the need for core taping; makes possible reduced insulation cost. Rounded corners prevent shorting wire to core, allow winding directly on the core.

These cores are supplied in special sizes or in standard AIEE sizes, in one-, two-, or four-mil oriented nickel-iron alloy Hipernik® V and in one- or two-mil 4-79 Permalloy. Complete listing in Westinghouse publication 44-720.

Hermetically sealed Hipermag cores are available in production lots with normal delivery. All Hipermag cores are tested — by Roberts constant-current, flux reset technique, or to your specifications.

For more information about Polyclad hermetically sealed Hipermag cores and other Hipersil® or Hipermag cores, call your Westinghouse representative . . . or write Westinghouse Electric Corporation, P.O. Box 231, Greenville, Pennsylvania.

\*Patent applied for

J-70892

YOU CAN BE SURE...IF IT'S **Westinghouse**

CIRCLE 72 ON READER-SERVICE CARD

# REX

## TEFLON\* INSULATED WIRES AND CABLES

FOR HIGH TEMPERATURE APPLICATIONS — AND WITH UNEQUALLED ELECTRICAL AND MECHANICAL PROPERTIES.

Made to MIL-W-16878 specifications with either wrapped or extruded insulation, and with complete cabling facilities available to meet your exacting specifications.



### COMPARE THESE PERFORMANCE CHARACTERISTICS

	REX TYPE E	REX TYPE EE
Operating Temperature Continuous	200° C to -65° C	200° C to -65° C
Operating Voltage	600 volts RMS	1000 volts RMS
Spark Test	3000 volts RMS	4000 volts RMS
Dielectric Strength	2000 volts RMS	3000 volts RMS
Power Factor	.005 Max.	.005 Max.
Dielectric Constant	2.2 Max.	2.2 Max.
Insulation Resistance	>5000 meg/1000'	>5000 meg/1000'
Moisture Absorption	Nil	Nil
Flammability	Non flammable	Non flammable
Solvent Resistance	Unaffected by any commercial reagents	Unaffected by any commercial reagents

### CABLING IS A REX SPECIALTY



Complete design and cabling facilities are available to handle all cabling problems — efficiently, perfectly. The Rex reputation as the foremost specialist in designing and manufacturing cable justifies your complete confidence.

REX OFFERS YOU A COMPLETE LINE OF WIRE AND CABLE FROM ONE SOURCE WITH CENTRALLY LOCATED WAREHOUSES FOR FAST EFFICIENT SERVICE.

- Military Specification Wires
- Coaxial Cables
- Electronic Control System Wire and Cable
- Microwall Wire and Cable
- Communication Wires
- U.L. Wire plus specials of all types with a variety of insulations.



\*Teflon registered t.m. E. I. duPont de Nemours



Manufactured by

## THE REX CORPORATION

210 HAYWARD ROAD, WEST ACTON, MASS.

CIRCLE 95 ON READER-SERVICE CARD

## NEW PRODUCTS

### Trimming Potentiometer Rectilinear



Rectilinear trimming potentiometers, series RP-125, are 1-1/4 in. long. They meet MIL-R-19 specifications and come in a complete range of resistances. They have completely enclosed glass reinforced Alkyd housings.

DeJur-Amsco Corp., Dept. ED, 45-01 Northern Blvd., Long Island City 1, N.Y.

CIRCLE 96 ON READER-SERVICE CARD

### Tuning Fork Resonators

In frequencies from 400 to 2200 cps



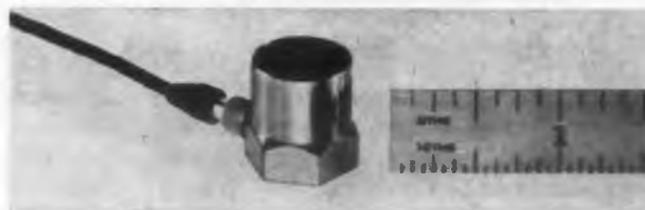
For operation with transistors or tubes, MJ series tuning fork resonators take 15 g 11 msec shock. In frequencies from 400 to 2200 cps, and in 0.01, 0.02, or 0.05 per cent accuracy ratings in -55 to +85 C range. Accuracies unaffected under 5 g vibration to 40 cps.

Philam Labs, Inc., Dept. ED, 90 Hopper St., Westbury, N.Y.

CIRCLE 97 ON READER-SERVICE CARD

### Accelerometer

Needs no impedance matching devices



Model 2215 accelerometer needs no impedance matching devices. The high capacitance of piezite element, 7000  $\mu\text{f}$ , provides a sufficient time



TYPE TJC FOR DC OPERATION VIDEO CONTACTS

Engineered specially for carrying video and other high frequency currents. Unusual flexibility of design permits a wide range of contact spring assemblies and combinations to be used. Fast operate, release and transfer time. Low interspring and spring-to-frame capacitance. Send for details.

# COMAR

ELECTRIC COMPANY  
3349 ADDISON ST., CHICAGO 18, ILL.

RELAYS • SOLENOIDS • COILS • SWITCHES • HERMETIC SEALING  
CIRCLE 98 ON READER-SERVICE CARD

## Miracles in Miniaturization

with MPB  
Pivot Bearings

For use with  
60° pivot cones

MPB pivot bearings make impossible miniaturizations possible . . . greatly improve others. Smaller than 1/8" O.D., these MPB bearings are designed to withstand conditions of extreme vibration and thrust. Low frictional torque. Available in 440 stainless steel, MPB pivot bearings are perfect where shock resistance and low torque are essential. Applications include inertial guidance systems, missile components, liquid and gas metering instruments, and data transmission systems. Radial, high speed, duplex, angular contact, and thrust bearings also available. Specials on request. For MPB catalog of over 500 types and sizes, write Miniature Precision Bearings, Inc., 908 Precision Park, Keene, New Hampshire.



Helps you perform miracles  
in miniaturization

CIRCLE 99 ON READER-SERVICE CARD

constant to give good low frequency response when fed into standard read-out devices with input impedances from 1 to 10 meg. The unit has 5 mv per g sensitivity and flat frequency response below 2 cps to above 10 kc. It is linear dynamically,  $\pm 1$  per cent, and useful from  $-300$  to  $+200$  F.

Endevco Corp., Dept. ED, 161 E. California St., Pasadena, Calif.

CIRCLE 103 ON READER-SERVICE CARD

## Linear Amplifier

Non-overloading type



These non-overloading type linear amplifiers feature building block design with each major section packaged as a plug-in element. In three models: LA-600A, a basic amplifier with about the same performance characteristics as ORNL DD-2; LA-600B, which includes an integral/differential pulse height selector offering 1  $\mu$ sec double pulse resolution; and LA-600C, a modification for use with the PA-400 multi-channel pulse height analyzer.

Eldorado Electronics, Dept. ED, 2821 10th St., Berkeley, Calif.

CIRCLE 104 ON READER-SERVICE CARD

## Fluttermeter

For adjustment of recorder drives



Instrument to measure flutter or wow inherent in a recorder drive mechanism. A pre-recorded nominal 1000 cps signal is played on tape or disc through the recorder being tested. As the speed variations modulate the frequency of this signal, the fluttermeter amplifies this band of frequencies. The output of a magnetic discriminator is metered as a percentage of variation of the 1000 cps signal.

Kay Electric Co., Dept. ED, Maple Ave., Pine Brook, N.J.

CIRCLE 105 ON READER-SERVICE CARD

## KEEP UP-TO-DATE ON MAGNETICS



## GUARANTEED TO WITHSTAND 1,000 VOLTS!

### GVB-finished tape wound core boxes drop your production costs

We have developed a radical new finish for aluminum boxes for tape wound cores. Your production department will glow with delight, for we guarantee this finish to withstand 1,000 volts (at 60 cycles) without taping!

GVB, for Guaranteed Voltage Breakdown (limits), is what we call this new finish. It is perfectly matched to our aluminum core boxes, for it will withstand temperatures from  $-70^{\circ}\text{F}$  to  $450^{\circ}\text{F}$ . Potting techniques need not change, for GVB-finish lives happily with standard potting compounds.

By eliminating the need for taping the core box, you also eliminate a time consuming production step. By combining GVB-finish with our aluminum core box, we assure you a core capable of being vacuum impregnated down to 20 mm. of mercury.

And they are Performance-Guaranteed! Like all tape wound cores from Magnetics, Inc., aluminum-boxed or phenolic-boxed, you buy them with performance guaranteed to

published limits. The maximum and minimum limits are for  $B_m$ ,  $B_r/B_m$ ,  $H_1$  and gain. This data is published for one, two, four and six mil Orthonol<sup>®</sup> and Hy Mu 80 tape cores.

GVB-finished cores are ready for you now. So are the published limits for all Magnetics, Inc. tape wound cores. Write today for more GVB details, and for your copy of the guaranteed performance limits: Dept. ED-51 Magnetics, Inc., Butler, Pennsylvania.

**MAGNETICS inc.**

CIRCLE 106 ON READER-SERVICE CARD

He's  
minding  
**YOUR**  
business



**YOUR HEART IS HIS BUSINESS.** He's a research scientist—one of thousands supported by the Heart Fund. His life is dedicated to finding the unknown causes of the heart diseases, and new methods of treating and preventing them. He and your Heart Association have made *your* heart their business.

**YOUR HEART IS YOUR BUSINESS.** Whatever your way of life, your future depends on your heart. Heart disease causes personal suffering and undermines the happiness and economic welfare of the family. No one—no child or adult—is immune.

**THE HEART FUND IS EVERYBODY'S BUSINESS.** When you support the Heart Fund, you help all hearts. You support heart research—and you make it possible for your Heart Association to bring the latest advances in heart research to you and your family through your doctor.

**Give Generously for Every Heart You Love**

HELP YOUR HEART FUND  HELP YOUR HEART

CIRCLE 107 ON READER-SERVICE CARD

## NEW PRODUCTS



### Switching Unit

For semiautomatic operation

This switching device is a modulation operated relay-carrier operated relay. For semiautomatic operation, it may be used in any suitable situation requiring a switching device actuated by radio or audio voltage.

Westronics, Inc., Dept. ED, 3605 McCart St., Ft. Worth, Tex.

CIRCLE 108 ON READER-SERVICE CARD

### Transformers

For transistor application

For use in transistor application, these hermetically sealed transformers are tapped to allow a 6 to 53 v dc range. Model H-94 range is 6 v dc, 3 amp to 50 v dc, 1.2 amp; H-95 range, 6 v dc, 7.5 amp to 50 v dc, 3 amp; and H-96 range, 6 v dc, 18 amp to 50 v dc, 7.5 amp.

United Transformer Corp., Dept. ED, 150 Varick St., New York 13, N.Y.

CIRCLE 109 ON READER-SERVICE CARD



### High-G Testing Unit

Tests live circuits

By the use of a slip ring assembly, this unit can test a component under live circuit conditions while it is being spun at high speeds. One unit produces a speed up to 15,000 rpm and creates a relative centrifugal force of 20,000 g.

International Equipment Co., Dept. ED, 1284 Soldiers Field Rd., Boston 35, Mass.

CIRCLE 110 ON READER-SERVICE CARD



### SPAGHETTI SLEEVING

MADE FROM

# TEFLON\*

is Carefully Inspected  
and Controlled  
Dimensionally!

● PF spaghetti sleeving made from Teflon\* is widely used for slip-on insulation, instrument tubing, bundle sheathing, medical tubing, pigtails and similar applications. It slips on easily, in long lengths up to 3 feet, can be used with tinned or bare wire rather than silvered and it wears longer. 25 sizes, 2 wall thicknesses, 10 colors in stock, 100% inspected and controlled dimensionally, are available, all with these important advantages:

- good dielectric strength (500 to 2000 volts/mil)
- lowest dielectric constant (2.0) and dissipation factor (0.0002) of any solid dielectric
- no change of electrical properties with temperature (-25°C to +250°C) or frequency (60 cycles to 100 mc)
- zero moisture absorption
- unaffected by any commercial chemical
- stress relieved for negligible shrinkage
- continuous service temperature of 250°C—intermittent to 300°C

Write, wire or call for further details and engineering assistance. Ask, too, for information on PF Teflon\* flexible tubing, heavy-walled tubing and rod stock.

**PENNSYLVANIA FLUOROCARBON CO., INC.**

1115 N. 38th Street, Phila. 4, Pa. EVergreen 6-0000

\*Teflon—DuPont trade name for Tetrafluoroethylene resin

CIRCLE 111 ON READER-SERVICE CARD

## Voltage Divider

$\pm 0.1$  per cent linearity

Type 85-A Rinco-Pot voltage divider has resistance accuracy of  $\pm 0.05$  per cent of full scale resistance,  $\pm 0.01$  per cent linearity, and 0.002 per cent resolution. Frequency range is dc to 10 kc; resistance value, 10 K.

Rinco, Inc., Dept. ED, 7962 S.E. Powell Blvd., Portland 6, Ore.

CIRCLE 112 ON READER-SERVICE CARD

**SNAP ACTION SWITCH.**—Hermetically sealed, precision SBS-100A Limit-Switch meets MIL-S-6743 specifications. For missile and other use.

Sealectric Switch and Relay Corp., Dept. ED, 6025 N. Keystone Ave., Chicago 30, Ill.

CIRCLE 113 ON READER-SERVICE CARD

**TEMPERATURE INDICATOR.**—In combination with Thermal-Ribbons, Thermal-Indicator gives direct reading of temperature. Has  $-100$  to  $+200$  C operating range.

Minco Products, Inc., Dept. ED, 740 Washington Ave. N., Minneapolis 1, Minn.

CIRCLE 114 ON READER-SERVICE CARD

**MOMENTARY ACTUATOR.**—A4-86 spdt switch for push-button application on panel mounting for instruments and components for ground support equipment.

Electrosnap Corp., Switch Div., Dept. ED, 4230 Lake St., Chicago 24, Ill.

CIRCLE 115 ON READER-SERVICE CARD

**POLYESTER FILM CAPACITORS.**—Filmit E hermetically-sealed, metal-clad capacitors are shorter in length, have improved capacitance vs temperature stability curve.

Sprague Electric Co., Dept. ED, 347 Marshall St., North Adams, Mass.

CIRCLE 116 ON READER-SERVICE CARD

**MULTIPLE VARIABLE RESISTOR.**—Model 5 miniature 0.25 w unit supplied with up to four resistors on single steatite base plate. Resistance range of 1000 ohms to 5 meg.

Centralab, Div. of Globe-Union Inc., Dept. ED, 900 E. Keefe Ave., Milwaukee 1, Wis.

CIRCLE 117 ON READER-SERVICE CARD

CIRCLE 118 ON READER-SERVICE CARD >

## A NEW BRAND IN THE WEST



SEE THESE PRODUCTS  
AND SERVICES OF  
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**WHITTAKER CONTROLS**—  
advanced fuel control, hydraulic and  
pneumatic valves for aircraft and  
industrial uses.



**WHITTAKER GYRO**—rate,  
floated rate, and free gyros, including  
the new spring driven gyro.



**BRUBAKER ELECTRONICS**—  
get the story on the nation's leader  
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precision data reduction equipment  
for large film and glass plates for  
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astronomy, and flight tests.



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**ENGINEERING SERVICES**—  
learn about our complete facility for  
reduction of missile flight test data.

## TELECOMPUTING CORPORATION

915 North Citrus Avenue, Los Angeles, California

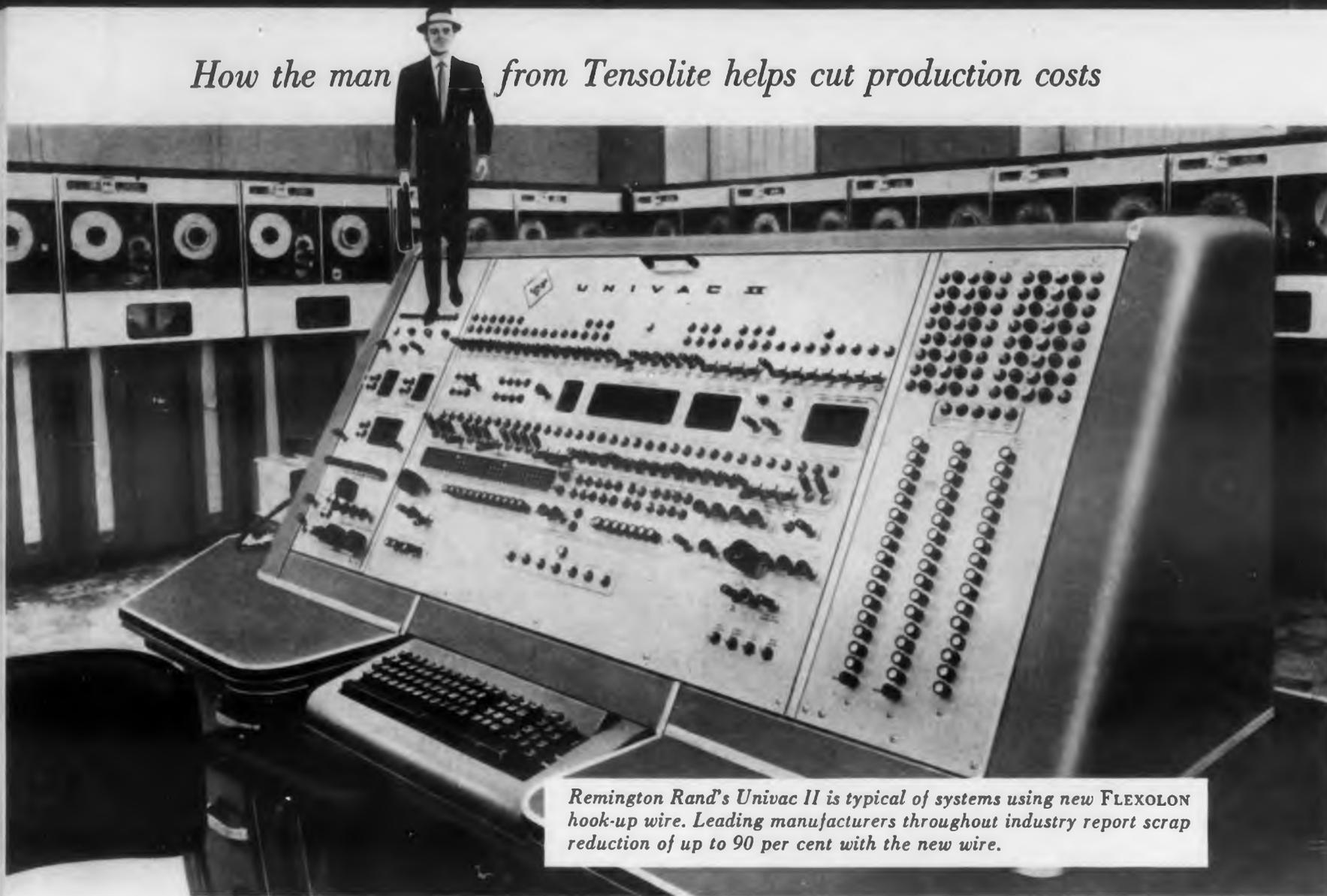
See, and get the facts on these products offered by Telco Electronic Sales Division: capacitors, microminiature relays, delay lines, switches, solenoids, and a complete family of magnetic amplifiers.

Specifically, look for Telco's new high temperature subminiature ceramic capacitor... operating temperature  $-55$  C to  $+155$  C... variation in capacity only  $\pm 10\%$  over entire temperature range... voltage rating 200 WVDC... these rugged, reliable capacitors, product of a brand new Telecomputing facility, serve a critical need in the electronics industry.

See Neuron, the high speed electromechanical counter at WESCON Booth No. 752.

WE'LL SEE YOU AT WESCON BOOTHS NO. 1718-19 AND 752

*How the man from Tensolite helps cut production costs*



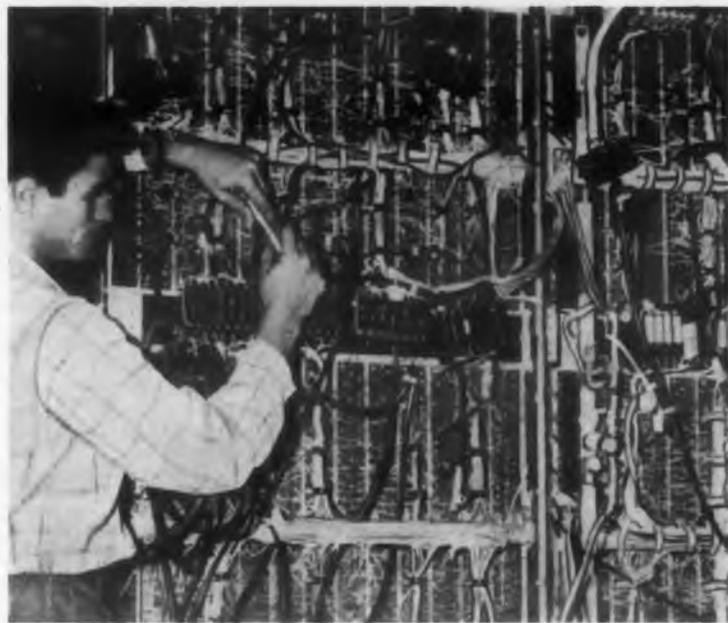
*Remington Rand's Univac II is typical of systems using new FLEXOLON hook-up wire. Leading manufacturers throughout industry report scrap reduction of up to 90 per cent with the new wire.*

## Guaranteed longer lengths of FLEXOLON high temperature wire reduce scrap at Remington Rand

Tensolite's FLEXOLON high temperature hook-up wire is setting new economy records throughout industry. For example, at Remington Rand where FLEXOLON wire is used in Univac II, the guaranteed 250-foot minimum length of FLEXOLON wire has drastically reduced wire scrap.

Securing long, economical lengths of wire has always been a major problem of the wire industry because of the occurrence of flaws in the dielectric material. With the revolutionary new technique utilized in FLEXOLON wire construction, flaws are greatly minimized and lengths are obtained that are far in excess of those produced by any other manufacturing process. Although a minimum 250-foot length is guaranteed, the average distribution of new FLEXOLON wire is approximately 750 feet, assuring even greater savings. Longer lengths of FLEXOLON wire will also cut your production costs by minimizing set-up time on automatic equipment.

To learn the many other benefits of FLEXOLON hook-up wire . . . its greater dielectric strength, extra flexibility, higher average concentricity . . . call the man from Tensolite. Or write for informative FLEXOLON hook-up wire bulletin.



*Univac engineer wires central computer with new FLEXOLON high temperature hook-up wire. Greater flexibility of the new wire also reduces wiring time.*

**Tensolite** INSULATED WIRE CO., INC.

West Main Street, Tarrytown, N. Y. • Pacific Division: 1516 N. Gardner St., Los Angeles, Calif.

FLEXOLON is a trademark of the Tensolite Insulated Wire Co., Inc.

## NEW PRODUCTS

### Potentiometers

$\pm 0.015$  and  $\pm 0.01$  per cent linearities

Two potentiometers. The MD 09-10, 7/8 in. in diameter, is a multi-turn unit with  $\pm 0.015$  per cent linearity, 0.0085 per cent resolution.

The MDH 20-10 is humidity resistant, packaged per MIL-E-5272A. The 10-turn unit has a 2-in. diameter and  $\pm 0.01$  per cent linearity.

Litton Industries, Components Div., Dept. ED, 5873 Rodeo Rd., Los Angeles 16, Calif.

CIRCLE 62 ON READER-SERVICE CARD

### Molded Transformer

At no mold charge



Epoxy molded with a partial tooling method, these custom-built transformers are supplied without mold charges. Alternate mounting by tabs, studs, or inserts. Units are designed to MIL-T-27A Grade 5 Class R and S; have 10,000 hr life.

Microtran Co., Inc., Dept. ED, 145 E. Mineola Ave., Valley Stream, N.Y.

CIRCLE 63 ON READER-SERVICE CARD

### Thyratron

Anode current of 2.5 amp dc

An argon-mercury vapor thyratron, the NL-710L has a lug base. Ratings are: filament volts, 2.5; filament current, 9 amp; anode current, 2.5 amp dc; peak anode current, 30 amp; and peak inverse and forward volts, 1500.

National Electronics, Inc., Dept. ED, Geneva, Ill.

CIRCLE 64 ON READER-SERVICE CARD

← CIRCLE 65 ON READER-SERVICE CARD

## Audio Oscillators

Furnish signals of 1 kc and 400 cps



PO-2 and CO-2 oscillators furnish audio signals of 1 kc and 400 cps at output levels of 0 and -60 db at an output impedance of 600 ohms. In the PO-2 output is available at two phone plugs; in the CO-2, at two clip leads.

Dunlap Electronics, Inc., Dept. ED, 764 Ninth St., Des Moines, Iowa.

CIRCLE 58 ON READER-SERVICE CARD

## Drift Transistors

For rf equipment

Types 2N247, 2N370, 2N371, and 2N372 germanium pnp drift transistors have good stability and minimum feedback capacitance. Designed for use in am broadcast band and short wave receivers, the units feature high gain at 1.5 mc to 20 mc, lower base resistance, and reduced collector capacitance.

Sylvania Electric Products Inc., Dept. ED, 1740 Broadway, New York 19, N.Y.

CIRCLE 59 ON READER-SERVICE CARD

## Integrating Gyros

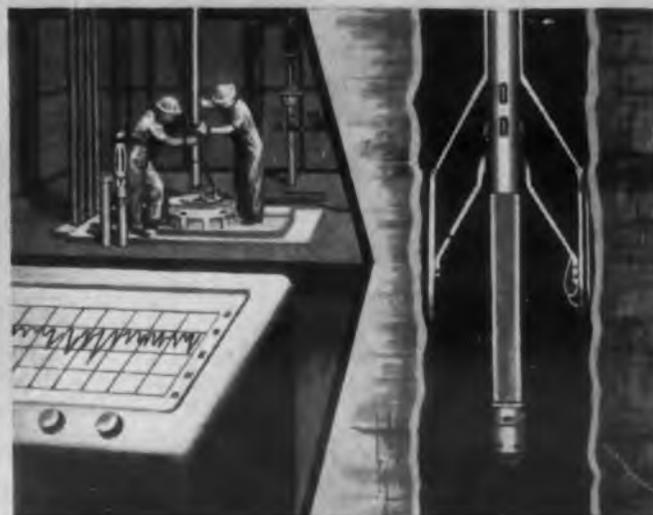
Fully floated



Trimmed drift rates of 0.1 deg per hour are guaranteed in this series of 20 IG single axis floated integrating gyros. Of fully floated construction, the gyros are contained within a housing 2 in. in diameter.

Reeves Instrument Corp., Dept. ED, Roosevelt Field, Garden City, N.Y.

CIRCLE 60 ON READER-SERVICE CARD



**INSTRUMENTATION**—In instrumentation, such as this geophysical measuring equipment, where miniaturization and resistance to environmental conditions are important, TFE resins are unsurpassed. They are unaffected by penetrating oils, heat, shock, vibration or resoldering; thermal and dielectric properties permit miniaturization, resulting in substantial space and weight saving.



**ELECTRONIC BUSINESS MACHINES**—Non-flammability, safe emergency overloading, and solder resistance are three important reasons why TFE resins are used in machines such as this data-processing equipment. Servicing of wiring panels can be done quickly, with a minimum of downtime, because TFE resins are unaffected by soldering temperatures.



**PROCESS CONTROL EQUIPMENT**—Process controls, instrumentation, and other industrial electronic equipment can be more reliable and more easily serviced at reduced costs with TFE resins. They have zero moisture absorption, are non-flammable, and are chemically inert. Neither potting temperatures nor soldering iron heat will damage TFE resins.



**OUTDOOR EQUIPMENT**—TFE resins are ideal for outdoor or underground wiring applications. They have unmatched insulation resistance, and are completely unaffected by exposure to salt water, sunlight, or other extremes of weather. Oil, gasoline, and other solvents have no effect on TFE resins, and they remain flexible in extremes of heat or cold.

## For top performance in electronic circuitry specify wire and cable insulated with TEFLON TFE-fluorocarbon resins

Achieve utmost reliability and safety for your wiring. Reduce assembly and inspection costs. Cut weight and space requirements. These are a few of the advantages being realized by the use of wire and cable insulated with TFE resins.

TFE resins are almost ideal dielectrics, because they combine outstanding electrical and mechanical properties. They do not age, are non-flammable, have great flex life, maintain superior tear resistance, and display excellent dielectric properties.

Best of all, you can enjoy sales and cost advantages by using wire protected by TEFLON TFE-fluorocarbon resins.

Look up your local supplier in the Yellow Pages (under "Plastics—Du Pont") . . . or for technical information write to: E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 188, Du Pont Building, Wilmington 98, Delaware.

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

► Write for the "HOTTEST STORY IN WIRE INSULATION." It gives you the facts that can help make your design, your product, your installation—a winner.



**TEFLON**<sup>®</sup>  
TFE-FLUOROCARBON RESINS

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

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

CIRCLE 61 ON READER-SERVICE CARD



## SILICON POWER RECTIFIERS



## APPLICATION GUIDE FOR SILICON RECTIFIERS ...

*If you work with rectifiers, this free design handbook will help you with your application problems.*

### PARTIAL CONTENTS

- Selection procedure and data.
- Seven typical, effective rectifier circuits and design factors for each.
- How to provide for transient loads, series operation, magnetic amplifier circuits, stacks.
- Curves on current ratings vs case temperature and current ratings vs air temperature.
- Electrical measurements.
- Rectifiers built to required specifications.

### MILITARY RELIABILITY

Four types of rectifiers that meet the MIL-E-1/1024, 989, 990 and 991 are fully described with curves and tables.

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**MICROWAVE ASSOCIATES, INC.**

BURLINGTON, MASSACHUSETTS • BRowning 2-3000

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## NEW PRODUCTS

### Power Supply

Multiple outputs



Output voltages for the model 308-B power supply as 0 to +600 v dc, -300 v dc, 0 to -150 v dc, and 6.3 v ac. For line voltage 115 v  $\pm 10$  per cent, dc regulated high voltage output has less than 50 mv change no load to full load at any output voltage.

Mercury Electronic Co., Dept. ED, Box 450, Red Bank, N.J.

CIRCLE 128 ON READER-SERVICE CARD

### Gearheads

For servo motors

Size 11 gearheads for BuOrd servo-motor MK 14 model 2. Planetary types with ratios up to 2500 to 1 with a torque rating of 25 oz in. and maximum backlash of 10 min. Over-all length is 0.800 in. Spur type gearheads are available with ratios up to 20,000 to 1.

U. S. Gear Corp., Dept. ED, 81 Bay State Rd., Wakefield, Mass.

CIRCLE 129 ON READER-SERVICE CARD

### Lamp

60,000 hour life expectancy



Burning continuously at 5 v, this lamp can be expected to last 60,000 hours or 7 years. It measures 1/8 to 1/4 in. in length. The lamp withstands voltage surges up to 30 v.

Chicago Miniature Lamp Works, Dept. ED, 1500 N. Ogden Ave., Chicago 10, Ill.

CIRCLE 130 ON READER-SERVICE CARD

## Here's Your... TUBING "KNOW-HOW" BOOK



### FACTS ON...

- HOW TO SELECT
- TEMPER...ALLOYS
- WORKING PROPERTIES
- TOLERANCES of TUBING

Here's a data book every engineer, purchaser and user of fine alloy tubing should have as a reference. Covers how to select tubing, the properties to look for, typical applications . . . tolerances, temper and alloys. Discusses drawing, annealing, finishing and testing. Gives range of sizes, length tolerances. Data on Bourdon tubing, pointer tubing and the exclusive Precision Coaxitube.

This booklet is available for use as a reference and buyer's guide to those sending requests on company letterheads to Dept. 7, Precision Tube Company, North Wales, Pa.

**GET YOUR COPY...  
NO CHARGE OR  
OBLIGATION!**



CIRCLE 131 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 20, 1958

## High Speed Commutator

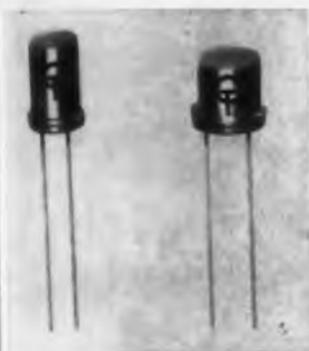
Takes 1200 samples per sec



The Type 33-514 high-speed commutator will sample up to 100 inputs at a rate of up to 1200 samples per sec. In effect, the commutator is an automatic, high-speed sp100t switch.

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

CIRCLE 132 ON READER-SERVICE CARD



## Precision Resistors

Tolerance of  $\pm 0.05$  per cent at 25 C

Packaged in two case styles, R-2 and R-5, these units range from 0.1 ohm to 750 K with a tolerance of  $\pm 0.05$  per cent at 25 C. The temperature range is  $-65$  to  $+125$  C. The power ratings of the R-2 and R-5 are 1/4 w and 1/3 w respectively.

General Transistor Corp., Dept. ED, 91-27 138th Place, Jamaica 35, N.Y.

CIRCLE 133 ON READER-SERVICE CARD



## AC Voltage Regulator

Contains adjustable outputs

Model 2501, 2.5 kv ac line voltage regulator has a regulation accuracy specified at  $\pm 0.01$  per cent. Other specifications include an input voltage range of 95 to 130 v at 55 to 65 cps; output voltage adjustable from 110 to 120 v ac; 3 per cent maximum distortion; power factor from unity to 0.7 lagging; and time constant of 0.2 sec.

Sorensen & Co., Inc., Dept. ED, Richards Ave., South Norwalk, Conn.

CIRCLE 134 ON READER-SERVICE CARD

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DESIGN

A HAYDEN Publication,

830 Third Avenue, New York 22, N. Y.

**H**ELIPOT's newest potentiometer... the single-turn, 1-1/16" A.I.A. diameter, all-metal series 5200... fends off 2,000 cps at 30G's, repels 10 cycles NAS 710, procedure III humidity, rides out 50G's shock and 100G's acceleration.

We're tough, too... on the 5200's mechanical tolerances. Register face, diameter and shaft runouts are all held to 0.001" max... spring-loaded shaft eliminates endplay.

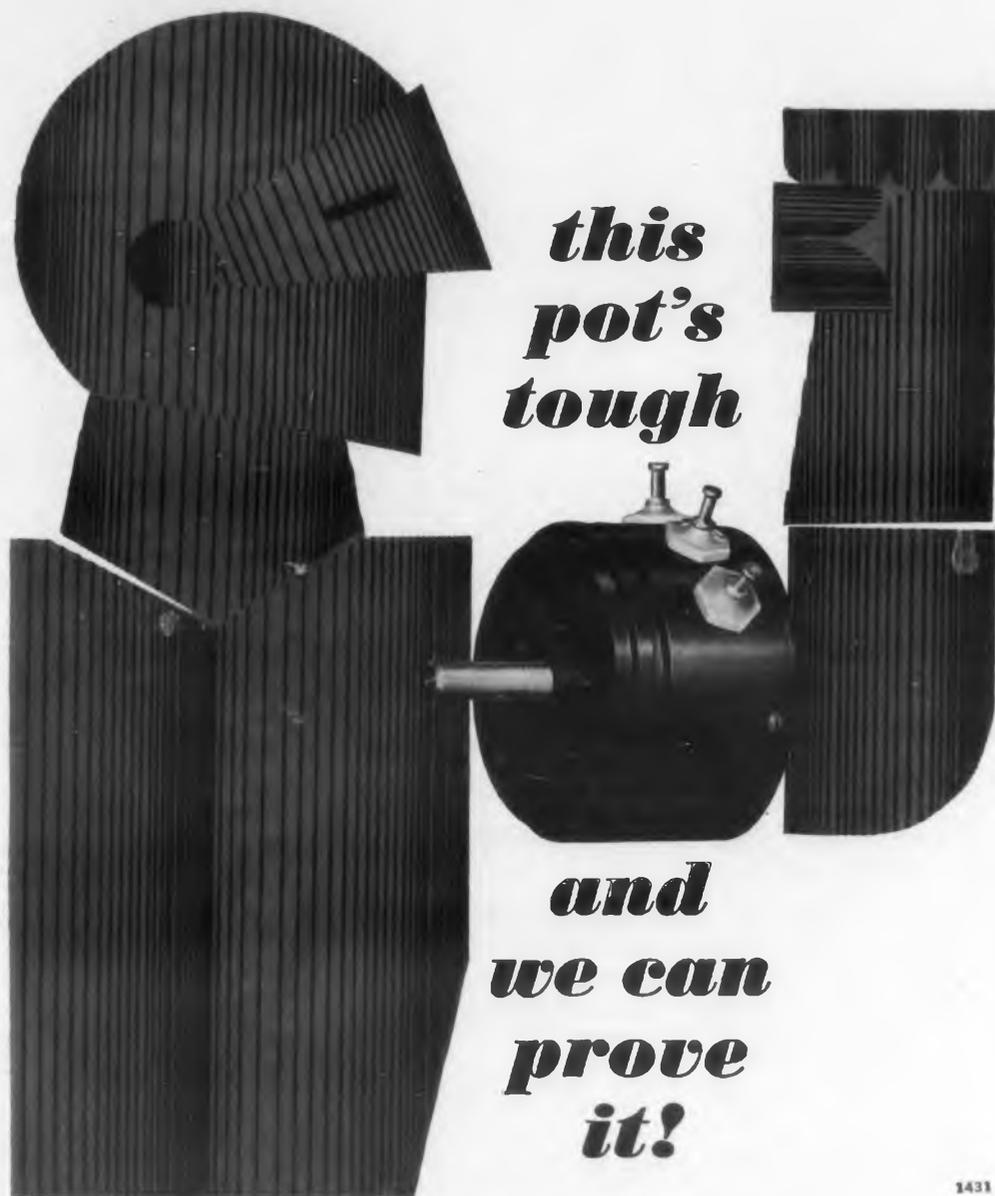
All this with linearity to  $\pm 0.15\%$ ... power rating of 3 watts at 100°C (derating to zero at 150°)... 250 to 100,000 ohms standard resistance range... and certified test data to prove our every claim.

What a pot for airborne applications... at a down-to-earth price! Write for data file C 82 for the proven facts.

**Beckman®** / **Helipot**

Helipot Corporation, Newport Beach, California  
a division of Beckman Instruments, Inc.  
Engineering representatives in 27 cities.

potentiometers... dials... delay lines...  
expanded scale meters...  
rotating components... breadboard parts



CIRCLE 136 ON READER-SERVICE CARD

1431

## NEW PRODUCTS

### Directional Coupler

Forward output of  $50 \pm 0.3$  db down



The model JP 400 mc precision coaxial directional coupler provides a forward output which is  $50 \pm 0.3$  db down from the forward power at center frequency. Reflected output is  $40 \pm 0.3$  db down from the reflected power.

Amtron Corp., Dept. ED, 17 Felton St., Waltham 54, Mass.

CIRCLE 137 ON READER-SERVICE CARD

### Mercury Diffusion Pump

Measures 2 in.

The MHG-40 is an all metal, 2-in. mercury diffusion pump with high limiting forepressure. The water cooled, 3-stage unit can maintain a speed of 40 liters of air per second in the  $3 \times 10^{-4}$  to  $2 \times 10^{-2}$  mm Hg pressure range with a peak of 52 liters per second at 10 microns.

Consolidated Electrodynamics Corp., Rochester Div., Dept. ED, 1775 Mt. Read Blvd., Rochester, N.Y.

CIRCLE 138 ON READER-SERVICE CARD

**TRANSFORMER.**—Reference type with guaranteed accuracy of  $\pm 10$  ppm at 400 cps. Encased in stainless steel.

Bush Transformer Corp., Dept. ED, 707 North St., Endicott, New York.

CIRCLE 139 ON READER-SERVICE CARD

**POWER TRANSISTOR.**—DT80 has an 80 v collector diode rating and offers a gain at 1.2 amp of 100. Gain spread is held to a two-to-one ratio.

General Motors Corp., Delco Radio Division, Dept. ED, 726 Santa Monica Blvd., Santa Monica, Calif.

CIRCLE 140 ON READER-SERVICE CARD

**LINEAR POSITIONER.**—Lineatrol is a gear motor which has a potentiometer to produce a remote indication of position or for use in automatic control circuits.

The Jordan Co., Inc., Dept. ED, 3235 W. Hampton Ave., Milwaukee 9, Wis.

CIRCLE 141 ON READER-SERVICE CARD



When you specify  
**CONNECTORS**

specify  
**Automatic**

Highest standards of quality. Modern high speed automatic machinery, and up-to-date production procedures, based on over 15 years experience in the manufacture of precision parts for the Army, Navy, Air Force and Atomic Energy Commission.

More and more companies in the electronics and telecommunications industries are specifying "Automatic's Connectors."

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WRITE, WIRE OR PHONE FOR FURTHER INFORMATION.

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METAL PRODUCTS CORP.

319 Barry Street, Brooklyn 11, N. Y. • EVERGREEN 8-0364

CIRCLE 142 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 20, 1958

**SERVO-HANGERS.**—Designed to mount most standard servo components, for both 60 cycle and 400 cycle systems. All necessary hardware is included with the hangers.

Reeves Instrument Corp., Commercial Products Division, Dept. ED, 207 E. 91st St., New York 28, N.Y.

**CIRCLE 143 ON READER-SERVICE CARD**

**CIRCUIT BREAKER.**—Protection for circuits from 1/2 to 3 amp. It measures 0.68 by 1.14 in. and projects 1.81 in. behind the panel.

Mechanical Products, Inc., Dept. ED, Jackson, Mich.

**CIRCLE 144 ON READER-SERVICE CARD**

**POWER SUPPLY.**—Model PS38A-1 supplies up to 4 amp at 28 v dc output (variable from 24 to 32 v).

Magnetic Controls Co., Dept. ED, 6405 Cambridge Ave., Minneapolis 26, Minn.

**CIRCLE 145 ON READER-SERVICE CARD**

**PRESSURE SWITCH.**—Will close or open contact at any preset absolute pressure in the range of 0.2 psia to 15.0 psia. Repeatability is 0.1 psia.

Aero Mechanism, Inc., Dept. ED, 8938 Lindblade St., Culver City, Calif.

**CIRCLE 146 ON READER-SERVICE CARD**

**SCALER.**—Model 132, features universal high-speed counting for use in medical and industrial research. Capacity of 99,999 counts indicated on five cold cathode Dekatron glow tubes.

Baird-Atomic, Inc., Dept. ED, 33 University Rd., Cambridge 38, Mass.

**CIRCLE 147 ON READER-SERVICE CARD**

**LOG CONVERTER.**—Accessory for the RCL 256-channel analyzer, Model 21006 precision converter gives logarithmic analog display on cathode ray tube or strip chart recorder.

Radiation Counter Labs, Inc., Dept. ED, Skokie, Ill.

**CIRCLE 148 ON READER-SERVICE CARD**

**INDICATOR LIGHTS.**—Series L5100 units contain two recessed rubber O rings that afford watertight fit. They mount in a 1/2 in. panel hole.

Hetherington, Inc., Dept. ED, Folcroft, Pa.

**CIRCLE 149 ON READER-SERVICE CARD**

**RELAY.**—The E420D 4pdt, 20 amp relay meets MIL-R-5757B and MIL-R-6106B requirements.

Electro-Mechanical Specialties Co., Inc., Dept. ED, 1016 N. Highland Ave., Los Angeles 38, Calif.

**CIRCLE 150 ON READER-SERVICE CARD**

**GRASSHOPPER FUSES.**—Designed to carry their rated capacity for ten minutes.

McGraw-Edison Co., Bussmann Mfg. Div., Dept. ED, University at Jefferson, St. Louis 7, Mo.

**CIRCLE 151 ON READER-SERVICE CARD**



## “S” is for Signal, Safety and Synthane



Typical pushers, machined from Synthane laminated plastics, used for railway signal relay.

Railroads can't even think in terms of failure. And that is why, among the many working parts that constitute railway signal relays, you find pushers made of Synthane laminated plastics.

These pushers, on which life itself depends, must in the words of one manufacturer have “excellent insulating characteristics—be durable and unchanging,” must “not chip, wear and thus leave residual dust or particles which would cause trouble if they should lodge on the electrical contacts.”

Synthane has all of these characteristics plus a combination of many

**CIRCLE 152 ON READER-SERVICE CARD**

other useful properties required for reliable performance. Equally important is the dependability of Synthane, the company, as a source of supply. You are urged to visit us and see for yourself the plant behind Synthane sheets, rods, tubes and fabricated parts—or to discuss this important point with our representative. Meanwhile, write for our new, complete catalog.

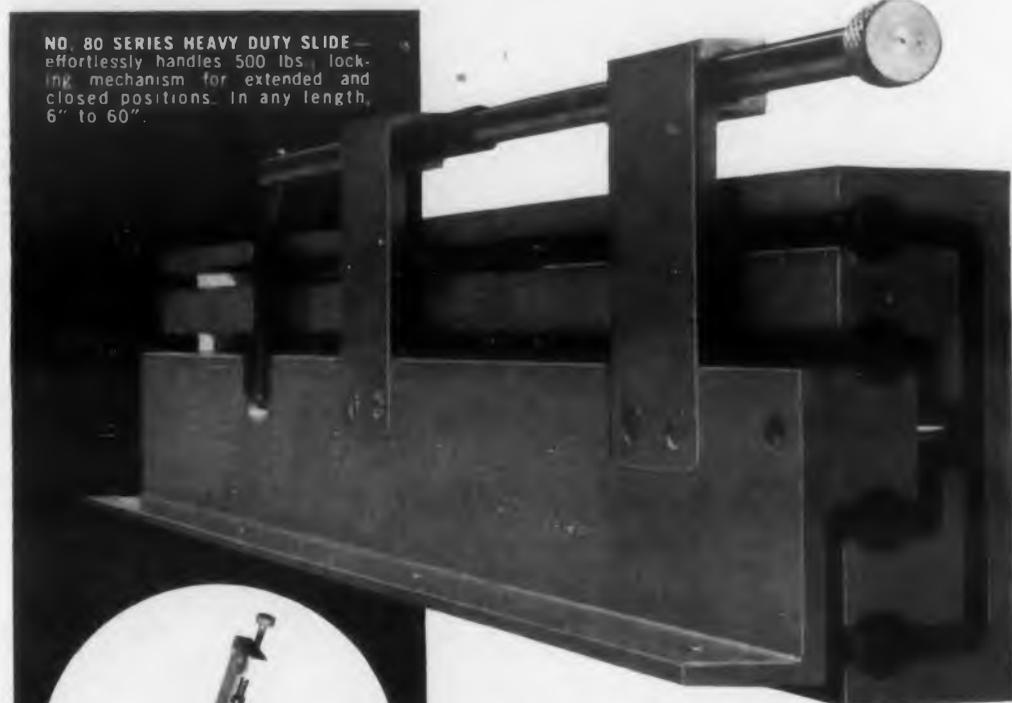
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SYNTHANE CORPORATION, 42 RIVER ROAD, OAKS, PA.

one of America's major sources  
of Chassis Slide Rails

# JONATHAN

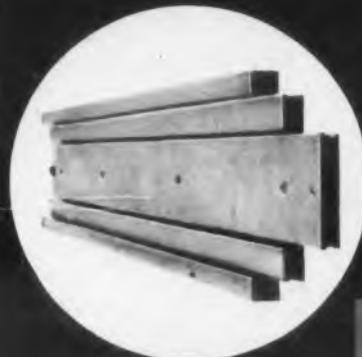
**PROTOTYPE DELIVERY: 10 DAYS**  
**PRODUCTION: 2-3 WEEKS**



**NO. 80 SERIES HEAVY DUTY SLIDE**—effortlessly handles 500 lbs. locking mechanism for extended and closed positions. In any length, 6" to 60".



**NO. 54 SERIES SLIDE**—50 lb capacity, equipped with pivot and locking mechanism for 45°, 90° or 135°. Any length, 6" to 30".



**NO. 150 SERIES THINLINE SLIDE**—less than 1/2" thick, handles 150 lbs. full ball bearing slide. Any length, 6" to 36"—fits all standard racks and panels.

Chassis slide rail buyers ask 4 critical questions:

**Where can I get rapid delivery?** For prototype delivery in 10 days, or production in 2 to 3 weeks—call on Jonathan.

**Who has a complete line of slides?** Jonathan's 96 page catalog offers an almost unlimited range of models.

**Where can I obtain superior quality slides?** Jonathan slides meet all applicable military specifications; are renowned for exceptional construction.

**Where can I obtain competitive prices?** Large plant facilities and high volume production at Jonathan result in mass-production economies. Call or write today concerning your needs.

Write today for  
Free Catalog.



# J

## JONATHAN MFG. CO.

720 E. WALNUT AVE., FULLERTON, CALIF.  
51 CHAMBERS STREET, N. Y. 1, N. Y.

CIRCLE 153 ON READER-SERVICE CARD

## NEW PRODUCTS

**INSULATION BREAKDOWN TEST SET.**—Portable Model MD-1 is a commercial version of military set. Operates from a 115 v, 60 cps power source or a 24 v dc power supply.

Industrial Instruments, Inc., Dept. ED, 89 Commerce Rd., Cedar Grove, N.J.

CIRCLE 154 ON READER-SERVICE CARD

**VOLTAGE REGULATORS.**—Stabiline type TM automatic tubeless magnetic regulators come in 1 and 5 kva ratings for 115 v, 60 cps  $\pm 5$  per cent, single phase duty.

The Superior Electric Co., Dept. ED, Bristol, Conn.

CIRCLE 155 ON READER-SERVICE CARD

**POLARIZED RELAYS.**—Series P spdt relays will handle over 1000 pulses per sec. Various coil resistances up to 5000 ohms each coil. Contact ratings from 60 ma to 2 amp with voltages to 120 v ac or dc.

The Hart Mfg. Co., Dept. ED, 110 Bartholomew Ave., Hartford 1, Conn.

CIRCLE 156 ON READER-SERVICE CARD

**INSTRUMENT KNOBS.**—Aluminum. In 12 different colors and 1/8 and 1/4 in. shaft sizes.

Vemaline Products Co., Dept. ED, P.O. Box 222, Hawthorne, N.J.

CIRCLE 157 ON READER-SERVICE CARD

**MAGNETIC DC AMPLIFIERS.**—Model 100C3 low level amplifier is added to Series 100C. Power gain greater than 120,000. In voltage gains of 250, 500, and 1000.

California Magnetic Control Corp., Dept. ED, 11922 Valerio St., North Hollywood, Calif.

CIRCLE 158 ON READER-SERVICE CARD

**PIN HEADERS.**—For use as tube bases, these solid headers can withstand 700 C.

Advanced Vacuum Products Inc., Div. of General Ceramics Corp., Dept. ED, Stamford, Conn.

CIRCLE 159 ON READER-SERVICE CARD

**PHOTOELECTRIC TACHOMETER.**—DY-2504A transistorized unit measures rotation speed or accumulated turns. Comes with output-pulses/per revolution of 60, 100, 120, 180, 200, or 360.

Dynac, Inc., Dept. ED, 395 Page Mill Rd., Palo Alto, Calif.

CIRCLE 160 ON READER-SERVICE CARD

**PRECISION GEARS.**—Stock face widths of 1/16 in. Also 1/32 and 3/32 in. face widths available.

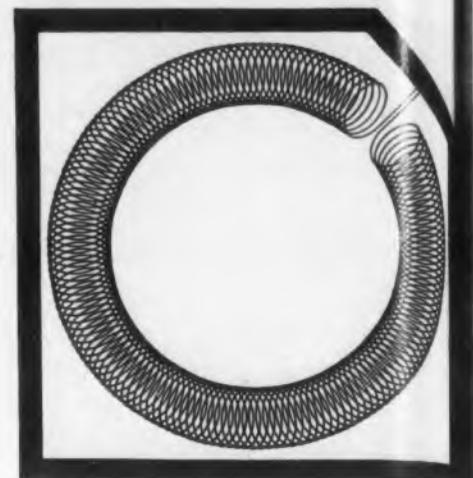
Dynamic Gear Co., Inc., Dept. ED, 20 Merrick Rd., Amityville, N.Y.

CIRCLE 161 ON READER-SERVICE CARD

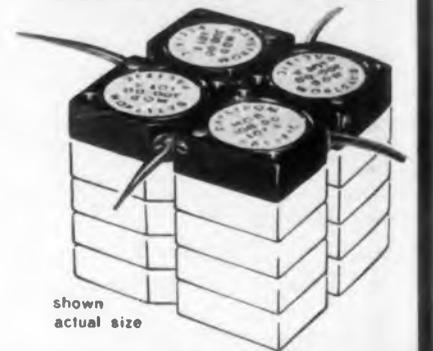
**FERRITE ISOLATORS.**—For 3/8 and 7/8 in. coaxial systems. The 3/8 in. isolator operates over 2000 to 4000 mc range, provides 10 db isolation.

Airtron, Inc., Dept. ED, 1096 W. Elizabeth Ave., Linden, N.J.

CIRCLE 162 ON READER-SERVICE CARD



## DAYSTROM PACIFIC SQUARETRIMS STACK UP BEST



shown  
actual size

Daystrom Pacific Squaretrims—submitting  
ature trimming potentiometers—stack  
up best because of these exclusive and  
unique features:

**EXCLUSIVE SQUARE DESIGN**—permits the stacking of as many as twenty 50K pots into one cubic inch

**MORE ACCURATE TRIMMING**—12 turns for one complete sweep of the wiper—almost one-third more than conventional pots

**GREATER STABILITY**—exclusive worm gear adjusting device for rugged mechanical stability...unique circular design which eliminates resistance changes due to thermal expansion-contraction effects on the mandrel

For complete specifications, contact the representative in your area...or write the factory direct.

**DAYSTROM PACIFIC**  
a division of DAYSTROM, INC.  
9320 LINCOLN BOULEVARD  
LOS ANGELES 45, CALIFORNIA

CIRCLE 163 ON READER-SERVICE CARD

**CARD-TAPE CONVERTER.**—Digital to analog Model 275 converts coded decimal and straight decimal inputs to a proportional analog dc voltage.

Electro Instruments, Inc., Dept. ED, 3794 Rosecrans St., San Diego, Calif.

CIRCLE 164 ON READER-SERVICE CARD

**METERS.**—For 5 per cent accuracy requirements. In ranges of dc sensitivities from 1 ma to 100 amp; in voltmeters up to 300 v.

Burton-Rogers Co., Dept. ED, 42 Carleton St., Cambridge 42, Mass.

CIRCLE 165 ON READER-SERVICE CARD

**POWER SUPPLY TESTER.**—For wide load conditions. Readily modified to test principal parameters of all supply types and makes having any number of dc outputs.

Western Design & Mfg. Corp., Div. of U.S. Industries, Inc., Dept. ED, Santa Barbara Airport, Goleta, Calif.

CIRCLE 166 ON READER-SERVICE CARD

**VACUUM GAGE.**—Type GTC-110 single-station, thermocouple unit. Powered by 1.5 v battery; covers range from 0 to 1000 microns Hg.

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

CIRCLE 167 ON READER-SERVICE CARD

**CONVERTERS.**—Series 1220 frequency to dc units provide selectable time constants from 1 msec to 1/2 sec. Full scale frequency ranges of 500, 2500, and 10,000 cps.

Systron Corp., Dept. ED, 2055 Concord Blvd., Concord, Calif.

CIRCLE 168 ON READER-SERVICE CARD

**MOUNTING SCREW.**—One-piece fastener eliminates retaining device and cross-threading.

Illinois Tool Works, Shakeproof Div., Dept. ED, St. Charles Rd., Elgin, Ill.

CIRCLE 169 ON READER-SERVICE CARD

**CONNECTOR PLUGS.**—Line of plugs to seal open ends of window connectors. Also spare wire caps.

Amp Inc., Dept. ED, 2100 Paxton St., Harrisburg, Pa.

CIRCLE 170 ON READER-SERVICE CARD

**HEATING ELEMENT.**—Wire mesh surface heating element is self mending in case of damage and gives a heat source every 0.028 in.

Electrofilm, Inc., Dept. ED, P.O. Box 106, North Hollywood, Calif.

CIRCLE 171 ON READER-SERVICE CARD

**RECTILINEAR POTENTIOMETER.**—Model 110 for measurement of linear motion. Nearly infinite resolution, typical linearity of 0.05 per cent for a 1 in. stroke.

Computer Instruments Corp., Dept. ED, 92 Madison Ave., Hempstead, N.Y.

CIRCLE 172 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 20, 1958



## REPLY SPEED-UP

Now, look for replies to your inquiries as fast as the mails can carry them! *Electronic Design's* new inquiry processing system gets the catalogs and product data you request back to you sooner, ready for your immediate use.

Here's how it works:

1. All inquiries received on Reader Service Cards are now processed and air mailed\* to manufacturer *the same day received.*
2. Inquiries are forwarded on pre-typed mailing labels ready for immediate reply. All the advertiser need do is affix the label and mail.

Same day processing and pre-typed labels put your reply—the information you request—on your desk days, in some cases, weeks, earlier than older methods.

Inquiry reply speed-up is another service to our readers . . . new in '58 . . . only in *Electronic Design.*

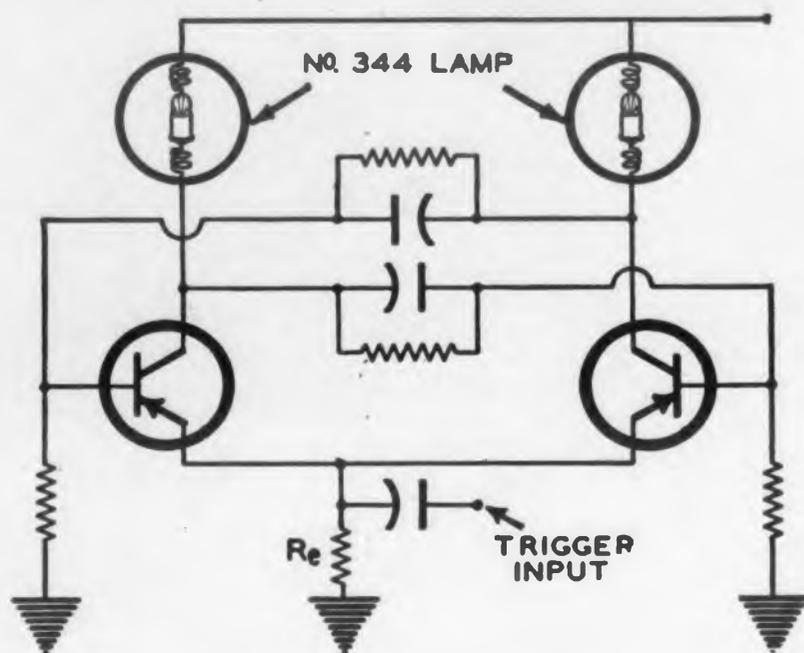
a HAYDEN publication

830 Third Avenue, New York 22, N.Y.

\*1st Class within one-day delivery zone

# General Electric announces new "VERY LOW CURRENT" lamp for use as indicators for transistorized circuits

*A possible use: as an indicator on a flip-flop circuit.*



**GE-344 incandescent lamp is rated at 10 volts,  
15 milliamperes; has life in excess of 5,000 hours**

General Electric's new GE-344 is designed for use in transistor circuits and many other applications where a small sized, low current indicator lamp is needed. Only  $\frac{7}{32}$ " in diameter,  $\frac{5}{8}$ " long, the GE-344 can be seen lighted under 100 footcandles of surrounding light. It uses only .15 watts (nominal), has a single contact midget flange base, and its electrical ratings allow significant savings in providing an indicator light in transistorized equipment. For additional engineering data on this new GE-344 lamp, write: General Electric Co., Miniature Lamp Dept. ED-88, Nela Park, Cleveland 12, Ohio. Ask for Bulletin No. 3-8066.



*Twice actual size*

*Progress Is Our Most Important Product*

**GENERAL  ELECTRIC**

## NEW PRODUCTS

**CONDENSER ELECTROMETER.**—Dynacon radioactivity measuring system for soft beta emitters such as tritium, carbon-14, and sulfur-35. Will accept and measure samples in solid, liquid, or gas phase.

Nuclear-Chicago Corp., Dept. ED, 229 W. Erie St., Chicago 10, Ill.

CIRCLE 174 ON READER-SERVICE CARD

**CONNECTORS.**—5-way binding post connectors with gold-plated machined brass parts. Have 30 amp current capacity, 1000 v working voltage.

The Superior Electric Co., Dept. ED, Bristol, Conn.

CIRCLE 175 ON READER-SERVICE CARD

**CLOSED CIRCUIT TV.**—Low-cost system combining TE-6-A camera, suitable lens, monitor or standard TV receiver, and required length of cable.

General Electric Co., Technical Products Dept., Electronics Park, Syracuse, N.Y.

CIRCLE 176 ON READER-SERVICE CARD

**POWER SUPPLY.**—The 301E features chopper stabilization and built-in standard cell reference. Output voltage is 1.02 to 512 v dc at 0 to 300 ma.

John Fluke Mfg. Co., Inc., Dept. ED, 1111 W. Nickerson St., Seattle 99, Wash.

CIRCLE 177 ON READER-SERVICE CARD

**PRESSURE TRANSDUCER.**—Type TR 719 operates in ranges from 15 to 3000 psi. Relatively good resistance to shock, vibration, and accelerations.

Servomechanisms, Inc., Dept. ED, 12500 Aviation Blvd., Hawthorne, Calif.

CIRCLE 178 ON READER-SERVICE CARD

**CHARGING CHOKES.**—Production models withstand  $-40$  to  $+150$  C. Encapsulated coil resists corona effects, voltage, and temperature shock.

Osborne Electronic Corp., Dept. ED, 712 S.E. Hawthorne Blvd., Portland, Ore.

CIRCLE 179 ON READER-SERVICE CARD

**TRANSISTOR CLOSURES.**—E-I standard line includes strain-free solderable types, compression weldable types, and compression solderable types.

Electrical Industries, Dept. ED, 691 Central Ave., Murray Hill, N.J.

CIRCLE 180 ON READER-SERVICE CARD

**MULTIPLIER PHOTOTUBE POWER SUPPLY.**—Has output of 800 to 2000 v dc at 0 to 25 ma; provides regulation of 0.015 per cent for both line and load, no load to full load.

Dressen-Barnes Corp., Dept. ED, 250 N. Vinedo Ave., Pasadena, Calif.

CIRCLE 181 ON READER-SERVICE CARD

**TOGGLE TENSION LATCH.**—Model 30L for use on airborne equipment boxes and similar closures requiring minimum latch clearance.

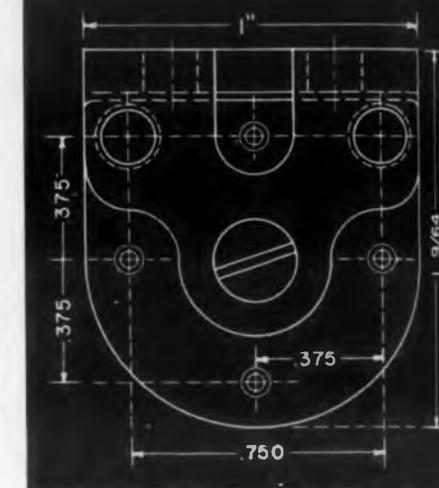
Camloc Fastener Corp., Dept. ED, 61 Spring Valley Rd., Paramus, N.J.

CIRCLE 182 ON READER-SERVICE CARD



## New "E" Relay

interchangeable with  
many other makes



Stromberg-Carlson's new type "E" relay combines the time-proven characteristics of the type "A" relay with a mounting arrangement common to many other makes.

As the sketch above shows, our new frame mounting holes and coil terminal spacing allow you to specify these relays—of "telephone quality"—interchangeably with brands you have been using. Costs are competitive and expanded production means prompt delivery.

Welcome engineering features of the new "E" relay are—

- ★ Contact spring assembly: maximum of 20 Form A, 18 B, 10 C per relay.
- ★ Coil: single or double wound, with taper tab or solder type terminals at back of relay.
- ★ Operating voltage: 200 volts DC maximum.

You may order individual can covers in a choice of 3 sizes for the new relay, as well as for our type "A" and "C" relays.

For complete details and specifications on the "E" relay and other Stromberg-Carlson relays, send for your free copy of Catalog T-5000R.

## STROMBERG-CARLSON

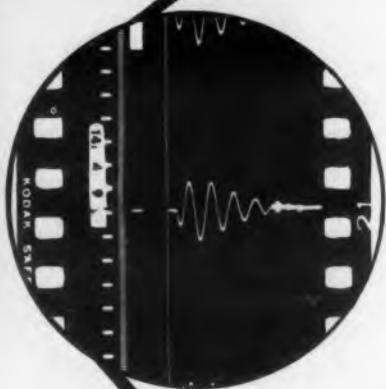
A DIVISION OF GENERAL DYNAMICS CORPORATION  
TELECOMMUNICATION INDUSTRIAL SALES  
116 CARLSON ROAD, ROCHESTER 3, N. Y.

CIRCLE 183 ON READER-SERVICE CARD

# The Beattie Oscillotron



PHOTOGRAPHS & RECORDS



IMPORTANT TRACES



## FOR LATER ANALYSIS

Electrically pulsed and automatic. Adaptable for remote control. Interchangeable 35 or 70 mm cameras. 100 ft. roll film magazines for single frame or continuous motion recording. All oscillotron cameras fit the standard K-5 periscope.

for more information write to



1000 N. Olive St., Anaheim, California

CIRCLE 184 ON READER-SERVICE CARD

**TOROIDAL CORES.**—Color coded Genalex III types in five standard permeability ranges: 14, 26, 60, 125, and 140. Seven standard sizes from 0.5 to 1.35 in. O.D.

Wallace E. Connolly & Co., Dept. ED, P.O. Box 295, Menlo Park, Calif.

CIRCLE 185 ON READER-SERVICE CARD

**MOLDED NYLON SCREWS.**—Expanded line includes machine screws with round, fillister, and flat heads. Also headless set screws with variety of points.

Gries Reproducer Corp., Dept. ED, 400 Beechwood Ave., New Rochelle, N.Y.

CIRCLE 186 ON READER-SERVICE CARD

**PRESSURE SWITCHES.**—Dual circuit units to actuate instruments, warning signals, and safety devices. For dc use.

John W. Hobbs Corp., Dept. ED, Yale Blvd. and Ash St., Springfield, Ill.

CIRCLE 187 ON READER-SERVICE CARD

**TRANSISTORIZED DIGITAL MODULES.**—Shift flip-flop model SF-101 and M-Pac plugboard model PB-101 are additions to series M transistorized dc to 100 kc digital modules.

Computer Control Co., Inc., Dept. ED, 92 Broad St., Wellesley 57, Mass.

CIRCLE 188 ON READER-SERVICE CARD

**DIMPLE MAGNETS.**—For loudspeaker and transceiver applications. Magnets utilize Alnico 5Cb, need no pole tips or retainers, though pole tips may be used.

Thomas & Skinner, Inc., Dept. ED, 1157 E. 23rd St., Indianapolis, Ind.

CIRCLE 189 ON READER-SERVICE CARD

**TUBE BASE PLUGS.**—In 7 and 9 pin miniature types with straight or bent pins, flat sides or stepped, and knurled inserts for side-screw applications.

Electronic Techniques, Inc., Dept. ED, 13761 Saticoy St., Van Nuys, Calif.

CIRCLE 190 ON READER-SERVICE CARD

**INSTRUMENT DOLLIES.**—Flat-top dolly for uses requiring level surface. Tilt-top for scopes.

P.B.R. Mfg. Co., Dept. ED, H and Luzerne Sts., Philadelphia 24, Pa.

CIRCLE 191 ON READER-SERVICE CARD

**INDICTAOR LIGHT ASSEMBLY.**—Type 50 extra-short horizontal assembly for use with the standard miniature bayonet T31/4 lamp.

Drake Mfg. Co., Dept. ED, 1711 W. Hubbard St., Chicago 22, Ill.

CIRCLE 192 ON READER-SERVICE CARD

**MEMORY CORE ANALYZER.**—Model 3303, 100 channel unit provides definitive analysis. Linearity better than 0.5 per cent; input counting rates greater than  $10^6$  cpm.

Radiation Instrument Development Lab, Inc., Dept. ED, 5737 S. Halsted St., Chicago 21, Ill.

CIRCLE 193 ON READER-SERVICE CARD

## NEW in

# Data Recording

# MONROE



## DATA/LOG



## NEW

- ... **PRINCIPLE.** Parallel entry DATA/LOG printers with automatically positioned carriages.
- ... **FORMATS** for printed copy.
- ... **CARRIAGES.** Programmable carriages accept narrow or wide forms up to 18 inches, with front feed carriages for card insertion.
- ... **CAPACITIES.** From three to 14 digits for each print cycle.
- ... **ACCUMULATORS.** Up to 4 accumulators with 14 digits each.
- ... **FACILITY.** Each DATA/LOG has its own control chassis, power supply, control relays, and timing pulses.

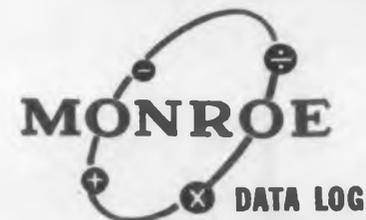
Series MC 205, provides 5, 6, 7 or 8 bit punched tape, with any coding for computer input. The basic printer provides up to 10 digits printout on a 13" or 4 3/4" fixed carriage, with or without accumulators. Two accumulators have 2 to 10 digits maximum each. 64 cycles per minute can be punched, and 140 cycles per minute printed.

### DATA/LOG PRINTERS INCLUDE:

Series MC 202, 13" or 4 3/4" fixed position carriage, with or without accumulators. Readout Speed up to 180 print cycles per minute.

Series MC 203 & 204 each provides up to 14 digits maximum, on an 18 1/2" or 15 3/4" programmable tabulating carriage. Up to 150 print cycles per min.

Series 203 comes without accumulators, Series 204 is available with up to 4 accumulators of 14 digits each.



Write to:  
MONROE Calculating Machine Company, Inc.  
Electronics Components Division  
60 Main Street, San Francisco, Calif.

CIRCLE 194 ON READER-SERVICE CARD

## NEW, LOW FREQUENCY RELIABILITY IN GLASS-ENCLOSED CRYSTAL



Precision components of the new RHG-DP crystals are enclosed and hermetically sealed in glass holders to assure maximum internal cleanliness and most reliable evacuation. The result is a series of sturdy, miniature, low frequency units having excellent long-term stability and higher Q.

### TYPICAL VALUES FOR 2 KC UNIT\*

Frequency range	1 to 15 kc
Holder	T5 1/2 glass bulb —Noval Base
Temperature range	—55 to +100°C
Frequency tolerance	±.015%
Effective resistance	75,000 ohms max.
Aging 8 hours—100°C	±.001% max.
Meets MIL specifications for vibration stability	

\*Reeves-Hoffman manufactures a broad line of crystals in the range from 1 to 1000 kc.

**REEVES-  
HOFFMAN**

WRITE FOR BULLETIN RHG-DP

DIVISION OF  
DYNAMICS CORPORATION OF AMERICA  
CARLISLE, PENNSYLVANIA

CIRCLE 268 ON READER-SERVICE CARD



## DIGITAL VOLT-OHMMETERS combine readability with reliability and accuracy

For your laboratory, incoming inspection, or in-line test positions—or wherever accurate and reliable measurements must be made quickly—you need a HYCON Digital Volt-Ohmmeter.

**READABLE** 1/2" digits, in line, with illuminated decimal point and polarity indicator for fast (2 second average) readout without interpolation error.

**RUGGED AND RELIABLE** with no delicate components—designed for continuous operation, and to withstand shock and vibration without loss of accuracy.

### Complete Data in Bulletin 645

Model 645AR 0.1% accurate, DC and Ohms..... \$875.00

Model 615AR 0.5% accurate, DC and Ohms..... \$485.00

Both instruments are 1% accurate on AC from 10 to 1000 volts; 2% accurate below 10 volts.

### 3 DIGITAL INSTRUMENTS IN 1

The HYCON reads DC volts in 4 decimal ranges from .001 V to 999 V... AC volts in 3 decimal ranges from 1.0 V to 999 V RMS... resistance in 5 decimal ranges from 1 ohm to 9.99 megohms. High Impedance (vacuum tube) input. Size 5 1/4 x 19", 11" deep. Complete with probes.

Order from your HYCON representative, or from:

**Hycon**  
ELECTRONICS, INC.  
A SUBSIDIARY OF HYCON MFG. CO.  
370 South Fair Oaks, Pasadena, California

CIRCLE 195 ON READER-SERVICE CARD

## NEW PRODUCTS

**NEUTRON SURVEY METER.**—Fast-slow model 20806 has 10 times greater neutron sensitivity than previous models. Fast model 20807 and slow model 20808 also available.

Radiation Counter Labs, Dept. ED, 5121 W. Grove, Skokie, Ill.

CIRCLE 196 ON READER-SERVICE CARD

**POWER SUPPLIES.**—30 v output with ripple below 1 per cent rms for voltage or load within rating. Regulation from no load to full load is 12 per cent.

Gates Electronic Co., Dept. ED, 2090 Barnes Ave., Bronx 62, N.Y.

CIRCLE 197 ON READER-SERVICE CARD

**CERAMIC CAPACITORS.**—Double-cup high-voltage types 90C and 91C for use in rf circuits up to 10 kv.

Sprague Electric Co., Dept. ED, 347 Marshall St., North Adams, Mass.

CIRCLE 198 ON READER-SERVICE CARD

**PRESSURE TRANSDUCER.**—Model P-501 adjustable range, double-coil variable reluctance type with a flat diaphragm pressure sensing element.

Yuba Consolidated Industries, Inc., Yuba Research and Development Center, Dept. ED, Benicia, Calif.

CIRCLE 199 ON READER-SERVICE CARD

**CONTROL PANEL ENCLOSURES.**—Type 12, completely liquid-tight, in single and double door models.

Keystone Mfg. Co., Dept. ED, 23328 Sherwood Rd., Warren, Mich.

CIRCLE 200 ON READER-SERVICE CARD

**POWER PENTODES.**—Models 6EH5, 12EH5, 25EH5, and 50EH5 for use in audio output stages of radio and TV receivers.

Radio Corporation of America, Electron Tube Div., Dept. ED, Harrison, N.J.

CIRCLE 471 ON READER-SERVICE CARD

**TRANSISTORIZED POWER SUPPLY.**—Model M-990 magnetic amplifier transistorized dc supply. Output of 24 to 32 v dc at 8 amp.

Perkin Engineering Corp., Dept. ED, 345 Kansas St., El Segundo, Calif.

CIRCLE 202 ON READER-SERVICE CARD

**EXPLOSION-PROOF DIGITAL INDICATOR.**—Type 6 3- or 4-channel units for use in hazardous areas. Range is up to 9000 counts.

George L. Nankervis Co., Cox Instruments Div., Dept. ED, 15300 Fullerton Ave., Detroit 27, Mich.

CIRCLE 203 ON READER-SERVICE CARD

**HELICAL GEAR ASSEMBLIES.**—Can be used to increase or decrease speed. Ratios from 1 to 1 up to 4 to 1. Shaft sizes of 1/8, 3/16, and 1/4 in. diam.

PIC Design Corp., Dept. ED, 477 Atlantic Ave., East Rockaway, N.Y.

CIRCLE 204 ON READER-SERVICE CARD

## Using Thermistors

Edited by  
**FENWAL ELECTRONICS**

### THERMISTOR PROBE ASSEMBLIES

Fenwal Electronics' new thermistor probe assemblies enormously simplify an engineer's design and development problems. Developed and built by Fenwal to your specifications, each assembly is a ready-to-use, easy-to-handle unit incorporating all the qualities that make Fenwal Electronics' thermistors outstanding—sensitivity, stability, reliability, fast response, light weight, and small size.



Three examples of complete thermistor probe assemblies Fenwal Electronics has designed and built to customers' specifications.

Fenwal Electronics develops and builds complete assemblies to various configurations and temperature ranges for specific applications. Probes can be completely interchangeable, and have identical resistance-temperature characteristics.

**Engineers:** Fenwal Electronics now has a thermistor kit No. G200, which includes 12 different individually packaged thermistors, each with complete data, for development work. \$19.95 f.o.b. Framingham.

Write FENWAL ELECTRONICS, INC., 38 Mellen Street, Framingham, Mass. for Bulletin EM-13, describing nine of the many thermistor probe assemblies. Fenwal Electronics can build for you. Or write for the Fenwal Electronics catalog (EMC-2).



Design — Engineering — Production  
of Precision Thermistors

CIRCLE 205 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 20, 1958

# New Product Announcement

**SWITCH.**—Model PLH push type switch enables the user to lock in a circuit and then release it by depressing the same button again.

The Capitol Machine Co., Switch Div., Dept. ED, 36 Balmforth Ave., Danbury, Conn.

CIRCLE 206 ON READER-SERVICE CARD

**VENTED CABINET.**—Measures 24 in. wide by 15 in. deep and holds standard contrasting silver grey hammer-tone panels.

WYCO Metal Products, Dept. ED, 6918 Beck Ave., North Hollywood, Calif.

CIRCLE 207 ON READER-SERVICE CARD

**POWER SUPPLY.**—Model 62-121 has a regulation of .05 per cent for a line change of 105 to 125 volts. Output range is 0.5-36 v dc at 15 amps.

Dressen-Barnes Corp., Dept. ED, Pasadena, Calif.

CIRCLE 208 ON READER-SERVICE CARD

**FLEXIBLE COUPLINGS.**—For close-tolerance use. Designed to eliminate back-lash and transmit uniform angular velocity at high speeds. Shaft sizes from 1/8 to 5/16 in.

Robertshaw-Fulton Controls Co., Bridgeport Thermostat Div., Dept. ED, Milford, Conn.

CIRCLE 209 ON READER-SERVICE CARD

**SELENIUM RECTIFIERS.**—Federal Slim-Line, in two sizes, covers range from 150 to 450 ma for half-wave rectifier applications and for B-plus supplies in voltage doubler circuits.

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

CIRCLE 210 ON READER-SERVICE CARD

**SERVO GEAR CLAMPS.**—Line consists of two piece T147 for use at high speeds; single piece T151 for speeds below 1000 rpm; and low-cost T143 for 200 rpm and under.

Sterling Precision Corp., Dept. ED, 7 Matinecock Ave., Port Washington, N.Y.

CIRCLE 211 ON READER-SERVICE CARD

**TWO-POINT NUT.**—Elimination of hex surfaces yields 40 per cent space saving in Kaylock H50 self-locking nut. Threaded nut element has two integral wrenching points.

Kaynar Mfg. Co., Inc., Dept. ED, Box 2001, Terminal Annex, Los Angeles 54, Calif.

CIRCLE 212 ON READER-SERVICE CARD

CIRCLE 213 ON READER-SERVICE CARD



## STEMCO TYPE MX\* THERMOSTATS

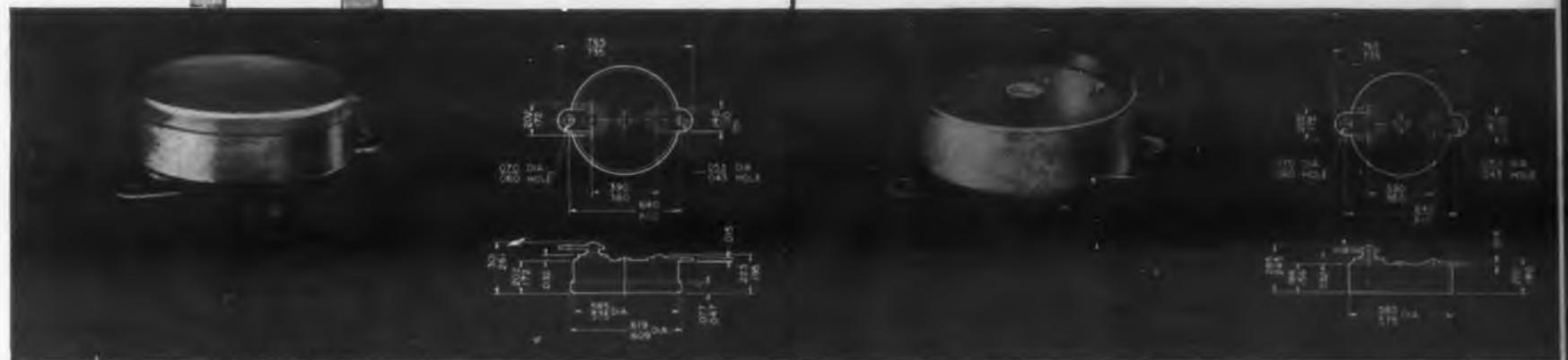
especially designed for missile, avionic and electronic applications

New Stemco Type MX Thermostats are miniature snap-acting units designed to *open* on a temperature rise. Being compact, lightweight units able to withstand high G's under wide ambient temperature ranges, Type MX thermostats are ideal for missile, avionic and other electronic applications where close temperature control is mandatory.

Basic design flexibility of the Stemco Type MX Series means the units can be supplied from regular production runs in a wide variety of models, both semi-enclosed or hermetically sealed. Ceramic or metal bases for semi-enclosed units, round enclosures or CR-7 crystal cans for hermetically sealed units. Several types of terminal arrangements, mounting provisions, brackets, etc., are available.

Stemco Type MX thermostats give you performance . . . small cubage . . . rugged reliability . . . at a production price.

\* 2° to 6°F differentials available



AA-7285

STEVENS manufacturing company, inc.  
Mansfield, Ohio

STEMCO

THERMOSTATS

# CELCO

## STANDARD

# YOKES

for MILITARY and COMMERCIAL PRECISION DISPLAYS

Single units or production quantities IMMEDIATELY AVAILABLE FOR 7/8", 1", 1-7/16", 2", 2-1/8", 2-1/2", CRT necks.

Write for Celco deflection yoke catalogue or for immediate engineering assistance call your nearest Celco plant.

Mahwah, N. J.  
DAvis 7-1123

Miami, Fla.  
PLaza 1-9083

Cucamonga, Calif.  
YUkon 2-2688

Susquehanna, Pa.  
ULysses 3-3500

**Celco**

*Constantine Engineering Laboratories Co.*



Transistor or Vacuum tube drive.

CIRCLE 201 ON READER-SERVICE CARD

## MILITARY

# CIRCUITS

## by METHODE

NOW, a special division for this high precision work:

- ★ Separate management and operating team specializing in reliable production of precision printed circuits
- ★ Special facilities for accurate and uniform short run punching and fabrication of printed circuits
- ★ Complete precious metal electroplating department to handle all finishes
- ★ The newest in equipment with the industry's largest manufacturing capacity devoted to printed circuitry
- ★ A number of important projects for missiles, radar and airborne ordnance continuously in production

METHODE also offers film insulated wiring harness and connectors for printed circuit applications. Write for bulletin.

Address: Military Contracts Coordinator

**METHODE Mfg. Corp.**  
7447 W. Wilson Ave.  
Chicago 31, Ill.

CIRCLE 214 ON READER-SERVICE CARD



## NEW PRODUCTS

**SELENIUM RECTIFIER.**—Low-cost unit for use in vibrating cushions and other appliances.

Radio Receptor Co., Inc., Dept. ED, 240 Wythe Ave., Brooklyn, N.Y.

CIRCLE 215 ON READER-SERVICE CARD

**SERVO PNEUMATIC REGULATOR.**—Model 192000-2 handles inlet pressures of 600 to 3000 psig with a flow rate of up to 40 lb of air per minute. For fuel pressurizing applications.

Wallace O. Leonard, Inc., Dept. ED, 373 S. Fair Oaks Ave., Pasadena, Calif.

CIRCLE 216 ON READER-SERVICE CARD

**SPDT CHOPPERS.**—Line of 7- and 4-pin miniature choppers for low noise applications.

James Vibrapowr Co., Dept. ED, 4050 N. Rockwell, Chicago 18, Ill.

CIRCLE 217 ON READER-SERVICE CARD

**RELAY.**—The PE-3 is used with resistive type photoelectric scanning heads within 25,000 ohms to 1.5 meg resistance.

Farmer Electric Products Co., Inc., Dept. ED, 2300 Washington St., Newton Lower Falls, Mass.

CIRCLE 218 ON READER-SERVICE CARD

**ROTARY SWITCH.**—Type JL multiple switch has eight contact positions and up to ten sections controlled by one knob.

Electro Switch Corp., Dept. ED, Weymouth 88, Mass.

CIRCLE 219 ON READER-SERVICE CARD

**BREAD BOARDS AND HANGER UNITS.**—Component and bearing hangers can be shifted to any position for highly accurate bread board mock-up.

Dynamic Gear Co., Inc., Dept. ED, 20 Merrick Rd., Amityville, N.Y.

CIRCLE 220 ON READER-SERVICE CARD

**DIGITAL COUNTERS.**—Feature low torque, low moment of inertia, high speed, and long life.

Durant Mfg. Co., Dept. ED, 1993 N. Buffum St., Milwaukee 1, Wis.

CIRCLE 221 ON READER-SERVICE CARD

**JACK.**—No. 2425 feed-through type accepts banana plug with 0.107 in. pin diam, 3/8 in. pin length.

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

CIRCLE 222 ON READER-SERVICE CARD

**SNAP-ACTING SWITCH.**—Type A switch for use in automatic devices. Electrical rating, 15 amp, 125 and 250 v ac.

The W. L. Maxson Corp., Unimax Switch Div., Dept. ED, Ives Rd., Wallingford, Conn.

CIRCLE 223 ON READER-SERVICE CARD

**THERMISTOR THERMOMETER.**—Model 46TUC multi-channel unit with range from 0 to 50 C in five over-lapping ranges 11 degrees wide.

Yellow Springs Instrument Co., Inc., Dept. ED, Yellow Springs, Ohio.

CIRCLE 224 ON READER-SERVICE CARD

## STRAITS

## TIN

## REPORT

New developments in the production, marketing and uses of tin



The Fish and Wildlife Service of the U.S. Department of the Interior has reported that "packaging frozen fish in tin results in superior storage life." Only tin prevents the deteriorating action of seeping oxygen on frozen fish in cold storage over a period of months.

Considerable laboratory progress has been made in the electroplating of tin as a bright coating through the addition of certain wood tars to the electrolyte. Some observers feel there is a distinct possibility that this bright tin plating may take the place of metal polishing in many applications throughout the metal industry.

A new machine has been designed in England to help speed up mass production soldering. It consists of an electrically heated solder bath with motor-driven pump to provide a stationary wave of fresh solder, which is exposed to moving printed circuit boards.



An invention was recently patented which is expected to lengthen the life of heavily stressed bearings from a few weeks to several years. A mesh of tinned wire is embedded just below the surface of babbitted bearings before pouring . . . to prevent movement in the bearing surface leading to fatigue, cracking and spalling.



Ask us to send you TIN NEWS, a monthly letter. It will keep you posted on tin supply, prices, new uses and applications.

**The Malayan Tin Bureau**  
Dept. L 13H, 1029 Connecticut Ave., Washington 6, D.C.

CIRCLE 225 ON READER-SERVICE CARD

**PLASTIC SCREWS.**—Lexan plastic screws, with shanks threaded just enough for each application, provide greater strength.

Pylon Co., Inc., Dept. ED, Attleboro, Mass.

CIRCLE 227 ON READER-SERVICE CARD

**MOTOR TACHOMETER.**—Model SJ9HLX7-1CC size 10 damping type motor has minimum stall torque of 0.5 in.-oz, operates from -54 to +105 C.

Eastern Air Devices, Inc., Dept. ED, 391 Central Ave., Dover, N.H.

CIRCLE 228 ON READER-SERVICE CARD

**WIRE HARNESS.**—Copper shielded Zippertubing with plastic or metal zipper track. ID's start at 3/8 in.; put-ups are 25 to 300 ft.

The Zippertubing Co., Dept. ED, 752 S. San Pedro St., Los Angeles 14, Calif.

CIRCLE 229 ON READER-SERVICE CARD

**TRANSFORMER.**—For industrial electronic tubes. Rated 30 kva, 240 v input with 3 secondaries, 10 v at 1000 amp.

Nothelfer Winding Labs, Inc., Dept. ED, P.O. Box 455, Trenton, N.J.

CIRCLE 230 ON READER-SERVICE CARD

**DELTA UNIT.**—Model 902-1 measures any physical quantity that can be converted into a change in capacitance.

The Decker Corp., Dept. ED, Bala Cynwyd, Pa.

CIRCLE 231 ON READER-SERVICE CARD

**INTERNALLY THREADED INSERT.**—Self-aligning Keensert series designed to compensate for misalignment of bolt holes.

Newton Insert Co., Dept. ED, 6500 Avalon Blvd., Los Angeles 3, Calif.

CIRCLE 232 ON READER-SERVICE CARD

**TRANSISTORIZED DC POWER SUPPLY.**—Uni-reg model Q26-30-1 with output range of 26 to 30 v at 0 to 1 amp.

Universal Electronics Co., Dept. ED, 1720 22nd St., Santa Monica, Calif.

CIRCLE 233 ON READER-SERVICE CARD

**LINE VOLTAGE REGULATORS.**—Claude Lyons automatic regulators weigh 11.5 lb, are independent of load from 0 to 100 per cent of rated value.

British Industries Corp., Dept. ED, 80 Shore Rd., Port Washington, N.Y.

CIRCLE 234 ON READER-SERVICE CARD

**VERTICAL OUTPUT TRANSFORMERS.**—Types A-113X, A-115X, A-113Z, and A-115Z drive 90 and 110 deg yokes with 10 to 14 mh inductance and 11 to 15 ohm resistance.

Triad Transformer Corp., Dept. ED, 4055 Redwood Ave., Venice, Calif.

CIRCLE 235 ON READER-SERVICE CARD

**JACKS AND PLUGS.**—Miniature jacks 2378 and 2515 and matching plugs 2379 for tight patch work on panel boards.

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

CIRCLE 236 ON READER-SERVICE CARD

*for maximum reliability*

*reduce  
tube  
temperatures  
up to  
40°C  
with*



## BIRTCHER KOOL KLAMPS

**MATERIAL**  
Heat treated silver alloy or Beryllium No. 25

**FINISH**  
Silver none — beryllium copper plated silver to Navy Spec. 46P5 or black Ebanol

**SIZES**  
Modifications available for all sub-miniature and miniature tubes and components.

Excessive heat is the number one cause of tube failure. Birtcher KOOL KLAMPS, made of 99½% pure, tempered silver, can reduce tube temperatures by as much as 40°C while holding them secure against shock and vibration. Available also in beryllium copper where temperature is less critical.

### THE BIRTCHER CORPORATION

INDUSTRIAL  
DIVISION

4371 Valley Blvd.,  
Los Angeles 32, Calif.

Write for catalog

CIRCLE 237 ON READER-SERVICE CARD

*new line with acrylic case*



**PACE**  
THE METER OF PRECISION

**custom  
produced  
to  
equipment manufacturers' specifications**

**PACE** meters are custom produced in production quantities to meet individual O.E.M. specifications for sensitivity, terminal resistance, damping, terminal posts, pointer, illumination, scaleplate design and color, case color, and other electrical and physical characteristics.

The latest automation techniques, rigid quality control and closely maintained atmospheric conditions assure the highest order of commercial panel instrument performance and reliability.

Illustrated: Model 45-P clear plastic 4½" meter, one of a family of acrylic-cased instruments, directly interchangeable with older standard phenolic-cased units of similar size. **PACE** also offers a wide range of phenolic-cased meters in 2½" to 7" sizes.

**PACE ELECTRICAL INSTRUMENTS CO., INC.**

A Division of Precision Apparatus Co., Inc.  
70-31 84th Street, Glendale 27, L. I., N. Y.

Export: Morhan Exporting Corp., 45½ Broadway, New York 13, N. Y.  
Canada: Atlas Radio Corp., Ltd., 50 Wingold Avenue, Toronto 19, Ont.

CIRCLE 238 ON READER-SERVICE CARD

Somers THIN STRIP  
© 25,000:1 This fantastic ratio is possible only at Somers, where the latest equipment produces thin strip down to .001", as wide as 25".

With the installation of one of the largest Sendzimir mills in the non-ferrous industry, Somers is prepared to meet the broadest range of dimensional specifications, since it is already supplying thin strip down to .0001" in narrower widths.

Pure Nickel, Monel, Inconel and Inconel "X" are produced in gauges from .0001" to .020". Stainless Steel, electrolytic Copper and its alloys, such as Brass, Nickel Silver and Phosphor Bronze from .0001" to .010".

For a complete survey of your strip problems at no cost or obligation, write for field engineer or Confidential Data Blank.

Somers Brass Company, Inc.  
116 Baldwin Ave.  
Waterbury, Conn.

CIRCLE 226 ON READER-SERVICE CARD

# Now A TRULY MULTIFUNCTIONAL PHASE ANGLE VTVM and PHASE-SENSITIVE NULL INDICATOR



MODEL 202-BR-D

## DIRECT READING

- Voltage
- Phase Angle
- In-Phase
- Quadrature

## FEATURES

- Direct reading 0-360°, no ambiguity.
- 1 mv to 300v full scale.
- VTVM operation to 50 kc.
- 10 microvolt null sensitivity.
  - 10 meg input impedance.
  - Available in any frequency to 10 kc.
  - Unaffected by harmonics with optional filters.
  - Low noise.

## REPRESENTATIVES:

N. Y., NEW ENGLAND: J. P. Brogan Assoc. • MET. N. Y.: B. B. Taylor Corp.  
MID ATLANTIC: Fred F. Bartlett Co. • MICH., OHIO, W. PENNA: Dayton-Anderson Elect. • KANSAS, MO., IOWA, S. ILL.: Desco Sales • SOUTH EAST: Col-Ins-Co. • WEST COAST: Gerald B. Miller • CANADA: Electrodesign



**NORTH ATLANTIC industries, inc.**  
603 main street, westbury, n. y. EDgewood 4-1122

CIRCLE 239 ON READER-SERVICE CARD

# PRECISION CHOPPER STABILIZED D.C. POWER SUPPLIES by John Fluke



MODEL 301C

1.02-1012 V.D.C.  
0-400 MA  
.005%  
.005%  
500 MICROVOLTS  
FROM CALIB. CONTROLS  
17½"H x 19"W x 15½"D  
\$995 FOB SEATTLE

## STANDARD CELL REFERENCE



MODEL 301E

OUTPUT VOLTAGE 1.02 to 512 V.D.C.  
OUTPUT CURRENT 0-300 MA  
REGULATION .005%  
STABILITY .005%  
RESOLUTION 500 MICROVOLTS  
READOUT DIRECT IN-LINE  
SIZE 8¼"H x 19"W x 15½"D  
PRICE \$595 FOB SEATTLE



**JOHN FLUKE MANUFACTURING CO., INC.**  
1111 W. NICKERSON ST., SEATTLE 99, WASHINGTON

CIRCLE 240 ON READER-SERVICE CARD

## NEW PRODUCTS

**DECADE BOXES.**—Line of ten models: three capacitance, three resistance, four inductance.

Aerovox Corp., Dept. ED, New Bedford, Mass.

CIRCLE 241 ON READER-SERVICE CARD

**REVERSIBLE SYNCHRONOUS MOTOR.**—Model RSM 80 in.-oz continuous duty motor, instantly reversible, in output speeds from 2/3 to 3600 rpm. Weighs 14 oz.

Hurst Tool & Mfg. Co., Inc., Dept. ED, Princeton, Ind.

CIRCLE 242 ON READER-SERVICE CARD

**TRANSISTORIZED POWER SUPPLY.**—Voltage regulated model SC-150-1 delivers 0 to 150 v, 0 to 1 amp. Regulation under 0.01 per cent or 0.002 v, whichever is greater.

Kepeco Labs, Inc., Dept. ED, 131-38 Sanford Ave., Flushing 55, N.Y.

CIRCLE 243 ON READER-SERVICE CARD

**GROUNDING SWITCH.**—GS-1 rotary switch for use where one or two circuits are occasionally connected to ground.

P. R. Mallory & Co., Inc., Dept. ED, Indianapolis 6, Ind.

CIRCLE 244 ON READER-SERVICE CARD

**HIGH PRESSURE SEALS.**—Hexseals series N-5000 one piece units for use on miniature push-button and toggle switches. Operate from -160 to +500 F.

Automatic & Precision Mfg. Co., Dept. ED, 252 Hawthorne Ave., Yonkers, N.Y.

CIRCLE 245 ON READER-SERVICE CARD

**VIDEO MONITOR CRT.**—Type 8FP4 90-deg crt for closed circuit and industrial TV receivers. Measures 11-7/16 in. front to back.

Sylvania Electric Products Inc., Dept. ED, 1740 Broadway, New York 19, N.Y.

CIRCLE 246 ON READER-SERVICE CARD

**UNIVERSAL CRYSTAL SOCKET.**—Tests crystals with variety of holder pins or leads. Usable from lowest frequencies to over 100 mc.

Lehigh Valley Electronics Engineering & Mfg. Co., Dept. ED, 215 S. Third St., Allentown, Pa.

CIRCLE 247 ON READER-SERVICE CARD

**RETAINING RING KIT.**—Contains 376 cadmium plated Truarc retaining rings. Sizes packed individually in numbered envelopes. Shaft sizes from 1/4 to 2-1/2 in.

Bearings Inc., Dept. ED, 3634 Euclid Ave., Cleveland 15, Ohio.

CIRCLE 248 ON READER-SERVICE CARD

**FLOW INTEGRATOR.**—Model 26 square-root integrator automatically totals flow. Maximum rate of 300 counts per minute.

Librascope, Inc., Dept. ED, 40 E. Verdugo Ave., Burbank, Calif.

CIRCLE 249 ON READER-SERVICE CARD

# PROTECT YOUR COMPONENTS

## ELIMINATE HOT SPOTS

### VENTILATED RELAY RACK CABINETS

MIL Spec Quality

Complete Package  
Modular Construction

Fully Controlled  
built-in  
Cross-ventilation  
System

Cool Exactly  
Where Needed

Cool Heat Load  
of 2-3 KW Input

Proven in  
4 Years' Operation  
in Government  
Laboratories



MODEL  
FC1-24V-68¼H

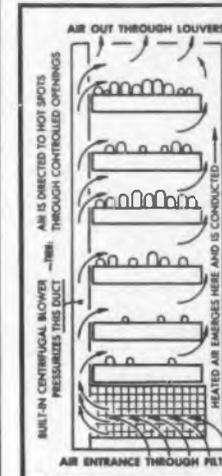
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STANDARD UNITS:  
19" to 24" Panels  
18" to 36" Deep

Matching Consoles  
Available

OTHERS TO YOUR  
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NOTE:  
Adjustable air-flow  
pattern to your  
exact needs is  
effected by snap-in  
closures—no  
'chimney' effect



- Available in cabinets or consoles —with 12-gauge or ¾" steel frame
- Adjustable interior rails afford ready mounting for chassis slides
- Front and rear doors with glass panels or cutouts
- Paint finish to customer requirements

Write for Complete Data: Series FC/ED

## ONE SOURCE...

for VENTILATED RELAY RACK  
CABINETS, CONTROL CONSOLES,  
BLOWERS, CHASSIS, 'CHASSIS-  
TRAK', RELATED COMPONENTS

ORchard 4-3510

## WESTERN DEVICES, INC.

600 W. FLORENCE AVE., INGLEWOOD, CAL.

\*For Inquiries on 'Chassis-Trak,' East of Rockies:  
Chassis-Trak Corp., 525 S. Webster Ave., Indianapolis

CIRCLE 250 ON READER-SERVICE CARD

# THIS IS ZIPPERTUBING

a method of making custom  
electronic cables in seconds...  
at a fraction of the cost!



MEETS  
MIL  
SPECS.

Now available in Vinyl, New Stretch  
Vinyl, Teflon, Nylon, Mylar, Neoprene.  
**Major Advantages**

1. Cables are made by you, on the spot, as needed, without machinery. Production delays eliminated.
2. New stretch compound provides tighter jacketing.
3. Highly abrasion-resistant. Temperature range, -90°F to 450°F.
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5. Provides re-accessibility to conductors, or can be permanently sealed.
6. New method permits cable termination with any type of connector.
7. Sizes from 1/4" ID—continuous lengths to 1000 ft.
8. New metal laminations for shielded or co-axial cable construction.
9. Perforated type or molded "Ys" and "Ts" simplify branchouts.

### Important

If you design or work with electronic cables, it will pay you to try ZIPPERTUBING. Field representatives are nearby—or send for free sample and technical literature.

Offices & Warehouses in All Principal Cities

## THE ZIPPERTUBING CO.

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TWX LA 840

CIRCLE 251 ON READER-SERVICE CARD

**ALLOY CONTACTS.**—Mass-produced Cor-Bond contacts made in one heatless operation. Variety of types and shapes.

Fansteel Metallurgical Corp., Dept. ED, 2200 Sheridan Rd., North Chicago, Ill.

CIRCLE 252 ON READER-SERVICE CARD

**HIGH CURRENT CONNECTOR.**—Series C2 miniature hexagonal unit, two contact, for high altitude applications.

DeJur-Amsco Corp., Dept. ED, 45-01 Northern Blvd., Long Island City 1, N.Y.

CIRCLE 253 ON READER-SERVICE CARD

**CYCLING TIMERS.**—Type 511 and 521 have 1 to 8 independent timed intervals, quickly adjustable. Cycle times from 6 sec to 48 hr.

Cramer Controls Corp., Dept. ED, Centerbrook, Conn.

CIRCLE 254 ON READER-SERVICE CARD

**TWO-STAGE REGULATOR.**—Type GS has magnetic amplifier control input stage and grid-controlled rectifier power output stage. Three sizes: 5, 12.8, and 36 amp maximum.

Clark Controller Co., Dept. ED, 1146 E. 152nd St., Cleveland 10, Ohio.

CIRCLE 255 ON READER-SERVICE CARD

**CENTRIFUGAL BLOWER.**—Turns about 3400 rpm, drawing 3.5 amp. Delivers about 285 cfm at 1.2 in. of back pressure.

Western Gear Corp., Dept. ED, P.O. Box 182, Lynwood, Calif.

CIRCLE 256 ON READER-SERVICE CARD

**MAGNETIC SWITCHES.**—Miniaturized types 6-81, normally open, and 6-83, normally closed, operate 45 deg from vertical position.

The Mercoid Corp., Dept. ED, 4201 Belmont Ave., Chicago 41, Ill.

CIRCLE 257 ON READER-SERVICE CARD

**MOVING COIL MECHANISM.**—End-pivoted model MEP-7 for use with aircraft instruments needing flag or alarm indications with short deflection angle. Weighs 1/2 oz.

Marion Electrical Instrument Co., Dept. ED, Grenier Field, Manchester, N.H.

CIRCLE 258 ON READER-SERVICE CARD

**CURRENT TRANSFORMER TESTER.**—Type AL-1 provides tests at any load from light to 200 per cent. Current ranges are 10 to 2000 amp.

Knopp Inc., Dept. ED, 1307 66th St., Oakland 8, Calif.

CIRCLE 259 ON READER-SERVICE CARD

**CHASSIS SLIDE.**—Model 4000 needs 1 in. side space on each side. Pair holds 350 lb.

Grant Pulley and Hardware Corp., Dept. ED, High St., West Nyack, N.Y.

CIRCLE 269 ON READER-SERVICE CARD

**FANS AND BLOWERS.**—F frame line for 115 or 220 v, 1 or 3 phase, 60 or 400 cps applications.

Air-Marine Motors, Inc., Dept. ED, 369 Bayview Ave., Amityville, N.Y.

CIRCLE 270 ON READER-SERVICE CARD

# AIRCRAFT ARMAMENTS, INC.

Cockeysville, Maryland

AAINC. MODEL 2830

## MISS-DISTANCE MEASURING SYSTEM

AN/USQ-11

- developed by Naval Ordnance Laboratory, Silver Spring, Maryland
- product-engineered and produced by Aircraft Armaments, Inc.



### FOR TARGET DRONES

**OUTSTANDING FEATURES:** Meets MIL-E-5272A 5400B, 16400 -- provides data in 2 min. -- requires transponder in drone only -- measures salvo firings -- determines miss on multiple targets. Target equipment (less power supply) under 2 lbs. Accuracy confirmed by field tests.



TARGET  
TRANSPONDER

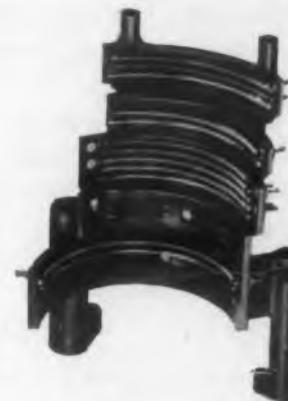
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CIRCLE 271 ON READER-SERVICE CARD



DUAL COIL SECTOR UNIT in which elements are independently phasable with slider positions.

## A HELCO sector type potentiometer simplifies your overall design



LARGE SECTOR TYPE for airborne computer, manufactured to customer specs. and design.

This type is designed as a direct component of your product, tailored to individual product features. We adapt the potentiometer moving member directly to the moving member of your assembly, and the non-moving member directly to your chassis. This design does away with housings and couplings, giving you:

- SMALLER SIZE—because no housings or bearings used.
- LESS WEIGHT—many parts are eliminated.
- HIGHER RELIABILITY due to reduced complexity.
- LOWER OVERALL COST—no brackets or hardware needed, and units cost less to produce.

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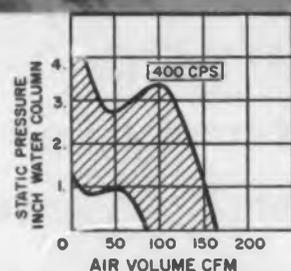
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CIRCLE 272 ON READER-SERVICE CARD

## For 400 CPS Cooling Applications



# AXIMAX-3



For airborne and missile cooling applications, the AXIMAX-3 when turning at 20,000 rpm will deliver 165 cfm at free delivery. This performance is possible although the fan is only 2.8" in diameter, 2.3" in length and weighs a mere 14 ounces.

Variation in driving motors include constant speed and Altivar designs. The latter automatically vary their speeds inversely with density and thereby approach constant cooling with a minimum of power drain and noise.

Mounting is simplified by the provision of "servo" clamping rims at either end of the barrel. Airflow can be reversed by turning the fan end-for-end. Electrical connection is made to a compact terminal block. Power requirement is 400 cps, 1 or 3 phase.

Write today for complete technical details to . . .



## ROTRON mfg. co., inc.

WOODSTOCK, NEW YORK

In Canada: The Hoover Co., Ltd., Hamilton, Ont.

CIRCLE 274 ON READER-SERVICE CARD

## NEW LITERATURE

### Deflection Components 472

Precision deflection systems and components designed for ITV and broadcast cameras and other cathode ray tube applications are described in 6-page Form 3R 3295. Pictures and text present commercial and ruggedized components for image orthicons, vidicons, TV monitors, radar, flying spot scanners, and compositrons. Radio Corporation of America, Commercial Electronic Products, Camden 2, N.J.

### Hardware 276

Catalog W600 lists a full line of electronic and electrical components. It includes solder terminals, swagers, terminal boards, hardware, insulated terminals, coils, coil forms, and capacitors. Dimensional drawings and detailed specifications cover each product. Cambridge Thermionic Corp., 445 Concord Ave., Cambridge 38, Mass.

### Precision Marking 277

A four-page pamphlet, "Precision Marking And Fabrication in All Metals, Plastics and Phenolics," is available. The bulletin describes the manufacture of precision engraved marking and fabrication of dials, scales, panels, instruction plates, and precision screen printing. Gray Pantograph Engraving Co., 200 Washington St., Hoboken, N.J.

### Toroids and Filters 278

A 24-page, clip-bound catalog containing a table of operational functions, diagrams, and information on useful relationships for network design. Ortho Filter Corp., 196 Albion Ave., Paterson 2, N.J.

### Power Supplies 279

A line of transistorized low-voltage high-current dc supplies, with outputs of 6, 12, or 28 v, at 15 or 30 w, is discussed in a product data sheet now available. Complete specifications for 6 different models are provided. Sorensen & Co., Inc., Richards Ave., S. Norwalk, Conn.

### Connector Test Report 280

Laboratory testing of miniature electrical connectors is the subject of a 29-page report now available. A complete series of tests for electrical, environmental, and physical characteristics is discussed with the aid of diagrams and tables. The Deutsch Co., 7000 Avalon Blvd., Los Angeles 3, Calif.

### PC Facilities 281

A concise discussion of printed circuit facilities. The 4-page brochure outlines the physical and engineering facilities for circuits used in missiles, guidance systems, computers, data processing equipment, radar and quality instruments. Electralab, Inc., Industrial Center, Needham Heights 94, Mass.

### Clutches and Brakes 284

Described in a 4-page leaflet are the performance, specifications, and dimensional characteristics of miniature industrial clutches and brakes. The illustrated units feature high torque rating, rapid response, zero backlash, and light weight. Autotronics, Inc., Box 812, Florissant, Mo.

### Semiconductors 285

Electrical and physical characteristics of semiconductor products are covered in a recently published folder. Product lines have been broken down into categories which include: silicon junction diodes, medium voltage diodes, zener reference diodes and elements, zener power voltage regulators, and silicon solar cells. Hoffman Electronics Corp., Semiconductor Div., 930 Pitner Ave., Evanston, Ill.

### Resin Rods 286

Fact Sheet No. 1 is a 4-page brochure, which gives sizes available, new engineering data, tips on machining, and typical uses of Teflon rod stock. Diameters of these rods range from 1/32 to 2 in., in extremely small increments. Chemplast, Inc., 3 Central Ave., E. Newark, N.J.

**Decade Counter Tubes 287**

An 8-page brochure is now available concerning electrical characteristics and application data on the most popular counter tube types. While listing min and max ratings on a variety of bi-directional counter tubes, it also contains information on the latest drive circuits, including an improved 0 to 4 kc driver and a simple circuit for counting rates of 30 kc and below. Sylvania Electric Products, Inc., 1100 Main St., Buffalo, N.Y.

**Vibration Film 288**

"Vibration and Its Measurement" is the title of a technical film, which gives viewers the opportunity to see special equipment designed for measuring accelerometer sensitivity at 500 F while mounted to a standard shaker, in addition to the test procedures and special devices designed to measure lateral sensitivity. Design criteria for an accelerometer are compared with desired ranges of frequency, dynamic loading and environment. Endevco Corp., 161 E. California St., Pasadena, Calif.

**PC Design Data 289**

In an effort to define correctly certain special terms regarding high quality printed circuitry, a collection of design data sheets has been released. Entitled "Printed Circuit Design Data," it presents a more exact description of the various contributory factors and provides important definitions of such terms as: registration, silver migration, and bond strength. Electralab, Inc., Industrial Center, Needham Heights 94, Mass.

**Resin Wall Chart 290**

A compilation of data concerning various standard resins. The resin categories covered in the chart are: stycast casting resins, eccocoat plastic surface coatings, eccobond adhesives, cements and sealants, eccoseal impregnating resins, and eccobild tooling resins. Such properties as thermal expansion coefficient and max and min use temperatures are shown. Information is given as to possible uses and expected results. Emerson & Cuming, Inc., 869 Washington St., Canton, Mass.

**Printed Circuits 291**

A 4-page booklet supplies information pertaining to printed circuits, copper-clad laminates, base laminates, and fabricated parts. The bulletin provides tables, design recommendations, and tolerances. Northern Plastics Corp., Second & Market Sts., LaCrosse, Wis.

**Relays 292**

A wide assortment of relays, steppers, solenoids, rectifiers, and related components is described in a 16-page folder. Universal Relay Corp., 42 White St., New York 13, N.Y.

**Toroids and Filters 293**

Toroids, filters and related networks for military, industrial and commercial applications. Catalog 104 consists of 16 color pages covering applications together with schematics and performance curves. Developments in the field of telemetering, including a new series of constant delay band pass and low pass filters, are featured. Burnell & Co., 10 Pelham Parkway, Pelham, N.Y.

**Mean Temperature Nomogram 294**

To avoid the incorrect "easy method" of finding the average temperature difference, a nomogram for logarithmic mean temperature difference has been devised. It involves three columns: the initial temperature difference, the key, and the final temperature difference. Dean Products, Inc., Dean Thermo-Panel Coil Div., 616 Franklin Ave., Brooklyn 38, N.Y.

**Transistor Chart 295**

The availability of a revised transistor interchangeability chart has been announced. It covers all EIA registered types comparable to the company's own types. General Transistor Corp., 91-27 138th Pl., Jamaica 35, N.Y.

**Resistance Soldering 296**

The techniques of resistance soldering on a production basis are described in Bulletin 105M. Advantages of this type of soldering, application notes and equipment available are discussed in the 18-page illustrated brochure. Wassco Electric Products Corp., 204 S. Larkin Ave., Joliet, Ill.

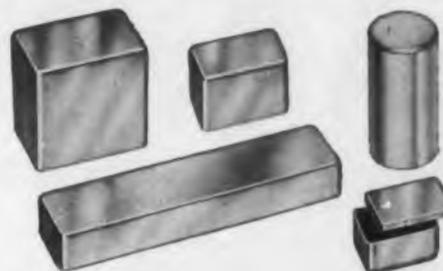


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## RUSSIAN TRANSLATIONS

### What The Russians Are Writing



J. George Adashko

#### MICROWAVES

**Experimental Study of the Mutual-Synchronous Operation of Reflex Klystrons in the Three Centimeter Band** by S. D. Gvozdover, A. I. Kostiyenko, and C. P. Lyubimov. REE 1/58, pp 105-111, 8 figs.

An experimental investigation is made of pair-by-pair mutual-synchronous operation of several reflex klystrons with shifted frequency characteristics, feeding a common load. It is shown that this operation can take place without jumps in the frequency and the oscillator power. The resultant range of electronic tuning of the system of several klystrons can exceed the sum of the ranges of the individual klystrons. This article is a continuation of work done by one of these authors and reported in *Radio-tekhnika i Elektronika*, 1957, Vol. 2, page 1048, August issue.

**Contribution to the Theory of a Spin Generator** by S. S. Kurochkin. REE 2/58, pp 198-201.

The Bloch equations (*Physical Review*, 1946, 70, 460 and 474) are used to determine the conditions under which self-excited oscillations can be maintained in a frequency modulated self-oscillator. The frequency of the oscillations is determined by a system of nuclear spins (specimen) placed in perpendicular crossed magnetic fields (this generator was proposed by Schmelzer, Lectures on the Theory and Design of an Alternat-

ing-Gradient Proton Synchrotron, Geneva, 1953). See Figs. 1 and 2. The author also determines the oscillation frequency and explains the mechanism whereby the build up of the frequency amplitude is limited.

**Effect of Load on Mutually-Synchronous Operation of Two Reflex Klystrons** by A. I. Kostiyenko and G. P. Lyubimov. REE 1/58, pp 112-115.

Companion article to the one by Gvozdover, Kostiyenko and Lyubimov on page 104 of the same issue of *Radio-*

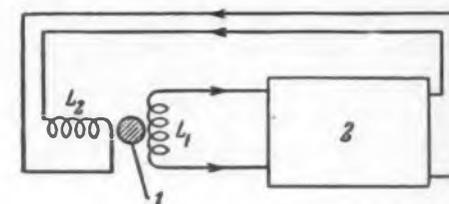


Fig. 1. Spin generator with crossed coils.

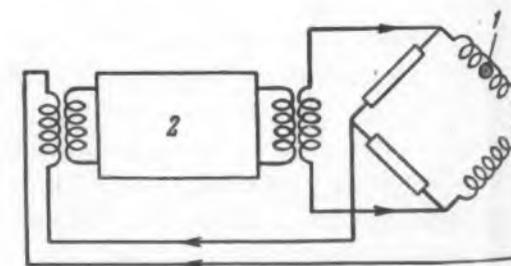


Fig. 2. Spin generator with bridge.

*tekhnika i Elektronika*. The authors have determined experimentally the dependence of the bandwidth of synchronization and of the range of electron tuning of two mutually-synchronous klystrons in the three-centimeter band on the impedance-frequency characteristic of the load. It is shown that both the resulting range of electron tuning, as well as the bandwidth of the synchronization, depend very strongly on the form of the impedance vs. frequency curve of the load and the maximum occurs when the input impedance of the load changes little with frequency. Reference is made to an article by Reed in the *Bell System Technical Journal*, 1953, Vol. 32, No. 3, page 715.

## CIRCUITS

**Synchronization of Self-Oscillators by a Periodic Sequence of Pulses** by P. N. Zanadvorov. REE 2/58, pp 202-213, 7 figs.

The author considers the possible ways of investigating the synchronization of self-oscillators by means of periodic sequence of pulses. The investigation is carried out by means of phasing functions. In the case of low-amplitude radio frequency pulses it is possible to effect synchronizations at frequency deviations corresponding to poly-harmonic beats. The stability region of the synchronization and of the stationary process are examined.

**Radio Station for 420—425 Mc** by B. Yelizarov. R 2/58, pp 24-26, 2 figs.

Description of a walkie-talkie, awarded first prize in the 14th-All-Union Exhibit for Radio-Amateur Equipment.

**Low Frequency Power Amplifier with High Efficiency** by D. V. Ageyev. R 2/58, pp 45-47, 6 figs.

In 1951, D. V. Ageyev proposed the use of pulse power amplification for low frequency circuits for better efficiency, and proposed also a method of technical realization of this idea. A few years later R. Charbonnier proposed a different pulse-amplifier design. Both versions had certain shortages, which are claimed to be eliminated in the scheme described in this article.

## ELECTRON PHYSICS

**Experimental Investigation of the Electron Conductivity of a Space Charge Cloud in a Magnetron** by V. P. Tychinskiy. REE 1/58, pp 116-130, 10 figs.

This paper was delivered on the day of radio conference held in May 1956. Electron conductivity was measured and cyclotron resonance curves of magnetrons were determined. These results were compared with calculated values obtained by the author in an earlier paper (*Radiotekhnika i Elektronika*, 1957, Vol. 2, No. 7, page 112). The author finds good qualitative agreement, and frequently quantitative agreement, with the calculations and explains the anomalies of the electronic efficiency of magnetrons, due to the resonant layers produced in the space charge cloud. Some of the most recently published work in this field (D. Reverdin, *Journal of Applied Physics*, 1951, 22, 257; L. E. S. Mathais (*Journal of Electronics*, 1955, Vol. 1, No. 1, page 18; and H. C. Nedderman, *Journal of Applied Physics*, 1955, Vol. 26, No. 12, page 1420) are found to contradict each other.

**Electron Beam in a Helix Placed in a Dielectric Medium** by V. P. Shestopalov. REE 1/58, pp 131-141, 3 figs.

The propagation of electromagnetic waves in a helix placed in a dielectric medium is investigated in the presence of an electron beam. An expression is derived for the components of the electromagnetic field in various regions of the system, and the resultant dispersion equation is analyzed. As the dielectric constant of the medium in which the helix is placed is increased, the gain of the system diminishes with increase in the range of electron-beam velocities for which amplification is possible.

**Certain Laws of Electronic Current in Vacuum** by M. D. Khaskind. *Journal of Applied Physics*, 2/58, pp 424-428, 2 figs.

The author uses the method of similarity and dimensionality to derive a substitute for the Langmuir "three-halves" law, which is known to be incorrect for low anode voltages. The author claims to establish a general law,



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## RUSSIAN TRANSLATIONS

which is obeyed by the voltage-current characteristic of the electron current in diodes, and which also explains saturation current in thermionic emission. The use of the dimensionality method explains why deviations in the characteristic from the "three-halves" law takes place both in the presence and in the absence of initial velocities of the electrons that leave the cathode. This means that in addition to the initial velocities, there are other factors which are not taken into account in the "three-halves" law theory.

**Nonlinear Theory of Traveling Wave Tube. Part III. Effect of Space Charge Forces** by L. A. Vaynshteyn and G. F. Filimonov. REE 1/58, pp 80-84, 8 figs.

The nonlinear equations of the traveling wave tube, derived in the first two parts of the article (*Radiotekhnika i Elektronika*, 1957, Vol. 2, No. 7, page 883 and No. 8, page 1027) are used to investigate the effect of Coulomb repulsion forces on the operation of a traveling wave tube operating as an amplifier. The results are compared with the works of other investigators, who take the space charge forces into account differently. These other workers are Tien, Walker and Volontis (*Proceedings IRE*, 1955, Vol. 43, page 260), Rowe (*Proceedings IRE*, 1956, Vol. 44, page 200; *Transactions IRE*, 1956, ED-3, 39) and Tien (*Bell System Technical Journal*, 1956, Vol. 35, page 349).

**Grid Integrators of Increased Accuracy for the Calculation of Fields in Electron-Optical Systems** by G. V. Der-Shvarts. REE 2/58, pp 252-256, 3 figs.

The author gives the theory of grid electric-integrators that permits integration of the Laplace equation for plane-symmetrical and axially-symmetrical fields.

**Mechanism Whereby the Efficiency of a Backward Wave Generator (Karsinotron-O) Increases with the Space-Charge Parameter** by G. N. Rapoport. REE 2/58, pp 255 to 261, 4 figs.

Companion article to the preceding one, explaining the increase in backward-wave oscillator efficiency with increasing QC. The author uses a special model of backward wave tubes with separate sections of velocity modulation,



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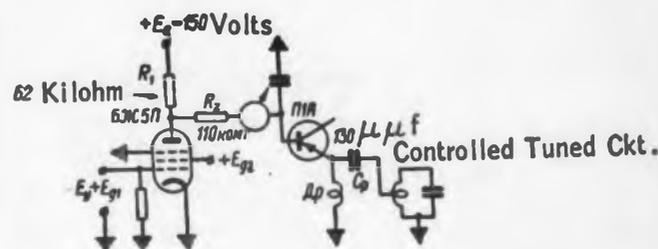
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drift, and power taken from the electron beam. Besides the references listed in the first article, the author refers also to work by Sullivan (*Proceedings IRE*, 1954, 42, 1658) and Heffner (*Proceedings IRE*, 1954, 42, 1930).

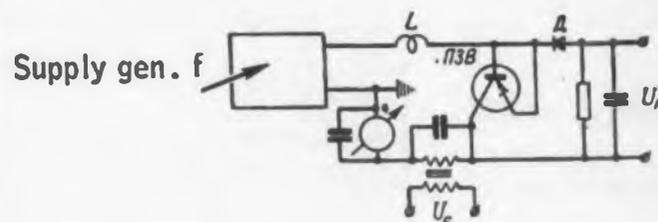
## SEMICONDUCTORS

**Certain Possibilities of Employing the Diffusion Capacitance of Semiconductors** by B. K. Kozlov. EC 1/58, pp 22-25, 6 figs.

The distributed diffusion capacitance in the p-n junction of semiconductors has been getting considerable attention in recent times. The author discusses the practical applications of this phenomenon, as applied to the automatic tuning of a heterodyne and to dielectric amplification. See Figs. 3 and 4.



**Fig. 3.** AFC for heterodyne. Changing the grid voltage of the tube by 0.1 v changes the heterodyne frequency by approximately 10 kc at a signal frequency of 250 kc. Thus, it is possible to obtain a very high AFC coefficient with a properly designed frequency detector and a dc amplifier. In this case the AFC is due not only to the change in the diffusion capacitance, but also the change of the active resistance of the emitter-base section. This circuit operates satisfactorily at frequencies up to 15 mc.



**Fig. 4.** Dielectric amplifier stage. A 24 mv signal ( $U_e$ ) can be amplified to about 0.3 v at  $F = 1$  kc, showing a good possibility of amplifying low-level signals. The author states that this is by far not the optimum design.

**Certain Titanate Ferrites at Microwave Frequencies** by R. G. Mirimanov and L. G. Lomize. REE 1/58, p 155.

Report on the measurements of the dielectric constant and losses at 3.2 cm.

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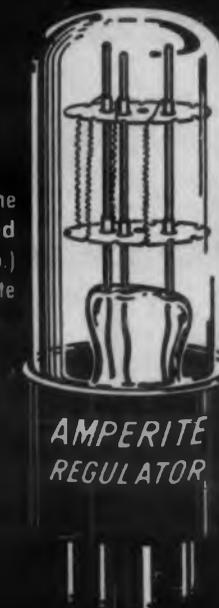
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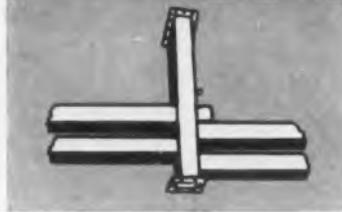
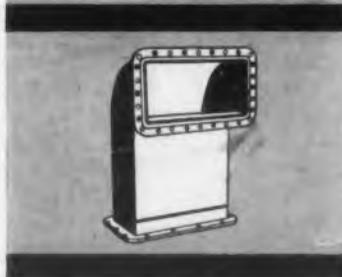
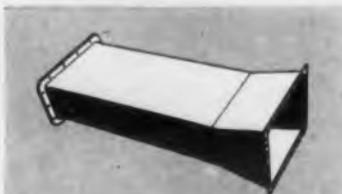
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## GERMAN ABSTRACTS

E. Brenner

## Design

# Of Two Phase Networks

THE NETWORK shown in Fig. 1 can be designed so that the output voltages  $V_1$  and  $V_2$  differ in phase by 90 deg. in a frequency band  $f_1$  to  $f_2$ , within an error margin,  $L$ , which depends on the frequency ratio  $f_2/f_1$  and the number of all-pass sections,  $n$ . Darlington's graph shown in Fig. 2 relates  $L$  to  $f_2/f_1$  for various values of  $n$ . The theoretical

background for the design of such a network was reported in a previous paper (abstracted in *ED*, Nov. 1, 1957).

The networks  $N_1$  and  $N_2$  consist of  $n$  all-pass lattice two-ports of the type illustrated in Fig. 3. The element values are related to the (real) characteristic impedance  $R_0$  and to the characteristic roots  $p_m$  by the formulas

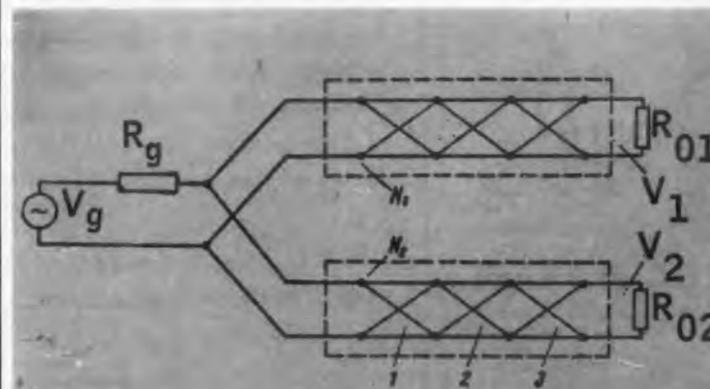


Fig. 1. Two phase network.

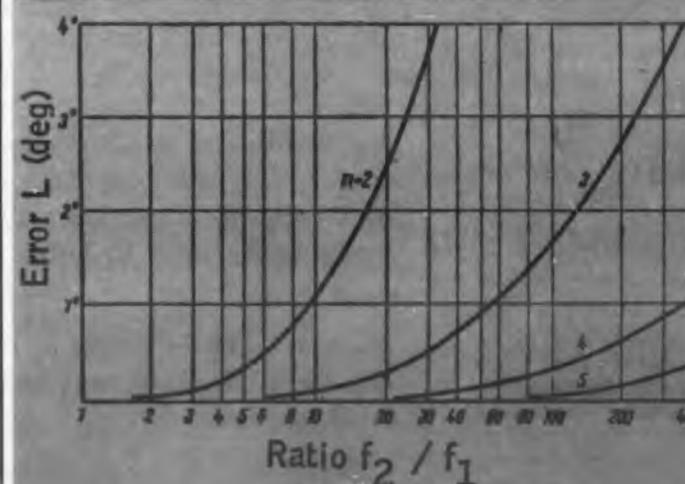


Fig. 2. Curve to relate error in degrees,  $L$ , to frequency ratio and number of sections,  $n$ .

$$R_1 = R_0 - \frac{(1-\alpha)}{(1+\alpha)}; R_2 = R_0 \frac{4\alpha}{1-\alpha^2};$$

$$C = \frac{(1+\alpha)^2}{4\alpha R_0 p_m} \quad (1a)$$

$$R'_1 = R_0^2/R_1; \quad R'_2 = R_0^2/R_2;$$

$$L = R_0^2 C \quad (1b)$$

The parameter  $\alpha$  is the attenuation of each lattice with  $R_0$  as the termination impedance. The value of the source impedance,  $R_s$ , is of no consequence.

For each lattice chain the output input voltage ratio is proportional to the ratio of polynomials  $h(-p)/h(p)$  where  $h(p)$  is a Hurwitz polynomial which, for the assumed structure, has real roots only.

The function which relates  $V_2$  to  $V_1$  has the form

$$\frac{V_1(p)}{V_2(p)} = \frac{k_1 h_1(-p) k_2(p)}{K_2 h_1(p) h_2(-p)}$$

$$= K_3 \frac{H(p)}{H(-p)} \quad (2)$$

The zero and pole location for the desired phase characteristics are given by

$$p_m = \frac{2\pi f_1}{j} \operatorname{sn} \left[ j \frac{4m+1}{4n} K^1 k \right] \quad (3)$$

where  $K^1$  is the complete elliptic integral of the first kind with modulus  $(1-k^2)^{1/2} = k^1$  and  $k$  is  $f_1/f_2$ .

Function  $\operatorname{sn}$  is the elliptic sine function. Equation 3 gives as many roots in the left half as in the right half plane. It can be shown that a root in the right half plane,  $p_m^{(r)}$ , is related to a root in the left half plane,  $p_m^{(L)}$ , through

$$p_m^{(r)} p_m^{(L)} = (1-2\pi)^2 f_1 f_2 \quad (4)$$

It frequently happens that the use of elliptic functions in equation 3 is inconvenient. In that case the roots  $p_m^{(r)}$  can be determined by expansion, using the Thetafunction. A rapidly convergent series is obtained:

$$P_m^{(r)} = 2\pi \sqrt{f_1 f_2} \cdot \frac{\sin \pi v_m - q^2 \sin 3\pi v_m + q^6 \sin 5\pi v_m - q^{12} \sin 7\pi v_m + \dots}{\cos \pi v_m + q^2 \cos 3\pi v_m + q^6 \cos 5\pi v_m + q^{12} \cos 7\pi v_m + \dots} \quad (5)$$

where

$$v_m = \frac{1}{2} \frac{4m+1}{4n}; m = 0, 1, 2, \dots, n-1$$

and

$$q = \exp \left[ -\pi \frac{K(k)}{K(k^1)} \right] \approx \epsilon + 2\epsilon^5 + 15\epsilon^9 + 150\epsilon^{13} + \dots$$

and

$$\epsilon = \frac{1 - \sqrt{k}}{2 + 2\sqrt{k}}$$

The roots  $p_m^{(L)}$  are then determined from (4). Except for the constant  $k_3$ , the expression (2) is now known. The factors in Eq. 2 are then assigned to either  $N_1$  or  $N_2$  according to the following rule: The factors  $p_m^{(r)}$  are assigned to one network; the factors  $p_m^{(L)}$  are assigned to the other. This is also equivalent to arranging the roots in order of increasing absolute value and assigning them to  $N_1$  and  $N_2$  alternately.

At this point the  $\alpha$ s are still arbitrary positive numbers, less than unity. They are generally chosen such that  $R'_2$  is the resistance of the coil whose inductance is  $L$ . The characteristic impedance  $R_0$  is chosen so that convenient inductance values are obtained.

The original paper includes a numerical example with  $n = 3$ .

Abstracted from an article by G. Wunch Nachrichtentechnik, Vol. 8, No. 4, April 1958, pp 154-158.

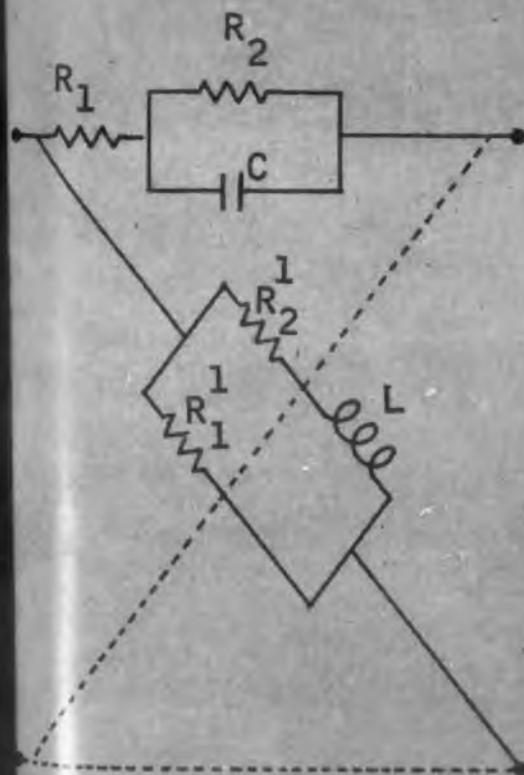
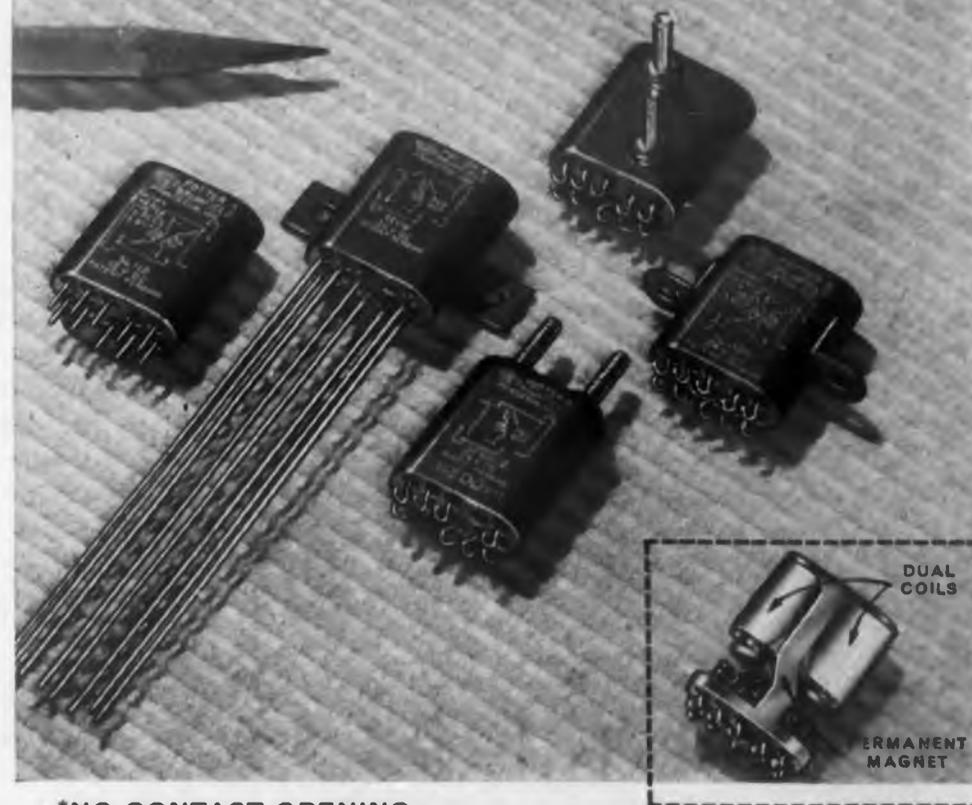


Fig. 3. Symmetrical all-pass lattice.

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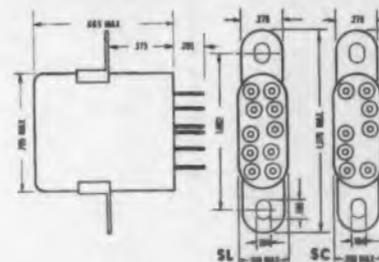
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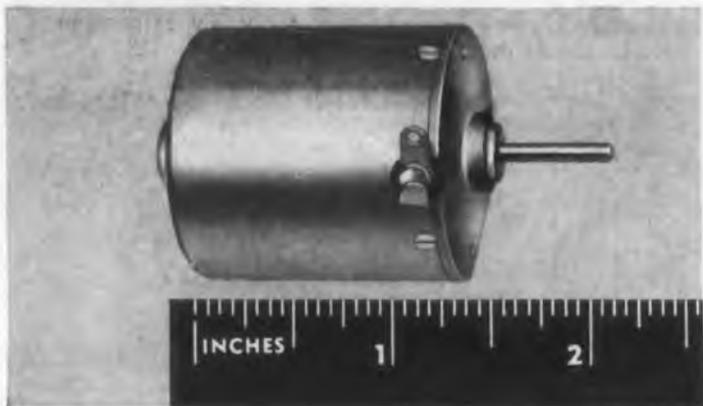
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## STANDARDS AND SPECS

Sherman H. Hubelbank

### Specifying Core Materials

AIEE No. 431, PROPOSED STANDARD FOR PRESENTING DATA ON MAGNETIC AMPLIFIER CORE MATERIALS, APRIL 1958.

The scope of this standard is to set forth the basic data on magnetic amplifier core materials that should be presented by manufacturers of core materials so that the magnetic amplifier will have available the parameters of the material that are particularly significant to magnetic amplifier design. The tests proposed are not intended as methods to be used for matching and grading magnetic amplifier cores. Copies of this proposed standard are available from the American Institute of Electrical Engineers, 33 West 39 Street, New York 18, N.Y. without charge.

### Steatite Standards, 1958

Up-to-date information concerning the various grades of steatite is contained in this standard. Steatite is defined as a generic term for kiln-fired ceramic compositions composed chiefly of various magnesium-silicate crystals. Included in this standard are the electrical properties, mechanical properties, and manufacturing tolerances required for design applications of steatites. Included in the material on testing are test specimens, inspection by acceptance sampling, military spec qualification samples, loss factor tests, dielectric tests, flexural strength tests, resistance to thermal change test, and non-porosity tests. The appendix includes design fundamentals for steatite ceramic components, standard design recommendations, and typical values. Copies of this standard may be obtained from the Steatite Manufacturers Association, 53 Park Place, New York 7, N.Y. for \$1.00 per copy.

### Connectors

MIL-C-25955(USAF), CONNECTORS, ELECTRICAL, ENVIRONMENTAL RESISTING, MINIATURE, WITH SNAP-IN CONTACTS, 9 JANUARY 1958

Miniature electrical connectors, plugs, and receptacles are covered by this recently issued spec. These connectors are of an environment resisting class with snap-in contacts and receptacles of identical mating dimensions of a hermetically sealed class with non-removable contacts.

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For complete information and your free copy of the 12 page Genalex design handbook on the use of toroidal cores please address Dept. E8

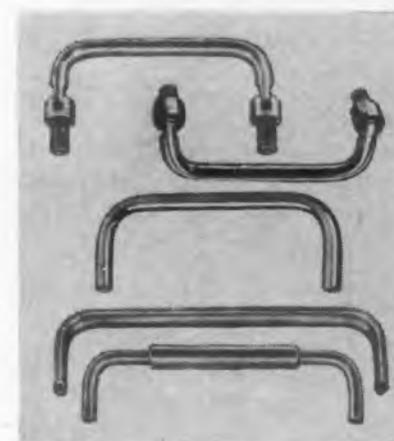
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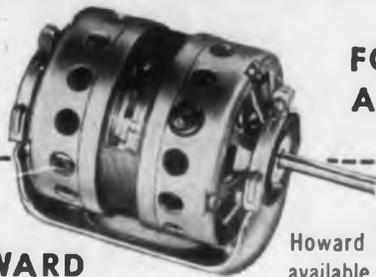
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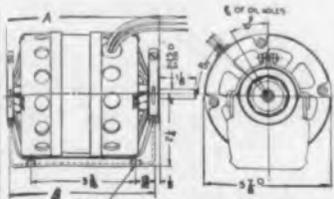
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## Toggle Switches

MIL-S-21195(SHIPS), TOGGLE SWITCHES, 23 JANUARY 1958

Requirements for toggle-type switches for use in ac and dc applications are covered in this spec. A typical type designation of switches meeting this spec is ST42A.

## Capacitors

MIL-C-0025B(USAF), CAPACITORS, FIXED, PAPER-DIELECTRIC, DIRECT-CURRENT (HERMETICALLY SEALED IN METALLIC CASES) 13 DECEMBER 1957

This is a limited coordinated spec for use by the Air Force. It has not been approved as a revision to MIL-C-25A, dated 9 March 1953, however, pending its issuance as a coordinated spec it may be used in procurement. The spec covers d-c, paper-dielectric, fixed capacitors hermetically sealed in metallic cases, intended primarily for filter, bypass, and blocking purposes where the a-c component of the impressed voltage is small with respect to the d-c voltage rating. This spec also covers removable mounting brackets for use with the capacitors.

USAF BULLETIN 134, STANDARDIZED NOMENCLATURE, SYMBOLS AND UNITS OF RADIOMETRIC QUANTITIES IN SPECIFICATIONS CONCERNING INFRARED EQUIPMENTS AND PROCUREMENT ITEMS, 13 JANUARY 1958

This document presents the radiometric nomenclature, symbols, and units along with the evaluation procedures to be used within the Air Force in the description and evaluation of infrared procurement items including equipments, devices, techniques, and research data.

MIL-T-9107(USAF), PREPARATION OF TEST REPORTS, AMENDMENT 1, 21 JANUARY 1958

It is no longer necessary that the following notice be included as part of test reports: "The information furnished herewith is made available for study upon the understanding that the Government's proprietary interests in and relation thereto shall not be impaired. It is desired that the Judge Advocates' Office, WCJ, Wright Air Development Center, Wright-Patterson Air Force Base, Ohio, be promptly notified of any apparent conflict between the Government's proprietary interests and those of others."

## Air Traffic Control

U.S. STANDARD MANUAL OF RADAR AIR TRAFFIC CONTROL PROCEDURES, 1 MAY, 1958

This standard has been officially adopted by the U.S. Army, Navy, Air Force, Coast Guard, and the Civil Aeronautics Administration to standardize the operation of the radar traffic control services.



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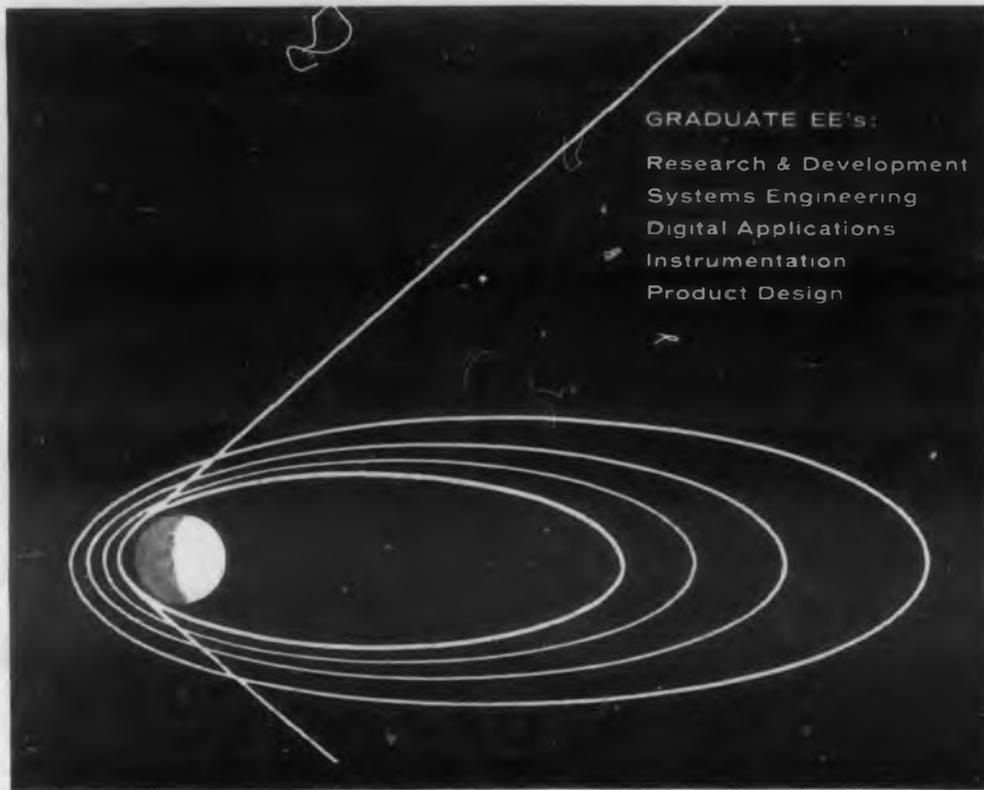
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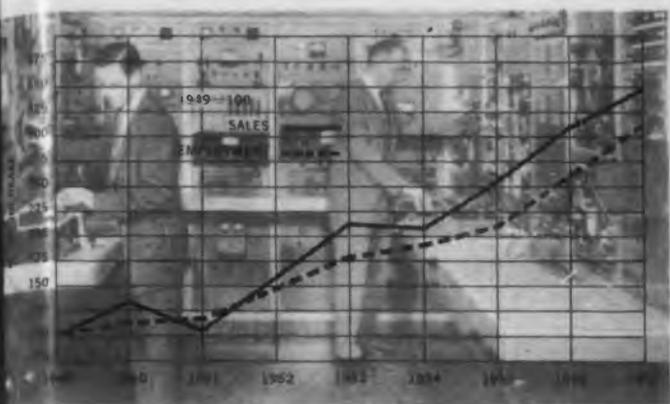


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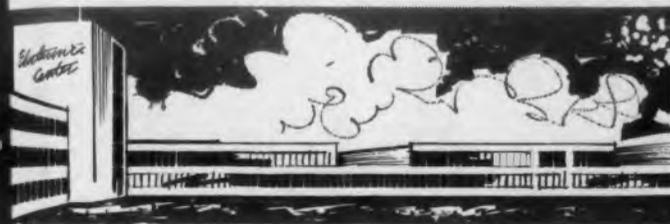
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If the highly desirable combination of *reliable performance* and *low cost* have been difficult for you to find, investigate these three new RCA units: RCA-2N581, RCA-2N583, and RCA-2N585. They are specifically designed, produced and controlled for computer applications; life-tested for dependable service; electrically uniform; available in commercial quantities; and are unusually low in price.

In addition to these three new types, RCA offers a comprehensive line of transistors for your most critical computer designs. For additional information on RCA Transistors, contact your local authorized RCA Distributor or your RCA Field Representative at the office nearest you.

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NEW GERMANIUM ALLOY-JUNCTION TRANSISTORS FOR  
MEDIUM-CURRENT SWITCHING SERVICE IN COMPUTER APPLICATIONS

RCA Type	Typical $f_{\alpha}$ -Cutoff Frequency Mc	Typical DC-Current Transfer Ratio Value at Collector Ma.	Maximum Collector Ma.
2N581* (p-n-p)	8	30 at -20	-100
2N583** (p-n-p)	8	30 at -20	-100
2N585* (n-p-n)	5	40 at +20	+200

\*Jeltec TO-9 Outline (formerly referred to as Jeltec Size-Group 30 Case)  
\*\*Jeltec TO-1 Outline

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