

June 11, 1958

# ELECTRONIC DESIGN

JUNE 25, 1958

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Magnetic Toggle Relay . . . . 20

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# FREED

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*Immediate  
Delivery*

## MAGNETIC AMPLIFIERS AND SATURABLE TRANSFORMERS

### FAST RESPONSE MAGNETIC AMPLIFIERS

2-response Phase reversible

Cat. No.	Supply Freq. C.P.S.	Power Out. Watts	Volt. Out. V. AC	AC or DC signal voltage req'd for full output.
MAF-1	60	13	110	1.0
MAF-4	400	5	57.5	Designed to be driven from vacuum tube or transistor preamplifier.
	400	10	57.5	
MAF-5	400	13	54	1.2
MAF-6	400	5	57.5	1.6
	400	10	57.5	0.6
MAF-7	400	15	57.5	2.5

### SINGLE ENDED MAGNETIC AMPLIFIERS

Cat. No.	Supply Freq. C.P.S.	Power Out. Watts	Sig. req'd for full out. MA-DC	Total res. contr. wdg. K $\Omega$	Load res. ohms
MAO-1	60	4.5	3.0	.685	3800
MAO-2	60	20	1.8	1.3	700
MAO-4	60	400	9.0	10.0	25
MAO-5	60	575	6.0	10.0	25

### PUSH-PULL MAGNETIC AMPLIFIERS

Phase reversible

Cat. No.	Supply Freq. C.P.S.	Power Out. Watts	Volt. Out. V. AC	Sig. req'd for full out. MA-DC	Total res. contr. wdg. K $\Omega$
MAP-1	60	5	115	1.2	1.24
MAP-2	60	15	115	1.6	2.4
MAP-3	60	50	115	2.0	0.5
MAP-3-A	60	50	115	7.0	2.9
MAP-4	60	175	115	8.0	6.0
MAP-7	400	15	115	0.5	8.8
MAP-8	400	50	115	1.75	0.6
MAP-11	400	10	115	.7	6.6

### SATURABLE TRANSFORMERS

Phase reversible

Cat. No.	Supply Freq. in C.P.S.	Power Out. Watts	Volt. Out. V. AC	Sig. req'd for full out. MA-DC	Total res. contr. wdg. K $\Omega$
MAS-1	60	15	115	6.0	27
MAS-2	400	6	115	4.0	10
MAS-5	400	2.7	26	4.0	3.3
MAS-6	400	30	115	4.0	8.0
MAS-7	400	40	115	5.5	8.0

All units designed for 115V-AC operation

Write for detailed information on these and other components for military and commercial applications. Send for NEW 48 page TRANSFORMER CATALOG. Also ask for complete LABORATORY TEST INSTRUMENT CATALOG.

## MILITARY TRANSFORMERS BUILT TO MIL-T-27A SPECIFICATIONS

### AUDIO TRANSFORMERS—STANDARD

Freq. resp. 300 to 10000 c.p.s.  $\pm$  2 db.

Cat. No. MGA	Type Designation TF1RX	IMPEDANCE LEVEL						Ratio	Max. Power IBM	Max. MA DC Unbal.
		Prim. K $\Omega$	CL	Split	Sec. $\Omega$	CL	Split			
-1	-15AJ	10.	✓		90K	✓	✓	1:3	+15	10
-2	-16AJ	.6		✓	4, 8, 16			6.12:1	+33	0
-3	-10AJ	.6		✓	135K		✓	1:15	+15	0
-4	-16AJ	.6		✓	600		✓	1:1	+15	0
-5	-13AJ	7.6/4.8			600		✓	3.56:1	+33	40
-6	-13AJ	7.6/4.8			4, 8, 16			21.8:1	+33	40
-7	-13AJ	15.	✓		600		✓	5:1	+33	10
-8	-13AJ	24.	✓		600		✓	6.32:1	+30	1
-9	-13AJ	60.	✓		600		✓	10:1	+27	1

### POWER TRANSFORMERS—STANDARD

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

Cat. No. MGP	Type Designation TF1RX	Hi V	V DC	A DC	Fil. #1		Fil. #2	
					V	A	V	A
-1	-03HA001	400/200	185	.07	5/6.3	2	6.3	3
-2	-03JB002	650ct	260	.07	5/6.3	2	6.3	4
-3	-03KB006	650ct	245	.15	6.3	5	5.	3
-4	-03LB003	800ct	318	.175	5.	3	6.3	8
-5	-03MB004	900ct	345	.25	5.	3	6.3	8
-6	-02KB001	700ct	255	.25	400—single and			
-7	-02LB002	1,100ct	419	.25	60 and 400—three			
-8	-02NB003	1,600ct	640	.25	phase on special order			

### FILAMENT TRANSFORMERS—STANDARD

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

Cat. No. MGF	Type Designation TF1RX01	V	I A	Test KV	Cat. No. MGF	Type Designation TF1RX01	V	I A	Test KV
-2	-GB003	2.5	10	2.5	-7	-JB008	6.3	10	2.5
-3	-FB004	5.	3	2.5	-8	-KB009	6.3	20	2.5
-4	-HB005	5.	10	2.5	-9	-JB012	2.5	10	10.
-5	-FB006	6.3	2	2.5	-10	-KB013	5.	10	10.

\*400—single and 60 and 400—3 phase on special order

### FILTER REACTORS

Cat. No. MGC	L Hy.	I DC MA	R DC $\Omega$	Test KV	Case	Cat. No. MGC	L Hy.	I DC MA	R DC $\Omega$	Test KV	Case
-2	4.	50	230	1.	AJ	-18	7.	200	135.	2.	HB
-3	10.	50	325	1.	EB	-19	10.	200	125.	2.5	JA
-4	20.	50	475	1.5	FA	-20	2.5	300	50.	2.	GA
-5	30.	50	650	1.5	FA	-21*	4.	300	62.	2.5	HB
-6	3.	75	175	1.	AJ	-22	6.	300	85.	2.5	JB
-7	6.	75	235	1.5	EB	-23*	8.	300	65.	2.5	KB
-8	12.	75	265	1.5	FA	-24	10.	300	100.	2.5	LA
-9	3.5	100	145	1.	EB	-25*	2.	400	37.	2.5	HB
-10	8.	100	180	1.5	FA	-26	6.	400	60.	2.5	KB
-11	12.	100	190	2.	GA	-27*	2.	500	35.	2.5	JA
-12	2.	150	92	1.5	EB	-28	4.	500	45.	2.5	KB
-13	4.	150	115	1.5	FA	-29*	7.	500	50.	2.5	MB
-14	8.	150	125	2.	GA	-30*	2.	700	20.	2.5	LB
-15	11.	150	120	2.5	JB	-31*	1.75	1,000	12.5	2.5	MB
-16	2.5	200	70	1.5	FA						

\*Not stocked, available on short del.

### PULSE TRANSFORMERS

Cat. No. MPT	Pulse Kilovolt	Duration Microsec.	Duty Rate	No. of Windings	Test KV	Z $\Omega$
-1	.25/.25/.25	0.2-1.0	.004	3	.7	250
-2	.25/.25	0.2-1.0	.004	2	.7	250
-3	.5/.5/.5	0.2-1.5	.032	3	1.	250
-4	.5/.5	0.2-1.5	.002	2	1.	250
-5	.5/.5/.5	0.5-2.0	.002	3	1.	500
-6	.5/.5	0.5-2.0	.002	2	1.	500
-7	.7/.7/.7	0.5-1.5	.002	3	1.5	200
-8	.7/.7	0.5-1.5	.002	2	1.5	200
-9	1./1./1.	0.7-3.5	.002	3	2.	200
-10	1./1.	0.7-3.5	.002	2	2.	200
-11	1./1./1.	1.0-5.0	.002	3	2.	500
-12	.15/.15/.3/3	0.2-1.0	.004	4	.7	700

## TELEMETERING COMPONENTS

### BAND PASS FILTERS

Cat. No. Z $\Omega$ 500	Cat. No. Z $\Omega$ 2,500	3dB Bandwidth per cent of F $_0$		Center Frequency F $_0$ (KC)	Per cent Deviation of F $_0$				Cat. No.
		9 3/4	19 1/2		8 1/2	15.	0.5	1.0	
FBP -10	-34	✓	✓	.4	✓	✓	✓	✓	-10
-11	-35	✓	✓	.56	✓	✓	✓	✓	-11
-12	-36	✓	✓	.73	✓	✓	✓	✓	-12
-13	-37	✓	✓	.96	✓	✓	✓	✓	-13
-14	-38	✓	✓	1.3	✓	✓	✓	✓	-14
-15	-39	✓	✓	1.7	✓	✓	✓	✓	-15
-16	-40	✓	✓	2.3	✓	✓	✓	✓	-16
-17	-41	✓	✓	3.0	✓	✓	✓	✓	-17
-18	-42	✓	✓	3.9	✓	✓	✓	✓	-18
-19	-43	✓	✓	5.4	✓	✓	✓	✓	-19
-20	-44	✓	✓	7.35	✓	✓	✓	✓	-20
-21	-45	✓	✓	10.5	✓	✓	✓	✓	-21
-22	-46	✓	✓	12.3	✓	✓	✓	✓	-22
-23	-47	✓	✓	14.5	✓	✓	✓	✓	-23
-24	-48	✓	✓	22.0	✓	✓	✓	✓	-24
-25	-49	✓	✓	22.0	✓	✓	✓	✓	-25
-26	-50	✓	✓	30.0	✓	✓	✓	✓	-26
-27	-51	✓	✓	30.0	✓	✓	✓	✓	-27
-28	-52	✓	✓	40.0	✓	✓	✓	✓	-28
-29	-53	✓	✓	40.0	✓	✓	✓	✓	-29
-30	-54	✓	✓	52.5	✓	✓	✓	✓	-30
-31	-55	✓	✓	52.5	✓	✓	✓	✓	-31
-32	-56	✓	✓	70.0	✓	✓	✓	✓	-32
-33	-57	✓	✓	70.0	✓	✓	✓	✓	-33

### DISCRIMINATOR LOW PASS FILTERS

Cat. No.	Center Freq. F $_0$ (cps)	Cat. No.	Center Freq. F $_0$ (cps)	Cat. No.	Center Freq. F $_0$ (cps)	Attenuation
LPO -10	6	LPO -19	81	LPO -28	790	.2 DB at 0.5 F $_0$ 7 DB at 1 F $_0$ 20 DB at 2 F $_0$ 30 DB from 2.5 F $_0$
-11	8	-20	110	-29	900	
-12	11	-21	160	-30	1,050	
-13	14	-22	185	-31	1,200	
-14	20	-23	220	-32	1,600	
-15	25	-24	330	-33	2,100	
-16	35	-25	450	-34	2,200	
-17	45	-26	600	-35	10,000	
-18	60	-27	660			
Characteristic impedance of all—330 $\Omega$						

### INPUT

LPI -10	400	LPI -17	3,000	LPI -23	14,500
-11	560	-18	3,900	-24	22,000
-12	730	-19	5,400	-25	30,000
-13	960	-20	7,350	-26	40,000
-14	1,300	-21	10,500	-27	52,500
-15	1,700	-22	12,300	-28	70,000
-16	2,300				

Characteristic impedance of LPI-10 thru 23—30,000 $\Omega$   
of LPI-24 thru 28—5,100 $\Omega$

### MINIATURE BAND PASS FILTERS

Cat. No.	Center Freq.	Band width $\pm$ 3% of CF	40 DB att. at .5 and 2 times F $_0$
IBP-400	400	$\pm$ 3%	$\pm$ .5 & 2
IBP-1,000	1,000	$\pm$ 3%	$\pm$ .5 & 2

# ELECTRONIC DESIGN

DATA REQUEST PROCESS CARD  
Use Before Aug. 6th, 1958



Name JUN 20 1958

Title

Company

Company Address

City

Zone

State

For Change of Address:  
Old Company Name

Old Company  
Address

10	20	30	40	100	110	120	130	140	200	210	220	230	240	300	310	320	330	340	400	410	420	430	440	500	510	520	530	540	
1	11	21	31	41	101	111	121	131	141	201	211	221	231	241	301	311	321	331	341	401	411	421	431	441	501	511	521	531	541
2	12	22	32	42	102	112	122	132	142	202	212	222	232	242	302	312	322	332	342	402	412	422	432	442	502	512	522	532	542
3	13	23	33	43	103	113	123	133	143	203	213	223	233	243	303	313	323	333	343	403	413	423	433	443	503	513	523	533	543
4	14	24	34	44	104	114	124	134	144	204	214	224	234	244	304	314	324	334	344	404	414	424	434	444	504	514	524	534	544
5	15	25	35	45	105	115	125	135	145	205	215	225	235	245	305	315	325	335	345	405	415	425	435	445	505	515	525	535	545
6	16	26	36	46	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
7	17	27	37	47	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
8	18	28	38	48	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
9	19	29	39	49	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

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Old Company  
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10	20	30	40	100	110	120	130	140	200	210	220	230	240	300	310	320	330	340	400	410	420	430	440	500	510	520	530	540	
1	11	21	31	41	101	111	121	131	141	201	211	221	231	241	301	311	321	331	341	401	411	421	431	441	501	511	521	531	541
2	12	22	32	42	102	112	122	132	142	202	212	222	232	242	302	312	322	332	342	402	412	422	432	442	502	512	522	532	542
3	13	23	33	43	103	113	123	133	143	203	213	223	233	243	303	313	323	333	343	403	413	423	433	443	503	513	523	533	543
4	14	24	34	44	104	114	124	134	144	204	214	224	234	244	304	314	324	334	344	404	414	424	434	444	504	514	524	534	544
5	15	25	35	45	105	115	125	135	145	205	215	225	235	245	305	315	325	335	345	405	415	425	435	445	505	515	525	535	545
6	16	26	36	46	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
7	17	27	37	47	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
8	18	28	38	48	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
9	19	29	39	49	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

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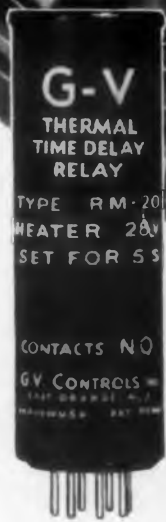
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9.0	$C_{in}$ ( $\mu$ mf)	7.2
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—	$C_{G-P}$ ( $\mu$ mf)	0.05 max.
0.55 max.	$C_{P-K}$ ( $\mu$ mf)	—

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Delegates at four-day Electromagnetic Relay Conference applied much of their energies to discussion of the reliability problem.

**MEETING REPORT** ELECTRONIC DESIGN presents a review of recent conference activity in lieu of the regular Engineering Review.

## Relay Conference Stresses Reliability

**Ben Patrusky**

Assistant Editor

**R**ELIABILITY continues to be the chief concern of relay manufacturers and users. There is little reason to expect improvement. The rapidly increasing stringent demands being made upon the manufacturer will outpace ameliorating effects in advances in the state-of-the-art.

At the Sixth Electromagnetic Relay Conference held at Oklahoma State University recently, one representative summed up the present situation this way:

"We are often being called upon to build relays which we are in no position to make. We build it anyway." He cited instances in which relays built for missile ground support equipment are being used in the missiles themselves.

Paul Gottfried of Inland Testing Laboratories, in a paper delivered at the Conference, explained: "Industry represented at the Conference is making the best relays it can make with present know-how . . . the best isn't enough . . .

while we're capable of determining how good a relay is when it is shipped, we cannot say how long it will stay that way."

The answer is to design reliability into the relay; it is not quality control.

Amplification of the reliability problem was offered by L. E. Massie, design specialist at Convair.

"It is safe to say that statistical evaluation (of reliability) restricts the selection of relays to high production items having an appreciable background of development and use. Many relays now being produced cannot maintain an acceptable degree of reliability. Random samplings disclose a wide variance in quality control and workmanship. This is understandable."

He explained that manufacturers rely on relay assemblers' judgments for such operations as alignment of contacts, contact pressure, and overtravel. Now with the emphasis on minia-

turized and sealed models with greater environmental performance "it is unreasonable to expect a high degree of efficiency from a group of assemblers putting in eight tedious hours a day."

Economic factors, of course, place high in manufacturers' considerations, and the frantic efforts expended to maintain similar tooling at the expense of improved but costly relays plays a highly important role.

"Reliability is basically an engineering responsibility," Mr. Massie stated, but too often the engineers' designs are "apt to be fettered and frustrated by this economic syndrome."

But relay manufacturers are not being caught with their flaps down entirely, as evidenced by several new developments unfolded at the Conference.

T. Ross Welch, manager of TC Components, described a new technique which permits reliability to be designed into the relay. Known as



**VOLTAGE TUNABLE**  
In Thousands—Mc.



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Specifications—QK518. Frequency: 2,000-4,000 Mc. Rapid electronic tuning by varying delay line voltage from 150-1,500 v. Power output: 0.1 to 1 w. Complete with compact permanent magnet. Approximate maximum dimensions: 10" long, 4 3/8" high, 4 7/8" wide.

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Wide, rapid electronic tuning—1,000 Mc. to 37,500 Mc.—is one outstanding performance advantage in Raytheon's extending line of Backward Wave Oscillators. Others are: permanent magnet focusing; high signal-to-noise ratio; operation under conditions of amplitude or pulse modulation.

Raytheon Backward Wave Oscillators are gaining wide acceptance in micro-

wave equipment applications as local oscillators for radar receivers and as signal generators.

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Excellence in Electronics

**MEETING REPORT**

the force-function technique, it helps the designer predict the force developed in the moving armature as a function of ampere-turns applied to the relay coil. Comparison of the two is obtained by direct readout on an x-y plotter. The technique reverses the often used method of reliability-through-statistics. Mr. Welch explained that the force-function curves measure hitherto unobtainable forces and make it possible for the designer to specify all the important parameters such as ampere-turns, amount of armature travel, contact over-travel and force, return spring action, pull-in, etc.

Mr. Gottfried and J. W. Grear of Sandia Corp. outlined step-by-step programs for producing reliable relays and eliminating inconsistencies within lots and from lot to lot.

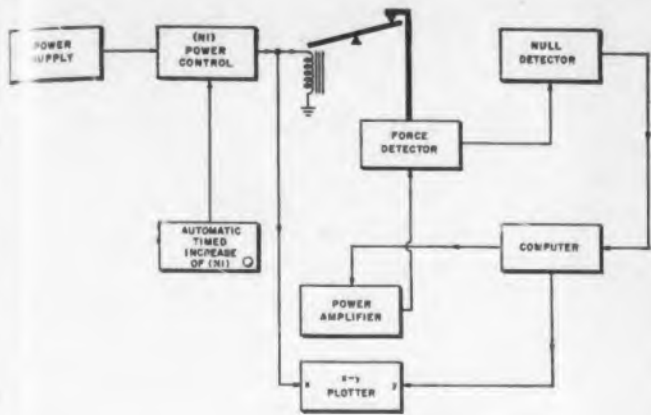
Nor did the Conference experience a dearth in state-of-the-art progress announcements. Two new developments unveiled at the Conference—a 200 C relay and a new mounting arrangement for relays—were of significant interest.

High temperature operation of the 200 C relay is permitted since no organic materials are present on the contact space. The coil is hermetically sealed from the remainder of the relay. High immunity to vibration and shock result from the small mass and relatively high force on contacts when made. Rough calculations were reported to indicate that the relay can with-



Standard bearers James Roughan (1), NARM president; Prof. Charles Cameron; and John Pfeffer, NARM vice-president; discuss standardization program.

◀ CIRCLE 4 ON READER-SERVICE CARD



**Block diagram of force function machine** for plotting force function curves. With suitable application machine permits design of reliability into relay during the early design stages.

stand some 100 g's of inertia forces to open the contact. Test results on development models indicated that the relay could perform satisfactorily at 250 C and higher. Some samples showed no deterioration at temperatures of 350 C. The relay is said to substantially meet the USAF specification (MIL-R-25018). P. N. Bossart of Union Switch and Signal Co. who described the new relay stated that there is "no reason to expect different results in production" from those obtained with development models. Production samples are expected in the third quarter this year.

Using a radically new mounting arrangement, Electronic Specialty Co. has developed a relay which is expected to optimize the performance of conventionally mounted subminiature airborne relays. As described by H. S. Woodward, the relay is mounted right in the cable runs. Leads, which are brought out of each end, serve as supports. Known as the "in-line mounted relay," it provides a very low resonant frequency for the system and increases the damping factor to a very large value. Shocks of short duration are transmitted by such a system to the central mass but reduced in magnitude by a factor of 90 per cent or more when the resonant frequency is low.

At the Conference steps were also taken by the National Association of Relay Manufacturers, who cosponsor the Conference with Oklahoma State University, to thwart the rampant confusion now surrounding the "non-standardized" industry.

The NARM established a technical committee with the aim of preparing a test code to cover "all test requirements encountered by manufacturers of relays to meet the specifications required by the military and other customers."

Six subcommittees were designated to explore specific areas of testing and draw up codes in the following:

- Dry circuits



*Again the Behlman INVERTRON, a completely electronic A. C. Power Source, is in "good company". This time it's with Ford Instrument Co., Division of Sperry Rand Corporation, prime contractor for both the "standard" and Jupiter guidance systems. Famous for advanced research and development facilities, it is only natural Ford Instrument specified the famous Behlman INVERTRON!*

Ford Instrument engineer recording data from a simplex time recorder driven by the Behlman Sidereal Time Standard. The data will be used to compute the drift rate of the air bearing gyro on the test stand in left foreground of picture.

*A variety of INVERTRON models cover the range from milliwatts to kilowatts, from subsonic to supersonic frequencies and for single or multiphase output. Frequencies may be variable or fixed.*

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Representatives in all principal cities and Canada



Photograph courtesy Ford Instrument Co., Division of Sperry Rand Corporation.

CIRCLE 5 ON READER-SERVICE CARD

# ALLIED'S NEW ADDITIONS TO THE KH SUBMINIATURE LINE

## Types KHJ and KHY GENERAL FEATURES:

### Contact Data:

Contact Arrangement—DPDT

### Contact Rating—

Low-level up to 2 amps at 29 volts d-c,  
1 amp at 115 volts a-c 400 cps  
non-inductive or 0.5 amp inductive.  
Life—100,000 minimum at 125°C

Also available 3 amps at 29 volts d-c,  
2 amps at 115 volts a-c 400 cps  
non-inductive or 1 amp inductive.  
Life—100,000 at 3 amps or 500,000  
minimum at 2 amps at 125°C.

Initial Contact  
Resistance—0.05 ohms maximum

Contact Drop—1 millivolt maximum  
at low level rating, initial and during  
low level miss test

### Operate Data:

D-C Coil Resistance—up to 10,000 ohms

Nominal Power—1.2 watts

Pull-in Power—240 milliwatts (standard)  
100 milliwatts (special)

Operate Time—5 milliseconds max.

Release Time—3 milliseconds max.

### Dielectric Strength:

1000 volts rms at sea level  
500 volts rms at 70,000 feet  
350 volts rms at 80,000 feet

### Insulation Resistance:

10,000 megohms minimum at 125°C

## ENVIRONMENTAL FEATURES

### Vibration:

5 to 10 cps at 0.5 inch double amplitude  
10 to 55 cps at 0.25 inch double amplitude  
55 to 2000 cps at 20 g  
Shock: 100 g's operational • 200 g's mechanical  
Ambient Temperature: -65°C to +125°C

## MECHANICAL FEATURES

Weight: 0.5 ounces

### Terminals:

Hooked Solder • Plug-in • Printed Circuit

### Mountings:

2 or 4 hole brackets at base or center of gravity  
1 or 2 stud on top or side of housing

## MILITARY SPECIFICATIONS

MIL-R-25018 • MIL-R-5757C

## ACTUAL SIZES

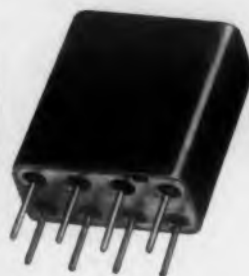
**Type KH**  
First  
Subminiature  
Relay  
**ORIGINATED BY  
ALLIED IN  
1952**



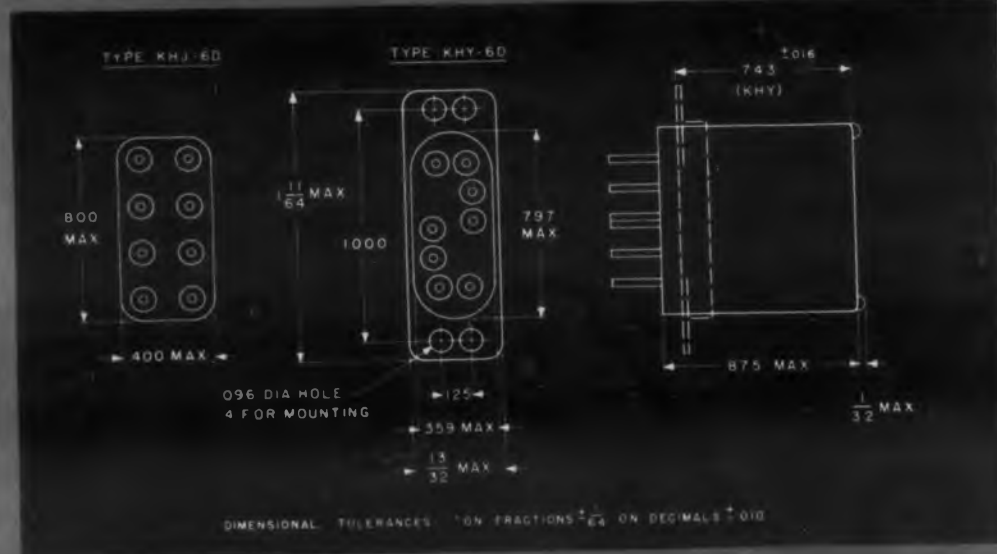
**Type  
KHY**



**Type  
KHJ**



Allied's type KHJ and KHY subminiature relays were developed to meet the present "Automation" need for relays with incremental grid spaced terminals and with improved performance. These relays have a higher contact rating and are designed to meet the increased vibration and shock requirements of the latest MIL specs. They are available with mounting brackets that are interchangeable with Allied's present type KH subminiature relay.



## MEETING REPORT

- Measurement of electrical characteristics
- Contact life testing
- Environmental testing
- Vibration testing
- Shock, acceleration, tumbling.

First reports will be made to the technical committee by June. The final report will be coordinated in time for the Electromagnetic Relay Conference to be held next year. According to NARM President James Roughan, standardization "will do much to eliminate one of our biggest problems—lack of communication between manufacturers and users."

Roughan estimated that there are now 125 to 150 relay manufacturers who in 1957 made combined sales totaling 125 to 150 million.

Another Conference delegate, who chose to go unnamed, suggested: "It will aid us to offset the military nonsense we are subjected to by giving us definitions of our own. The military are constantly changing personnel who frequently don't know what relays are all about. These fellows write specifications. Sometimes it gets to be pretty ridiculous."

But announcement of the standardization program stirred up quite a verbal storm between manufacturers and consumers concerning the value of such a program.

One delegate from an Army installation contended: "Application is the variable causing all the confusion. To imagine that the manufacturers are going to establish general test procedures for the man who needs the relay is highly absurd. We're the guys who specify the relays and they're going to tell us how to test them."

Representing a West Coast aircraft firm, another delegate stated: "Agreed that lack of communication is a paramount problem, but standardization of test procedures by the industry itself is by no means the answer. What we need is communication on a common plane to reduce the gap in understanding between the manufacturers and users."

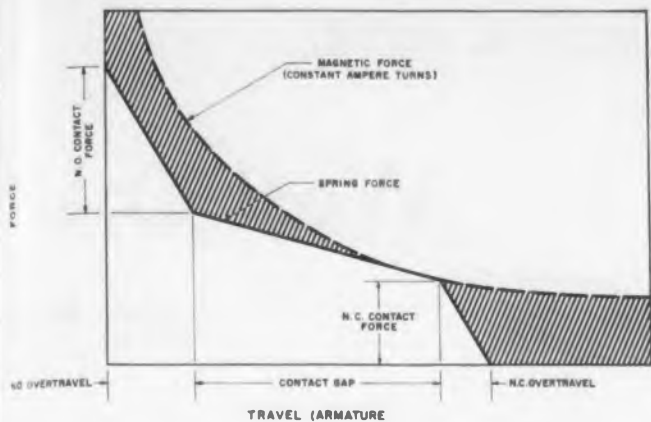
◀ CIRCLE 6 ON READER-SERVICE CARD



# ALLIED CONTROL



ALLIED CONTROL COMPANY, INC., 3 EAST END AVENUE, NEW YORK 31, N. Y.



**Force function curve.** Examination of curve indicates that as ampere-turn force increases gradually, there is a relatively large area of gray zone in which the armature is about ready to go. A desirable condition is that the armature remain open until the magnetic pulling force surpasses the restraining spring forces.

The relay industry must supply primarily tailor-made devices, and estimates are that there are presently 15,000 to 20,000 types in existence. And with new modifications and some radical changes due, new and different types of relays will be required demanding new and individual test procedures.

Prof. Charles Cameron of the Oklahoma School of Engineering, who is conference coordinator, asserted:

"If we knew what we wanted in a relay, at least as far as aircraft and missile needs are concerned—since this is an area quite restrained by limitations in the state of the art—about 90 per cent of the manufacturers' problems would be whipped. We need to know how relays will perform under particular situations in particular circuits."

(Prof. Cameron has harbored for a long time the conviction that manufacturers are not paying enough attention to transient effects on relays. He feels that test procedures are not the complete answer by any means, since relay characteristics may change from application to application. He also feels that transient analysis will play a considerable role in achieving reliable relays. He has delivered at this and previous conferences several papers concerning transient analysis of relays and their implications.)

A representative from another aircraft corporation revealed that 50 per cent of the relays they purchase must be rejected.

Generally, the industry is aware of its limitations and is striving very diligently to alleviate them. But the very nature of this electromechanical device suggests that the rewards will come only after much painstaking effort.

## 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

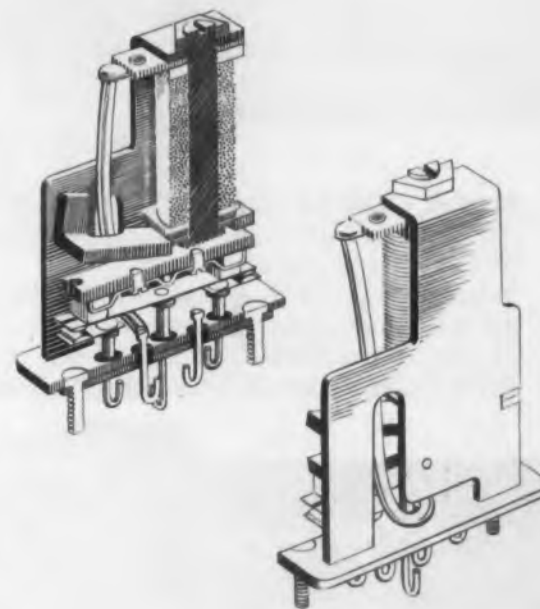
##### FEATURES

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



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**-hp- 152B Dual Trace Amplifier** (for 150A/AR) provides differential input and dual traces electronically switched between A and B channels at either 100 KC or on alternate sweeps. \$250.00.



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**-hp- 151A High Gain Amplifier** (for 150A/AR) offers 5.0 mv/cm sensitivity, response dc to 10 MC. 12 calibrated ranges. Pass band rise time 0.035  $\mu$ sec. \$200.00.



**-hp- AC-21C 50:1 Voltage Divider Probe** for 150A but usable with most other 'scopes, VTVM's, preamplifiers. 10 megohms input impedance; 2.5  $\mu$ f input capacitance. \$25.00.



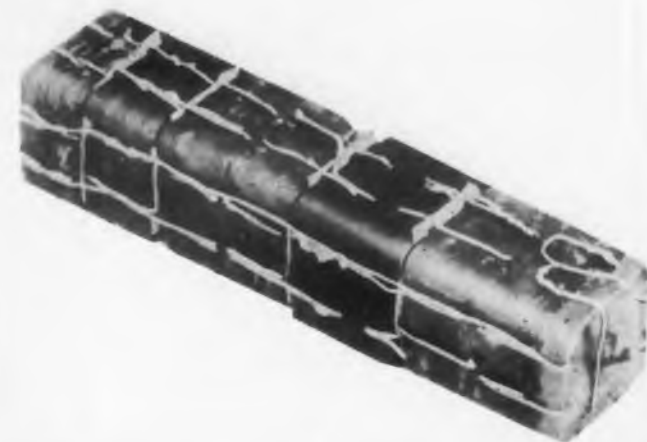
**-hp- 115A Oscilloscope Cart.** Designed for 150A, fits other 'scopes. Heavy chromed tube steel construction, lightweight. Scope shelf tilts 30° in 7½° increments. 4" rubber tired wheels, brakes. \$80.00.

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## MEETING REPORT

# West Coast Co

Tom Mount



**Solid micro-miniature modules** assembled serially. This arrangement is ideal for multi stage amplifiers. As an alternative, module could be mounted side by side on P-C board.

**NOTABLE** during the rash of conferences filling California's calendar in April-May was a genuine "basic research" attitude. Reaction has set in. The consensus, all across the board, was that reliability and better components would be developed through basic research, not so much refinement and testing. Hope was high that somewhere in the new DOD reorganization would be room for "generalized component research funds," as Russell Varian put it at a recent AWA meeting.

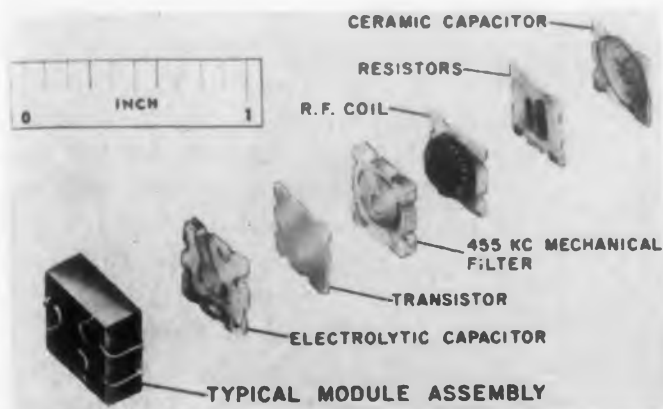
**Electronic Components Conference, Los Angeles**

Corridor-talk between sessions was less about the theme of the conference—reliability—than technique for investigating and using component materials structure to obtain higher performance and long life.

Two gentlemen from RCA, Dale and Cunningham, evoked a great deal of interest in their exposition of "A Revolutionary Electronic Equipment Design Concept." Briefly, Messrs. Dale and Cunningham described a microminiaturization process that carries existing compo-

## Conferences

West Coast Editor



**Typical wafer components** of the minification concept developed by RCA. Wafers are 0.3 in. square and most are 0.01 in. thick. Wafers are assembled into one unit and potted.

ment design to the ultimate *multi-function solid state unit*.

This is a single unit of solid material that would replace a combination of semiconductors, conductors, insulants, ferrites, ferroelectrics, etc., wired together, and function like an entire amplifier or radio receiver or other electronic gear.

The importance of this concept should not be under-estimated. It is not new—magnetic memory plates using ferrites, luminescence amplifiers and the like—are all based on the concept, but the increasing emphasis on this kind of thinking may revolutionize the industry in the not-too-distant future.

RCA's approach to the microminiaturization concept exploits presently known properties of basic solid state materials. A module is constructed of small (0.3 x 0.3 x 0.01 in.) standard wafers of capacitive, resistive, insulating and semiconducting materials stacked one on top of the other, and then sealed together as one module. It is not a kind of tinkertoy, Dale and Cunningham insist.

A personal radio consisting of five modules acting as a converter, two stages

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A general-purpose, 5" oscilloscope of superb design and construction, destined to become the new standard of the industry. This Du Mont scope offers a new high degree of reliability and performance, and incorporates the following features . . .

X-Y plotting with identical, calibrated, high-gain amplifiers.

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CIRCLE 10 ON READER-SERVICE CARD

## MEETING REPORT

of i-f and one audio amplifier, was constructed as a demonstration model. It fits into a fountain pen—and most of the space is taken by the ferrite core loop antenna and variable capacitor.

**Materials:** resistors are made of carbon composition, deposited carbon or metal. Precision capacitors ranging from 1 to 100  $\mu\text{f}$  per wafer can be made with ceramics. Higher capacitance can be obtained by depositing thin dielectric films on a 0.01 in. thick wafer—deposited quartz films show promise for low temperature coefficient capacitors with values up over 1,000  $\mu\text{f}$  per wafer. Utility capacitors with values up to 0.01  $\mu\text{f}$  can be made with conventional high-K dielectric ceramic 0.01 in. thick wafers.

Inductors are planned in the form of toroidal windings on ferromagnetic cores. Fixed tuned circuits will be made of a toroidal coil and associated fixed capacitors fitted within the module. Tunable elements may use back-biased semiconductor like the Varicap voltage variable capacitor.

### 7th Region Technical Conference and Trade Show, Sacramento

This conference was a disappointment to many of the design engineers present. As a regional affair, attendance, exhibits and quantity of technical information presented fell short of what might have been expected.

Of general interest to the design engineer: Telemeter Magnetic's Byrd and Naber's outline of the problems associated with transistorizing core memories, particularly core switch drivers and read amplifiers; and "Technique for Stabilizing An All Transistor DC Amplifier," by Cohu Electronics Research Division's Martin Klein. Dr. Klein described the use of a non-symmetric silicon transistor to raise the input impedance and stability of a dc amplifier, and matched synchronous transistor choppers driving a differential amplifier to compensate for temperature drift.

### Western Joint Computer Conference, Los Angeles

Notable was a panel discussion on logical computer design methods, where the East Coast-West Coast design con-

traversy was thoroughly hashed out. As is usual in such discussions no particular resolution was made one way or the other, though again as usual, most bystanders went away with the feeling that in the future more work would be done using logical equations—the West Coast method.

Bensky of Reese Engineering and R. K. Richards, a New York consultant, speaking pro-block diagrams pointed out that the use of Boolean algebra tended to obscure physical facts and that certain components, like the flipflop and counters, do not lend themselves to algebraic expression.

Engel of Ramo-Wooldridge and Litton Industry's Hess described the use of computers for component design analysis, an important facet of modern computer design, and the avoidance of logical design errors and imprudent logical design—such as over-loading—guaranteed through proper use of Boolean equations.

Points of interest to the designer at the conference were some new ideas in circuit design:

- The combination of a vacuum tube and a transistor into a bistable device. Rudich of Amperex Electronics chose a low power indicator tube (the 6977 sub-miniature) to serve as an active element as well as an indicator. He achieved a power output of 200 mw in a circuit with a trigger requirement of 30  $\mu$ v.

- A novel gating scheme using one diode to connect two circuits. W. J. Poppelbaum of the University of Illinois calls the technique "flow gating." It halves the hardware requirements of a flipflop complex. In this technique the gating is done by changing the supply that operates the bistable device—the average potential of the two circuits is adjusted so that information flows through the diode.

- New ways to use some of the shortcomings of diodes to advantage. Litton's Retzinger uses the carrier storage of a cross-coupling junction diode to speed up a flipflop.

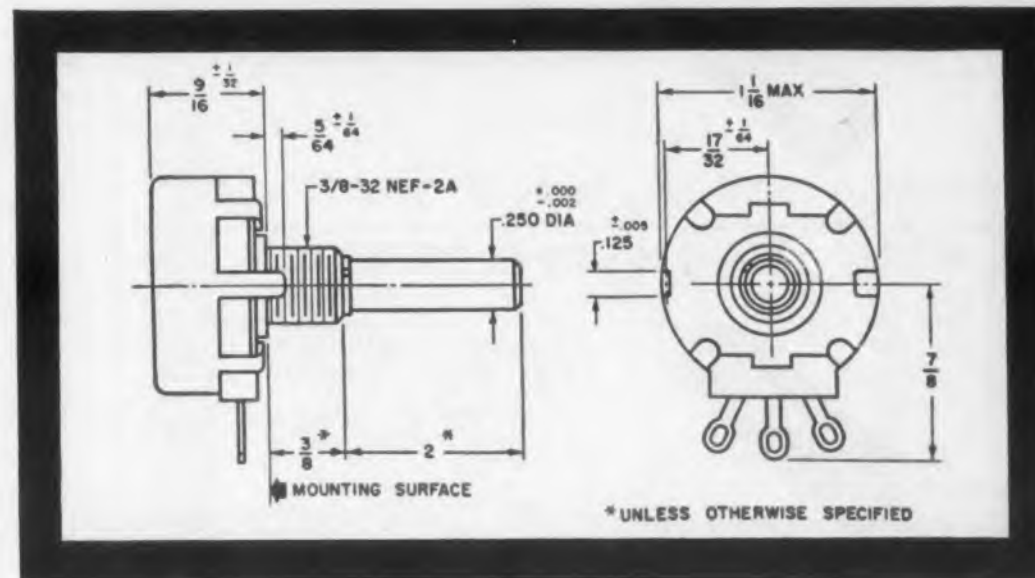
Of interest to the chess enthusiast was the description of a chess playing program for the IBM704. Bernstein, Roberts, Arbuckle and Belsky, all of IBM, showed a program which recognizes and can make all legal moves—with no restrictions on castling, promotions or *en passant* captures!

# HIGH RELIABILITY MOLDED CARBON POTENTIOMETERS

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Typically Clarostat quality, these are **superlative** carbon potentiometers. 2-watt rating. Meet all MIL-R-94 requirements for characteristic "Y" latest specifications. Make any comparison or test you wish!

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Astron Mylar\* Capacitors offer design advantages in size, reliability . . . performance under unusual environmental conditions . . . physical durability,

high insulation resistance and dielectric strength, and lower cost factors. All Astron Mylar\* Capacitors have a working temperature range of  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$

## Metallized Mylar\* Capacitors — Type RLR

A small size, low cost, uncased unit protected with a tough Mylar\* wrap and epoxy end seal . . . to  $125^{\circ}\text{C}$  without derating. The type RLR successfully meets environmental cycling tests in humidity and temperature as outlined in MIL-C-18312A (Navy Spec). Outstanding physical strength . . . and capable of withstanding a test of a D-C potential of twice the rated voltage, applied between terminals for two minutes maximum, without permanent breakdown. Smallest size is  $0.155''$  dia. x  $0.625''$  length.



FOR POTTED AND HERMETICALLY SEALED ASSEMBLIES . . . MILITARY HIGH RELIABILITY EQUIPMENT . . . RADIOS . . . COMMUNICATIONS . . . NOISE SUPPRESSION SYSTEMS.

## Flat and Round Miniature Mylar\* Dielectric Capacitors — Types XPR & XPF

Non-metallic cased units with a Mylar\* film dielectric and an outer Mylar\* tape wrap. The end seals are a plastic thermosetting, moisture resistant resin. The flat and round cases offer unique design flexibility . . . high insulation resistance . . . exceptional capacitance stability. XPF and XPR types can withstand a D-C test voltage of twice the rated voltage for a maximum period of two minutes at  $25^{\circ}\text{C}$ . Smallest size for type XPR is  $.230''$  dia. x  $.750''$  length; type XPF,  $3/4''$  length x  $5/32''$  thickness x  $9/32''$  width.



FOR POTTED AND HERMETICALLY SEALED ASSEMBLIES . . . TIGHT MINIATURE ASSEMBLIES . . . EQUIPMENT WHERE SPACE IS A PRIME FACTOR.

## Mylar\* Metallized Capacitors — Type RQL

A miniature, hermetically sealed, metal case assures outstanding reliability at high temperatures . . .  $125^{\circ}\text{C}$  without derating. This remarkable unit is a space saver and is available in various military case and mounting styles. Outstanding physical strength . . . and capable of withstanding a test of a D-C potential of twice the rated voltage, applied between the terminals for two minutes maximum without permanent breakdown. Smallest size is  $.235''$  dia. x  $11/16''$  length.



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TORONTO, ONTARIO

CIRCLE 12 ON READER-SERVICE CARD

## WASHINGTON REPORT



Herbert H. Rosen

### Army '59 Electronics Disappointing

Recently released hearing reports on the FY '59 appropriations for the U.S. Army show it running a poor third to its sister services, especially in electronics. It is estimated that the Army will spend about \$665 million on electronic equipment, services, and rentals. That's less than 7 per cent of the total \$9 billion appropriation. Meanwhile, the Navy is asking for about almost \$1 billion (10 per cent) and the Air Force, more than \$3 billion (10 per cent), to buy electronics.

The Army's \$665 million is deceiving. The sum reflects overall costs—personnel, facilities, lease rents, etc.—and not hardware and equipment purchases alone. A rough breakdown of the areas in which procurements are to be made shows:

- major procurements, missiles and equipment, \$285 million;
- operation and maintenance (O&M), \$200 million;
- R & D, \$80 million;
- security equipment, \$20 million;
- aircraft electronics, \$12 million;
- training devices, \$8 million;
- Army-wide communications services, \$60 million.

The major procuring agency for electronics, as would be expected, is the Army Signal Corps. The \$565 million it hopes to receive will be divided among studies, tests, personnel charges, and many other non-hardware costs, as well as the electronic and photographic equipment.

One challenging area in which the Army plans to devote effort is electronic warfare. Involved here is equipment to jam enemy projectile, and missile fuses. Also countermeasures to divert and confuse receivers in enemy drone systems, navigational aid equipment, and surveillance radar.

No matter what accounting system is used, it looks like the problem the Army had last year in finding money to equip its Pentomic troops and modernizing its overseas forces will remain with it this year. The small funds allotted to the procurement of simple hardware is deplorable. But of significant importance is the fact that inadequate R & D apportionment will prevent any positive advancements in the basic sciences vital to the existence of the U.S. Army.

## Value Engineering—A Boon

Under the leadership of the Navy Bureau of Ships, many more military departments are becoming aware of "value engineering." A similar awakening is occurring in industry. General Electric stimulated the idea in the Navy, and it has since been picked up by a growing number of companies. Presently the topic is even being included on the agenda of meetings and symposia. And the Industrial Education Institute is planning a series of one-day meetings across the nation. The mission: to acquaint industry with the merits of value engineering.

Actually, value engineering is merely the studious application of common sense to the design of a piece of equipment before it is built. Or even common sense applied to existing equipment. The goals are simply to cut cost and complexity while achieving the desired performance.

By total cost, the Navy means the combined cost of buying, installation, operation, and maintenance. Recognition is given to the fact that specification writers too often overwrite requirements in terms of practical need. However, the company designer, charged with making hardware out of the words, is in a better position to see where the spec writer went overboard.

The Navy is going all out for VE. MIL-V-19853 (SHIPS) is designed to make value engineering a requirement for all BuShips contracts. The Navy pays for the cost of value engineering a product. Moreover, the contractor will be able to share in the savings accrued to the Navy.

In terms of money, the Navy estimates that "actual savings . . . documented (were) \$8.30 for each dollar spent on Value Engineering in fiscal year 1957."

## Electronics R & D Widespread

By some standards, the value of R & D in this country amounts to more than \$12 billion. This includes government, industrial, and university sponsored programs. The National Science Foundation sets that value closer to \$5 billion.

To help anyone interested in obtaining R & D assistance, the Foundation recently published the *Directory of Independent Commercial Laboratories Performing Research and Development*. The document lists 565 independent commercial laboratories that are engaged, at least in part, in R & D activities. It is considerably more restricted, NSF says, than the National Academy of Sciences-National Research Council's *Industrial Research Laboratories of the United States*.

Copies of the Directory may be purchased for \$0.40 from the Superintendent of Documents, Government Printing Office, Washington 25, D.C.



Rome Cable reports . . .

## Du Pont Mylar® helps eliminate reject problem in manufacture of cable for "Titan" ICBM

**PROBLEM:** In designing its instrumentation cable for the "Titan" ICBM project, Rome Cable Corporation wanted a thin, abrasion-resistant tape to protect the insulated conductors from possible puncture by loose strands of the tin-copper braid (See C in illustration). They were also searching for a thin, heat-resistant core binder tape to prevent possible puncture from the outer braid (See A) during extrusion of the cable jacket.

**SOLUTION:** A tape of Du Pont "Mylar"

polyester film for both applications (See B&D). Reason: "Mylar" has the desired balance of mechanical and electrical properties . . . it's tough, abrasion- and puncture-resistant, even in thin gauges. "Mylar" has a high melting point . . . runs well on existing machinery.

**RESULTS:** The two tapes of "Mylar" eliminated shorted cables due to puncture from loose strands of metal. Solving this problem has helped Rome Cable stabilize production, save money on time and

materials and produce a cable that assures better performance and greater reliability in the ICBM.

**How can "Mylar" help you?** Whether you manufacture heavy-duty cable or tiny capacitors, it will pay you to evaluate the combination of properties found only in "Mylar". And when figured on an area basis, this tough, thin polyester film will often *cost less* than your present insulating material. For more detailed information, send in coupon.



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POLYESTER FILM

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E. I. du Pont de Nemours & Co. (Inc.)  
Film Dept., Room EL-5, Nemours Bldg., Wilmington 98, Del.

Please send the new booklet listing properties, applications and types of "Mylar" polyester film available (MB-11).

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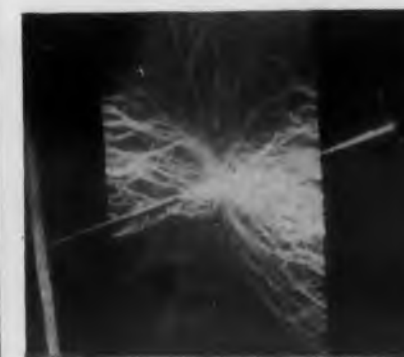
CIRCLE 13 ON READER-SERVICE CARD

## PROPERTIES OF "MYLAR"

"Mylar" offers a unique combination of properties that may help you improve performance and lower costs of your product. Here are two of the many important properties for evaluation.



**HIGH TENSILE STRENGTH.** "Mylar" is strong and durable. Instron Tester shows an average strength of 20,000 psi. It's dimensionally stable . . . resists moisture.



**HIGH DIELECTRIC STRENGTH.** Average of 4,000 volts per mil . . . average power factor of 0.003 to 60 cycles . . . dielectric constant above 3.0 at 72°F., 1,000 cycles.



## See the air-gap on this new lamination for miniaturization

Look at the air-gaps on this new performance-guaranteed lamination we have developed and are stocking. The F-187's fixed air-gap provides constant inductance or linear inductance, as needed, because it prevents d-c saturation of the stacked core.

The F-187  $\frac{3}{16}$ " wide center leg is designed for miniaturized filter circuits for communication applications. It is ideal for carrier equipment, and can be used most successfully for microwave, computer or other applications where frequency control is critical.

Being an "F" shape, the new standard stacks more easily than EI-187, and thus offers welcome savings on the production line. There can be advantages to you, too,

in being able to order any quantity, prototype or production, directly from stock.

There's more detailed information on this new member of Magnetics, Inc. family of "Performance-Guaranteed" laminations—and all of our other standard laminations. Just write—Magnetics, Inc., Dept. ED-49, Butler, Pa.



CIRCLE 14 ON READER-SERVICE CARD

## MEETINGS

**July 24-25: 5th Annual Symposium on Computers and Data Processing**

Albany Hotel, Denver, Colo. Sponsored by the Denver Research Institute, Electronics Div., University of Denver. Symposium will consist of technical papers on basic problems in the field of data processing, particularly in the areas of formalized analysis techniques, logical design techniques, automatic programming, systems organization, digital communications, and components and devices. Queries concerning the symposium may be addressed to C. A. Hedberg, Head, Electronics Div., Denver Research Institute, University of Denver, Denver 10, Colo.

**Aug. 6-8: Special Technical Conference on Non-Linear Magnetics and Magnetic Amplifiers**

Hotel Statler, Los Angeles, Calif. Sponsored by AIEE. The four technical sessions will include: technological and theoretical aspects of non-linear magnetics and magnetic amplifiers; computer applications; special purpose devices and applications; and "new frontiers" in the field. Exhibits will be displayed by 40 manufacturers selected for their contributions to the industry. For more information about the conference, write AIEE, 33 West 39th St., New York 18, N.Y.

**Aug. 13-15: 7th Annual Conference on Industrial Applications of X-Ray Analysis**

Albany Hotel, Denver, Colo. Sponsored by University of Denver, Denver Research Institute, Metallurgy Div. For additional information write William M. Mueller, Metallurgy Div., Denver Research Institute, University of Denver, Denver 10, Colo.

### Courses—Seminars

**July 7-11: Institute in Technical and Industrial Communications.** Colorado State University, Ft. Collins, Colo. Further details may be obtained by writing *Herman M. Weisman, Associate Professor, Department of English and Modern Languages, Colorado State University, Ft. Collins, Colo.*

**July 8-12 and July 14-18: Two Special Summer Programs on Strain Gage Techniques.** Massachusetts Institute of Technology, Cambridge 39, Mass. Additional information may be obtained from *Dr. William M. Murray, Professor of Mechanical Engineering, M.I.T.*

# EDITORIAL

## Must We Start From Scratch Each Time?

The benefit of standardization is a popular theme of the Defense Department. The case for using standardized *parts* is pretty clear. Standardizing *equipment* is usually out of the question if the state of the art is advancing rapidly. An in-between approach to standardization is to standardize the *design* approach. This editorial and several to follow will examine this concept.

Standardization of design steps has been suggested as feasible even for such a volatile field as digital computers for weapons systems. J. M. Bridges of ASOD has asked the computer industry to get away from designing from the ground up every time there is a new project thrown at them. A step in the right direction would be settling on standardized construction techniques and standard circuits. Designs adopted should permit change. They should be flexible to take advantage of technological advances as they happen. Possibly it's not too much of an oversimplification to believe that design techniques could change in a step pattern—where engineering would use a certain set of circuit designs for a time, then, after a significant contribution of the art comes along, change to the next better step.

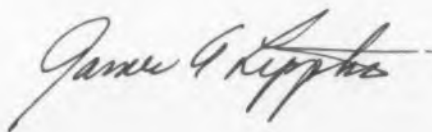
The standardization advocated by Bridges is a living thing. It does not stifle, nor does it allow each engineer to go off in his own direction each time he sits down with a slide rule. Bridges asked industry to take the lead in establishing standards.

ELECTRONIC DESIGN polled computer manufacturers some months back to get their reaction to this concept. We asked (1) what areas of computer design were susceptible to circuit standardization, (2) if physical modularization on a standardized basis could be accomplished, (3) for specific recommended standards. We also asked how to accomplish all this, or if it is too premature to think of standardizing.

The consensus of opinion was:

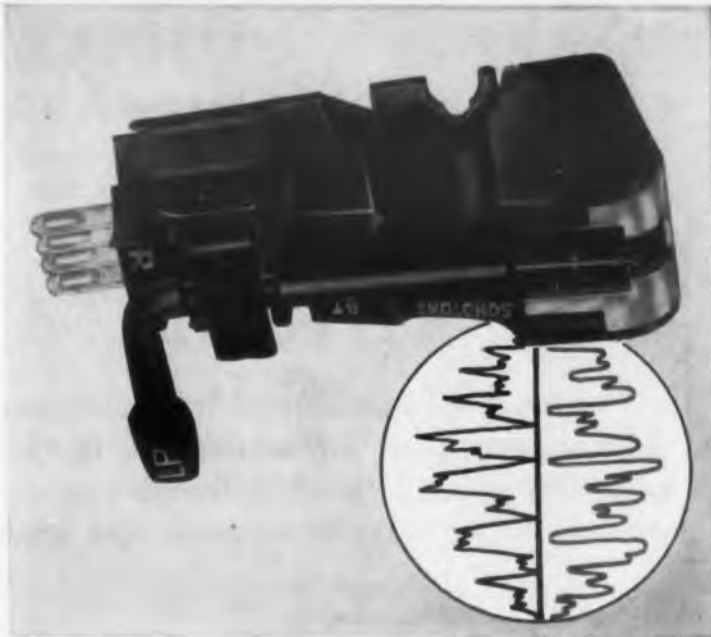
- It is too premature to standardize on any specific aspect;
- Some philosophy of flexible standardization is desirable and should be undertaken;
- If anything is to be done, the Defense Department must show the way.

The range of answers went from "impossible" to "we are doing it now." In future editorials we will examine replies in detail which point to better design. The problem is well stated by J. H. Bigelow of the Institute for Advanced Study in Princeton. To paraphrase Mr. Bigelow: Standardization will never be achieved as a goal—we can only provide incentive for its inclusion in planning, research, development, and production. Heretofore the first three stages have been all but ignored.



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Cartridge Weight .....	7.5 grams.
Channel Isolation .....	20 decibels.
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Electronic Applications Division, Dept. CGG-68

ELMSFORD, NEW YORK

CIRCLE 15 ON READER-SERVICE CARD

# Minimize Local Oscillator Drift\*

W. Y. Pan and D. J. Carlson

R.C.A. Victor Television Division  
Cherry Hill, N.J.

## Part 1

Conventional methods of frequency compensation and frequency drift measurement are inadequate in the face of the stability and reliability needs of modern complex receivers. Analytical approaches provide better ways to measure and minimize local oscillator drift.

VIRTUALLY every parameter of a local oscillator system has some effect on the operating frequency. Five significant factors affect the parameters, and hence the oscillator frequency.

**1. Harmonics**—Harmonics generated in a local oscillator cross modulate each other and the fundamental to produce currents at the fundamental frequency that are not necessarily in phase with the fundamental frequency currents from the normal mode of operation. The phase of the resultant fundamental frequency current changes the frequency of operation. This becomes sensitive to the amount and distribution of harmonics in the

circuit. A tuned circuit with a high Q can minimize the effect of harmonic voltages on frequency stability.

**2. Input-Power Fluctuations**—Fluctuations in line voltage, change the amount of power being supplied to the oscillator tube. This affects the temperature rise of the tube electrodes as well as the tuned-circuit elements. In addition, any input-power fluctuation alters the phase relationship between electrodes thus producing an instantaneous shift of the oscillator frequency.

**3. Secular Effect**—In most tuned circuits, the operating frequency changes with the passage of

time, even if the temperature and other conditions are maintained constant. This secular effect is often referred to as "aging." It is present to a greater or lesser extent in all known tuned circuits and tubes but may be held to a minimum by a choice of materials which are inherently stable.

**4. Humidity**—The conductivity, dielectric constant, and dielectric strength of air are affected by its pressure and humidity. Therefore, the frequency of a tuned circuit with air dielectric components is a function of these variables. Moreover, the mechanical dimensions of coil forms and supports often change with humidity. Precise control of frequency is, accordingly, possible only if suitable precautions are taken in the construction of the circuit elements.

**5. Ambient Temperature Rise**—The frequency deviation of an oscillator resulting from ambient temperature rise is commonly known as "warm-up drift." It is the principal and unavoidable cause of frequency instability in practically all receivers.

### How to Record Frequency Deviations

Heretofore, measuring oscillator warm-up drift was done by tracking the oscillator signal manually. An operator was required during the entire drift run. Sudden changes in oscillator frequency were often missed.

The operating principles of the automatic and continuous recording equipment are shown by the block diagram in Fig. 1. By using broadband networks in the rf unit, dependence of the recording equipment on the tuner local oscillator is eliminated and only the detected sine-wave difference-signal is used in the video unit. The sine wave is shaped into a square wave and later rectified. The dc output is directly proportional to the frequency deviation of the local oscillator under test.

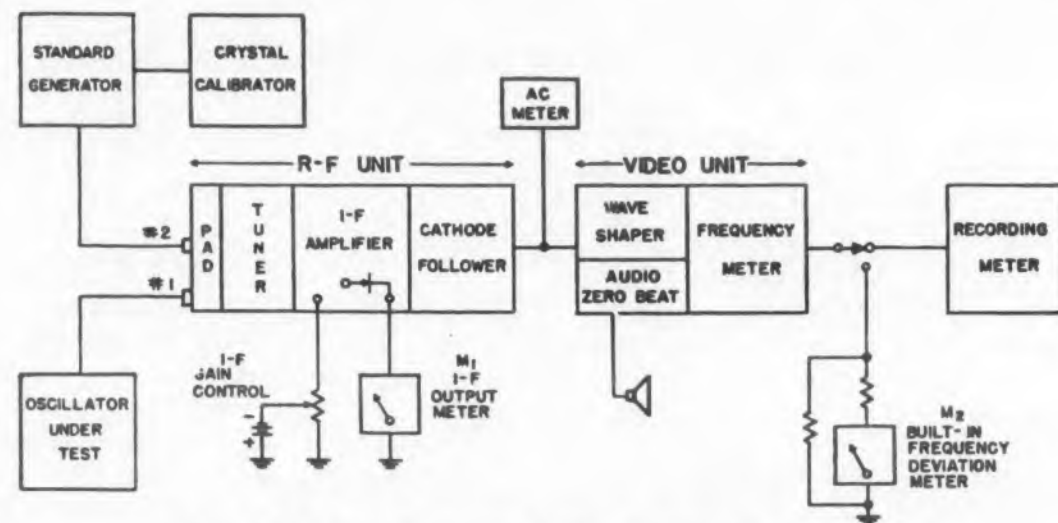


Fig. 1. Automatic frequency deviation recording apparatus.

\*By courtesy of Product Engineering, Radio Corporation of America.

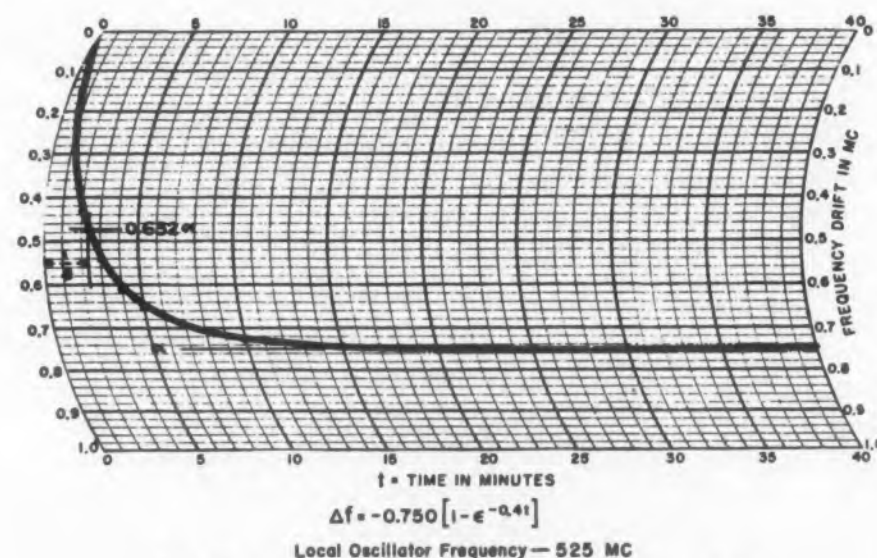


Fig. 2. A sample recording of local oscillator drift.



Fig. 2 shows a recording made by this equipment on the 1.0 mc full-scale range. The frequency of the oscillator under test was 525 mc, typical for some aviation radar and uhf television receivers. In this sample oscillator, all circuit elements external to the oscillator tube are not temperature-sensitive. Therefore, the oscillator frequency drift is caused only by the variations of tube capacitances.

#### Analysis of Local Oscillator Drift

■ **Oscillator-Tube Drift**—The heat flow in an oscillator tube depends on the instantaneous temperature of the hot bodies, the geometry of the tube elements, and other factors. The instantaneous cathode-to-grid radiation, for instance, is

$$Q = \alpha (1 - \epsilon^{-\beta t}) \quad (1)$$

where

$t$  = time

$\alpha$  = total radiated power

$\beta$  = a time constant, determining the rate of heat flow from the cathode to the grid.

The cathode-to-grid radiation raises the grid temperature which transforms the grid configuration and geometry.

The resultant physical changes taking place in the grid structure cause deviations in interelectrode capacitances and hence the oscillator frequency. For small frequency deviation ( $\Delta f$ ), the expression for  $\Delta f$  takes the same form as Eq. (1), except that  $\alpha$  = the maximum oscillator-frequency deviation and  $\beta$  = the rate of change of oscillator frequency.

The frequency characteristics of the 525 mc sample oscillator recorded in Fig.

2 can be represented analytically

$$\Delta f = -0.750 (1 - \epsilon^{-0.4t}) \quad (2)$$

where

$$\alpha = -0.750 \text{ mc}, \beta = 0.4$$

and the time,

$t = 0$  when the local oscillator has been energized exactly one-half minute to enable the receiver to attain operable conditions.

To determine the value for  $\beta$ , a point corresponding to  $0.632\alpha$  is located on the curve in Fig. 2. The time required at that point is the reciprocal of  $\beta$ . The dots drawn along the recorded curve are calculated from Eq. (2), and the accuracy of the analytical representation is believed to be good enough for all practical purposes.

■ **Circuit-Element Drift**—The general analytical expression of Eq. (1) applies also to any circuit element that is temperature-sensitive when it is subject to the flow of heat. When several such elements form parts of a local oscillator circuit, the frequency drift caused by each element must be expressed by an exponential equation; thus the overall frequency deviation  $\Delta f_o$  becomes

$$\Delta f_o = \alpha_1 (1 - \epsilon^{-\beta_1 t}) + \alpha_2 (1 - \epsilon^{-\beta_2 t}) + \dots \quad (3)$$

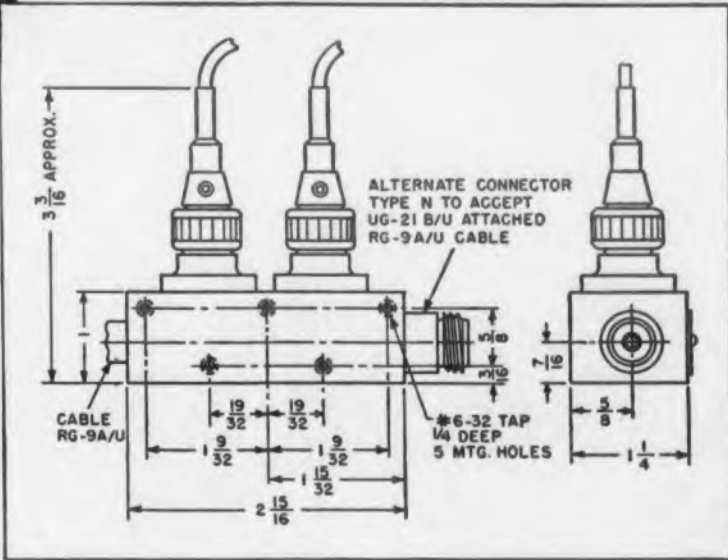
However, when the relative magnitudes of  $\alpha_1, \alpha_2 \dots$  vary substantially, or the values of  $\beta_1, \beta_2 \dots$  do not differ too much, the overall frequency deviations for all the circuit elements can be approximately given by

$$\Delta f_o = \alpha_o (1 - \epsilon^{-\beta_o t}) \quad (4)$$

Part 2 of this article will show a practical stabilization procedure.



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# COMPACT, 3-OUNCE TIME DELAY RELAY

with silicone-controlled  
delay from 1/4 to 120 seconds



**Worth a closer look . . .** the Heinemann Type A Silic-O-Netic Relay. Despite its small overall size, the relay offers many big performance features.

For example, double-pole, double-throw switching . . . at fast snap-action contact speed.

The relay is a load carrier in itself: it may be energized continuously . . . does not require auxiliary lock-in circuits.

And it has a hermetically sealed time element that is forever free from the effects of aging or fatigue. The Type A Relay has proven itself in countless applications; it will give you reliable service over a long, long operational life.

For full details, refer to Bulletin T-5002. A copy will be sent on request.

## BRIEF SPECS

**Time Delays:** from 1/4 to 120 seconds

**Overall Dimensions:** 2-1/16" x 2" x 1-9/16"

**Contact Capacity:** 3 amps at 120V AC, 1.5 amps at 240V AC (non-inductive load), 1 amp at 50V DC, 0.5 amp at 125V DC.

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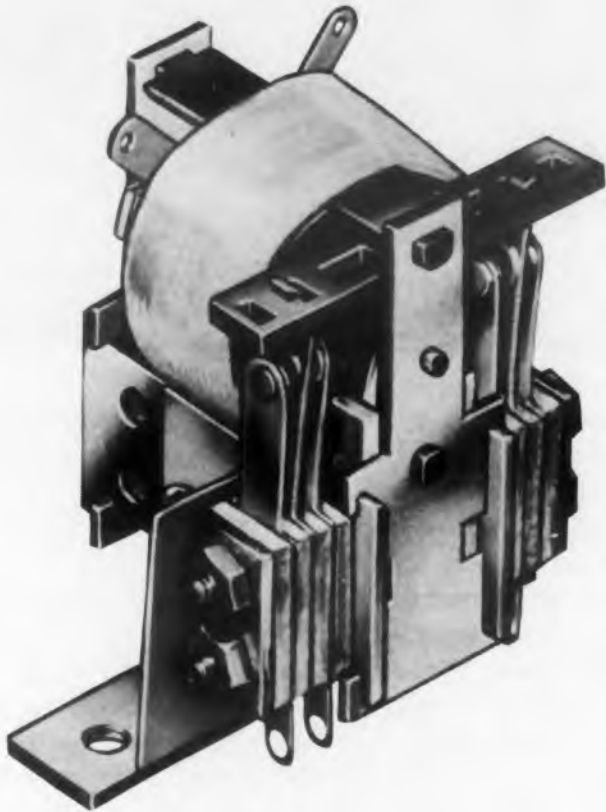
156 Plum St., Trenton 2, N. J.



S.A. 1678

CIRCLE 17 ON READER-SERVICE CARD

# Magnetic Toggle Relay



## Holds Without Holding Power

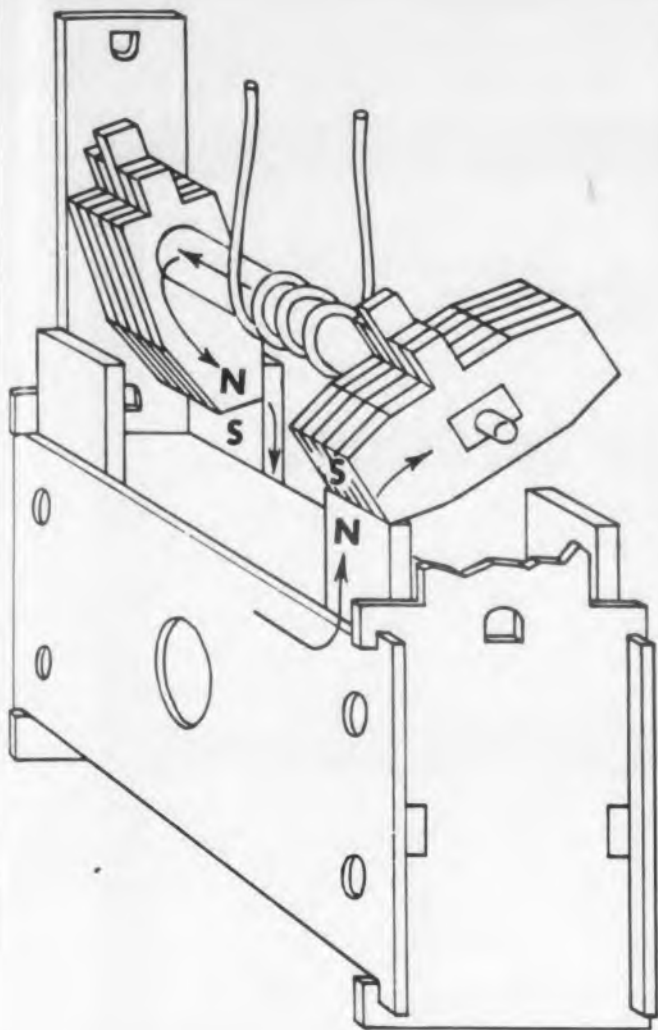
**W**ITHOUT mechanical latching, or electrical holding power, this relay is always in a fully energized position. Designed by American Monarch Corp., 81 Lowry Ave. N.E., of Minneapolis, Minn., it represents a radical departure from conventional relay designs—the first in many, many years.

With the same coil, the new relay operates from ac or dc voltages, and from 1 to 115 v. Unlike former relays, this one is pulse operated, and has two very stable positions. When the coil is pulsed with a voltage of the right polarity, the relay switches, and stays in the new position. Another similar pulse has no effect. A pulse of the opposite polarity is needed to switch the relay.

Two permanent magnets hold the Magnetic Toggle Relay (MTR) in either of its two normal positions. The coil armature acts as the magnet keeper. The ends of the armature are magnetically polarized when current is applied to the coil.

If a pulse creates an armature field to oppose the permanent magnet's field, the armature is repelled from one pair of poles and attracted to the other. That's what makes the relay toggle.

While the MTR can operate with a continuous current, it is basically a pulse operated device. A typical unit with a 100 ohm coil will toggle in 4 msec with 20 v applied. The operating pulse, in this case, provides 16 mw-sec. If 100 v



Magnetically held relay in cutaway view.

were applied, the relay would pull in faster.

Since the MTR is a completely new approach to relay design, there are places where it will not fit in existing circuitry. But its advantages are many.

In a conventional relay, coil power must be enough to pull in the spring-loaded contact assembly, and overcome contact pressure and external forces acting on the contact assembly, like shock, acceleration, and vibration. The MTR is free of these requirements.

- It doesn't have the unreliable drop-out point of conventional relays.
- It requires no holding power.
- It operates over a wide voltage range—and fast.

Its rotating action can drive normal contact assemblies, sliding contacts, rotary switch type contacts, leaf types, and others.

It can even be toggled manually, to generate a high energy pulse.

For more information on the MTR, turn to the Reader-Service card and circle 18.

**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-48.



**ACHESON** *Colloids Company*  
PORT HURON, MICHIGAN

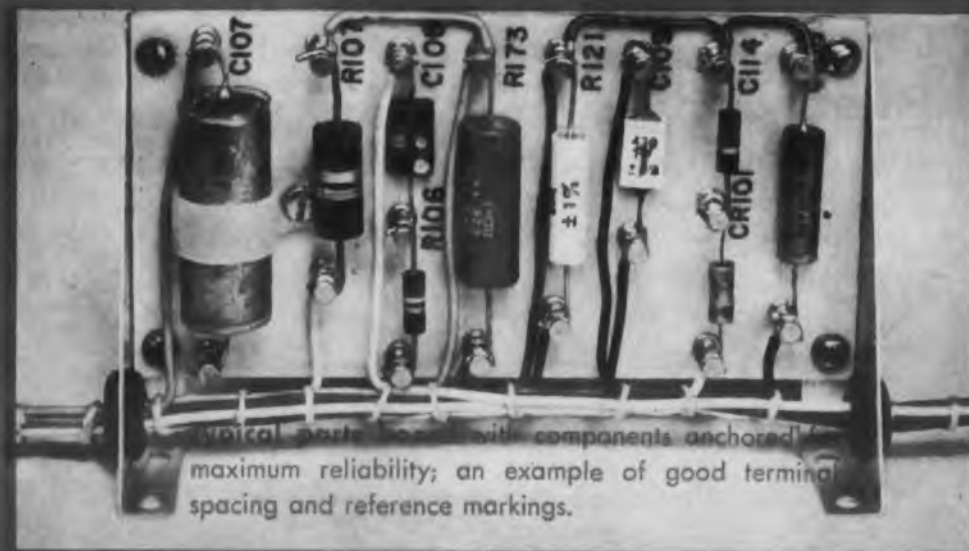
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CIRCLE 19 ON READER-SERVICE CARD



Typical parts board with components anchored for maximum reliability; an example of good terminal spacing and reference markings.

It may seem silly to spend time "designing" a parts board. If you have such an idea, this article should dispel it. There are real design considerations involved—particularly if good equipment reliability is important. Every designer should find useful suggestions in Mr. Smith's presentation.

## Parts Boards Design Considerations

J. Roy Smith

Staff Reliability Engineer  
Cubic Corp.  
San Diego, Calif.

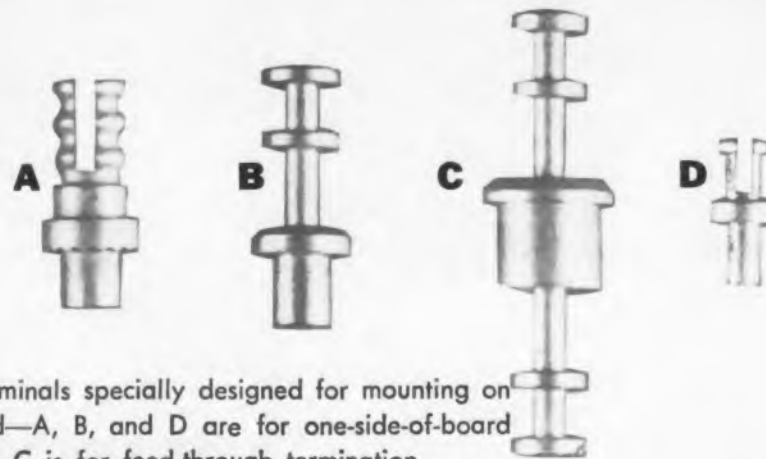


Fig. 1. Terminals specially designed for mounting on parts board—A, B, and D are for one-side-of-board termination; C is for feed-through termination.

**T**HE BOARD on which electronic parts are mounted (other than a printed-wiring board) usually consists of a rigid insulation material in sheet form containing solder-type terminals to support and connect small pigtail-mounted electronic parts to the equipment's internal wiring. This board sometimes referred to as a mounting strip or terminal strip, is often used for locating parts to make them more accessible for test and replacement, relieving crowded distribution of parts at tube sockets and other areas of complex wiring. When small parts must connect to other small parts and leads, the use of parts boards with the desired arrangement of terminals simplifies wiring. Also, the use of a parts board with flexible wires to tube sockets assures that the relative motions at tube-socket pins will not be transmitted to the pigtail leads.

Only parts which are connected by pigtail leads would logically be used on parts boards. These pigtail-type parts include fixed resistors

of all types with two-watt ratings or less, fixed capacitors of paper, mica, glass, ceramic and tantalum, semiconductor diodes, and pigtail-type r-f chokes.

Since one of the main reasons for using parts boards is to effect increased accessibility, parts and wiring should not be placed on both sides unless there is adequate accessibility on both sides. Parts and wiring must be accessible for both visual inspection and for replacement of parts. Accessibility is most important to both fault location and maintenance.

### Choosing the Material

The choice of material for parts boards mainly involves considerations for environmental effects. These environmental considerations include dielectric loss of the board material, insulation resistance, mechanical strength or its ability to flex and withstand impact, effect of moisture on electrical properties, fungus resistance, and

dimension stability. Other considerations which tend to compromise the choice of materials are ease of fabrication and relative cost.

Some military specifications require the use of laminated sheet, silicone resin, glass cloth (Type GSG, spec. MIL-P-997) in critical circuits where high impedances (above 1 megohm) must be maintained and where the board temperatures exceed 110 C. Laminated sheet, melamine resin, glass cloth (Type GMG, spec. MIL-P-15037) is the second choice. However, both of these materials are difficult to machine. Drills and cutting tools wear out quickly on these materials.

Laminated sheet epoxy resin, glass cloth (Type GEE, spec. MIL-P-18177) is a good compromise in the choice of board material in most applications. Its electrical properties are good and it is easier to machine. Phenolic resin laminates largely have been disqualified because of poorer electrical properties, although they are less expensive and are quite easy to fabricate. How-

ever, some progress is being made in the improvement of their electrical properties and may eventually result in their acceptance as a reasonable compromise for use in less critical applications.

Military specifications preclude the use of paper, cotton, or linen base laminates as electrical insulation because of moisture absorption and fungus nutrient capabilities. The accompanying table gives a ready comparison of the materials mentioned.

#### Size Limitations

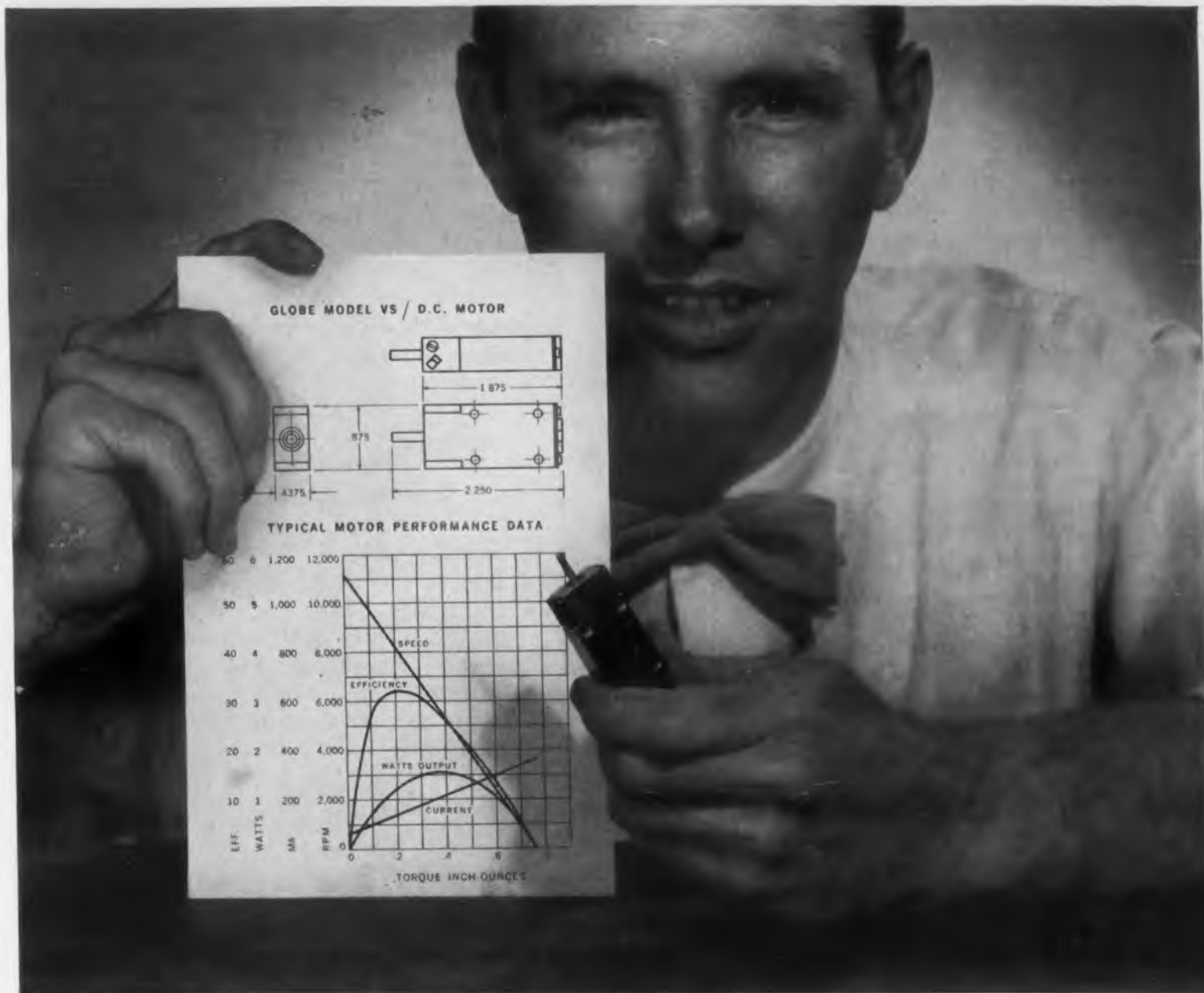
There are almost no size limitations for parts boards. They should be large enough to hold the necessary parts and small enough to fit within the space available. The board materials should be of sufficient thickness to minimize flexibility and to keep the board's mechanical resonance from becoming so low as to fall within the range of environmental vibration. The thickness should be greater on boards with larger slenderness ratios (board length  $\div$  width). The usual thickness of a typical board (2-1/2 x 5 in.) is 3/32 in.

#### Supporting the Board

The method chosen for the mechanical support of a parts board should be such as to adequately hold it in place and minimize relative motion to the chassis under intended environmental motion. Both rigid support at the bottom and lateral support at the top of the board is best in order to raise the natural resonance of the assembled board structure as high in frequency as possible and to limit motion similar to that of a vibrating reed. Cantilever brackets should be avoided unless the base of the brackets at the chassis is broad in dimension, perpendicular to the board length, or an additional bracket is placed at top to achieve lateral rigidity.

#### Selecting Terminals

The choice of terminals involves considerations on terminal size, capability of being rigidly anchored to the board, terminal material, plating, solder adherence, and the method of parts interconnection. Single-ended terminals are used when parts are mounted on only one side of the board and double-ended terminals for mounting parts on both sides. Acceptable terminals are made of brass suitably plated to increase ease of soldering. Since silver plating tarnishes easily, gold plating is frequently preferred. Terminals made of steel or ferrous metals are not suitable. Unsatisfactory terminals for parts boards include those punched from sheet stock or leaf terminals and those stud terminals intended to be mounted by a press fit in a hole. Such terminals are unsatisfactory because they are insufficiently anchored to the parts board.



## 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 3/4 ozs., is 3/16 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.

The fastest way to get full technical data on the VS motor is to phone or write direct: Globe Industries, Inc., 1784 Stanley Avenue, Dayton 4, Ohio, Telephone BALdwin 2-3741.

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# 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 21 ON READER-SERVICE CARD

Some of the more preferred types of terminals are shown in Fig. 1. The type A terminal is the universal type preferred for the majority of applications where parts are mounted on only one side of the board. It is a combination slotted, ferrule, and sleeve terminal. Connecting wires may be placed through the sleeve, in the slot, or around the terminal between the ferrules. Jumpers and connecting wires can be connected through the sleeve, leaving the slot and grooves for pigtail leads. The terminal is mechanically strong and when properly installed is largely immune to rotation and twist. It is stronger than other split types and is less bulky than stud-type terminals. It is probable that the military will modify specifications to permit soldered connections to be made without mechanical joints<sup>1,2</sup> for which this terminal is ideally suited since parts leads merely would be placed in the slot and soldered.

Types B and C are stud or turret terminals. Their use is limited to wrap-around wire connections, but they have the advantage of not requiring rotational alignment during assembly. The double type C terminal is necessary where parts are required to be mounted on both sides of the board. Type D is a miniature terminal, similar to type A, intended to be used where space is limited and where parts are small.

### Locating the Terminals

The parts should be logically arranged for minimum wiring, simplified interconnections, and the reduction of undesired coupling between parts. The terminals should then be located to accommodate the parts and to give them the best mechanical support possible. Standard parts boards with their uniform spacing of terminals have their place in breadboard and experimental models of electronic equipment; but, on prototype and final models, the parts board and placement of terminals should be tailored to fit the parts.

Terminals, widely spaced, requiring long leads on short parts, allow motion under shock and vibration like that of a plucked violin string. With the terminals moved in closer to the part, the mounting is stiffer, restricting the amplitude of resonant-string type motion. In general, the clearance between the soldered connection at the terminal and the body of the part should not be less than 1/4 in., and the combined length of both leads should not exceed 1 in. in total length.

The spacing of adjacent terminals, separating mounted parts, should be such as to accommodate the diameter or width of the parts. There should be sufficient clearance between parts to allow each one to rest against the board. Some military specifications also limit the closeness of

adjacent terminals to not less than 1/4 in. for reasons of minimum leakage resistance.

### Mounting the Parts

Parts should be placed between the terminals in such a manner that the limitations of lead length are not exceeded. In mounting parts, the leads should be reasonably straight but not stretched. A false impression has long existed that pigtail leads should contain a thermal expansion joint similar to that used in long steam pipes. This is wrong. The expansion of the part and lead with temperature seldom exceeds 0.003 in. and is not enough to be a problem. Furthermore, the expansion joint is detrimental in that the tools used to form the loop make nicks in the wire causing stress points which precede and accelerate lead breakage. Also, the unnecessary lead length allows more lateral motion of the part under shock and vibration which expedites breakage of the leads.

The leads should not be stretched while wiring to the terminals. Many part failures can be traced to stretched leads (like a man's arms pulled out of their sockets) which disturbs the internal lead-to-part junctions and paves the way for a future part failure. It is also unnecessary to wrap the pigtail tightly around the terminal with a turn and a half or so. Actually, by bending the lead slightly more than a quarter turn (not to exceed a half turn) adequate mechanical support results and, when soldered, the mounting and continuity will withstand any military environment. (It is expected that military specifications will soon adapt this arrangement.)

### Anchoring Large Parts

When mounting large parts by their pigtails, their size and weight allows great lateral displacement, enabling the part to vibrate through wide resonance excursions due to vibration. The mechanical resonance is usually so low as to be within the frequency band or environmental motions. The movement of the parts fatigues the leads which eventually break. Such parts should be clamped to the board by means of cable clamps of nylon or metal. As a general rule-of-thumb, parts larger than 3/8 in. diam and 1 in. in length should be clamped to the parts board. Some military specifications require that parts larger than 1/2 oz be clamped to the board.

The preferred clamps, as specified in MIL-STD-242A (SHIPS), section 501.1, are made of nylon or rubber covered metal. The commercial cadmium plated steel cable straps (Cinch No. 85 or equal) are also quite effective and have the advantage that the parts are clamped against the parts board itself. This closeness prevents relative motion between the parts, the board, and the terminals.

Metal mounting clips, similar to fuse clips, have been used to anchor parts on boards, but have the disadvantage that they space the part away from the board. Usually, it becomes necessary for the pigtail leads to be bent down to connect to the terminal. With parts of large diameter this is quite serious. When using such clips, there is still the possibility that under environmental motion, tension and bending motions will be applied to the leads.

#### Avoiding Heat

Heat emitted by mounted parts is usually low. Since resistors are usually derated up to fifty per cent for reliability considerations, it is not likely that they will produce much heat. The main sources of heat are the operating environment, equipment ambient temperature rise, and heat radiated by adjacent parts such as tubes, power resistors, and transformers. Heat caused by thermal radiation from nearby parts may be reduced by use of metal baffles between the source and the parts board.

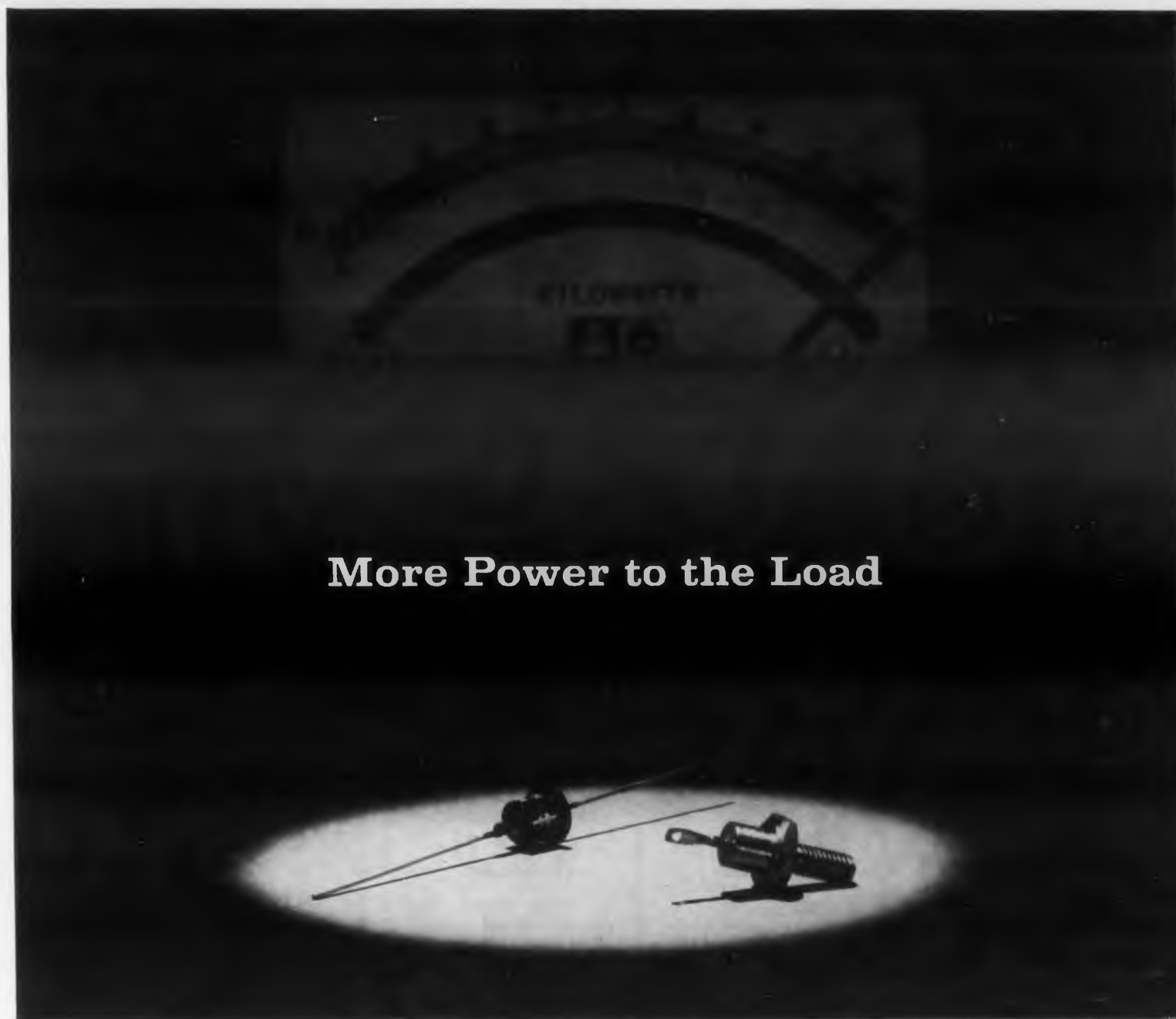
#### Marking The Part

All parts on the board must be identified by markings of reference designations (i.e., R203, C201) to facilitate fault location and parts replacement. Each marking should be located adjacent to the part but not obscured thereby. The location should cause no confusion as to which part is identified. Generally, preference is for the reference designation to be placed just below the right hand pigtail lead and parallel to the axis of the part when the board is viewed from one end. Specifications require that these markings be permanent and legible. Suitable marking processes include silk screening, stenciling with smudgeproof ink covered with a coat of clear lacquer, stamping, and engraving. If cross or interconnections on the parts boards are made by etched or printed wiring, the parts marking likewise might be made by the etched or printed wiring process.

A reference designation for a parts board itself is the letter "A" (i.e., A103), as it is the reference designation letter for structural parts or mounting devices. Since the parts board is intended to mount a group of parts, it fits the specification definition as being a mounting structure. This designation should be located on the board and also on the equipment chassis or supporting structure near the parts board.

#### References

1. Reliable Soldered Connections without Mechanical Joints, J. Roy Smith, *Electrical Manufacturing*, September 1956, pp. 143-145.
2. Tests of Soldered Connections without Mechanical Joints, NEL Report 755, by T. H. Hamm, U. S. Navy Electronics Laboratory, San Diego 52, Calif.



## More Power to the Load

### Hughes medium power, silicon rectifiers

The exceptionally high efficiency of these rectifiers, obtained by advanced development and construction techniques, makes possible power supply design which was previously impossible. Efficiency like this means less power loss in the rectifier and, for a given size of rectifier, more power to the load. Cooler operation also results, thereby contributing increased life since there is less heat to dissipate.

In most instances, the voltage drop across the rectifier is so small—and it is constant throughout the life of the rectifier—that it may be neglected in power supply design. The low drop improves regulation of the power supply too.

So specify the types listed at right and capitalize fully upon the advantage of high rectifier efficiency. In addition to the types shown, Hughes has two groups of 1N-numbered units, one with a lead-mount configuration and the other in the standard JETEC 7/16" hex package.

For literature or a visit from one of our sales engineers, please write: HUGHES PRODUCTS, Semiconductor Division, International Airport Station, Los Angeles 45, California

	STUD-MOUNT TYPES		
	Peak Inverse Voltage (Volts)	Average Rectified Current @ Specified Case Temperature (Amps max.)	Average Inverse Current (mA, max.)*
HR10671	100	3.0	150
HR10673	200	3.0	150
HR10675	300	3.0	150
HR10677	400	3.0	150
HR10679	500	2.0	135
HR10681	600	2.0	135

	LEAD-MOUNT TYPES		
	Peak Inverse Voltage (Volts)	Average Rectified Current @ Specified Ambient Temperature (mA max.)	Average Inverse Current (mA, max.)*
HR10422	100	350	100
HR10423	200	350	100
HR10424	300	350	100
HR10425	400	350	100

\* Averaged over one cycle at full rated conditions of current, voltage, and temperature with a resistive load.

Creating a new world with ELECTRONICS



# HUGHES PRODUCTS

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CIRCLE 22 ON READER-SERVICE CARD





**SNAPS BACK**

Reclaiming spring forces grip down. Holds it firmly in place against surface.



**NO PINCHING**

Handle back plate design permits grip to lift to 90° position. Keeps fingers free.



**EXTRA STURDY**

Easily attached, each handle is strong enough to lift 200 lbs. with ample safety factor.

## BEST HANDLE YET FOR INDUSTRIAL CONTAINERS, CARRYING CASES OR ELECTRONIC EQUIPMENT!

**Meets Military Specifications  
C-4150A and T-945A**

There's nothing fragile about this handle! It's strong, rugged, rattle proof, rust and corrosion resistant. Made of tough stainless steel and heavy-gauge anodized aluminum, it will lift 200 lbs. with a big safety factor in reserve.

This Bendix handle has proven its superiority on military and industrial carrying cases, shipping containers and

on electronic equipment. The special grip sleeve will not crack, chip, become sticky or tacky in temperatures from -65° to +160°F. Our patented design eliminates pinching, holds grip firmly against surface when not in use. Attaches easily with nuts and bolts, welding, etc.

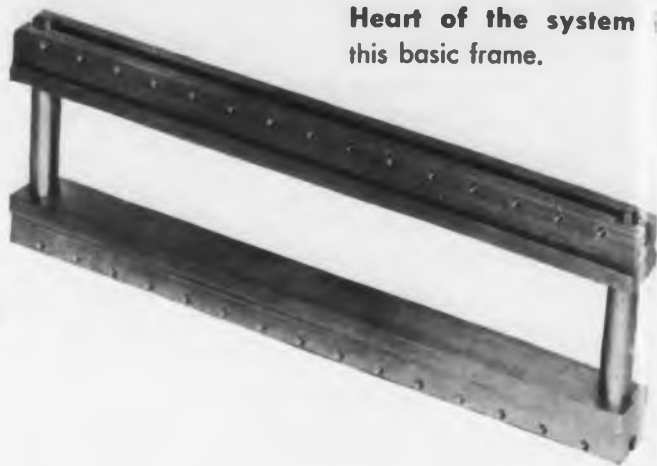
Write today for complete specifications and quantity discounts. Bendix-Friez, 1404 Taylor Ave., Baltimore 4, Maryland.

**Friez Instrument  
Division**



CIRCLE 23 ON READER-SERVICE CARD

Heart of the system is this basic frame.



Save design time

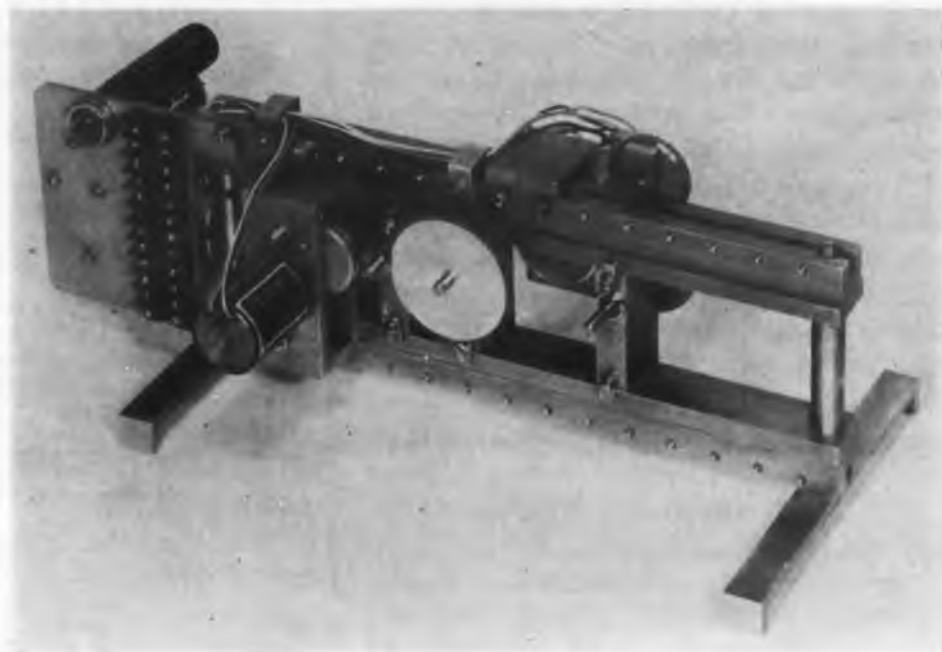
with a

## Miniature Servo Breadboard

**A**FTER you've tested the servo sub-assemblies, you can just slide them together to check the system performance. That is—if you use the new “Micromation” servo breadboard. This board is easy to assemble, and enables you to observe the dynamic performance of miniaturized servo systems.

Previous breadboards required time consuming parts placement before a system could be checked. Often, special parts and fixtures had to be made up. If a servo motor, synchro, or potentiometer required isolation from the system for separate checking, a troublesome parts-jockeying procedure was called for.

With the system just developed by Waldorf Instrument Co., Huntington Station, N.Y., individual servo subsystems can be integrated into a complete system by mounting frames in tandem, in over-under fashion, or both. Components can be isolated or slipped into position easily and quickly by loosening a pair of screws.



Not quite fully assembled servo subsystem.

The breadboard system has a 6 or 8 in. long frame, to which all components are secured; a stand to support one or two frames vertically; a rotary component mount for size 5, 8, 10, or 11 servo motors, synchros, or pots; and a bearing mount assembly which includes a bearing block and flanged stainless steel ball bearings with a pinion or plain shaft.

The system also includes a transfer gear assembly to mesh two gear trains mounted in frames where one frame is mounted over the other; an electronic component mounting assembly to hold a specially designed servo amplifier, power supply, and transformer, and a pair of standard terminal boards. Also included are an assortment of spur gears, pinion shafts, or plain shafts.

The breadboard makes it possible to complete closed loop, final test data prior to production engineering, with the same rotary components, gears, shafts, and spacings as are used in the final assembly.

For more information, turn to the Reader-Service card and circle 24.



**Rotary component mount.** Hole diameter is varied to accept size 5, 8, 10, or 11 components.



**Bearing mount assembly with pinion shaft.**



**Transfer gear assembly** is used when frames are mounted in over-under fashion.



# maintain and control reliability

with new

## PRE-PROGRAMMED INSTRUMENTATION

### NEW ROBOTESTER — IMMEDIATE AID TO IMPROVE MAINTAINABILITY OF EQUIPMENT RELIABILITY

A bold imaginative concept has evolved from Lavoie Labs in the form of a Programmed Instrumentation Approach with Failure Prediction. Designed for the active control of maintainability and reliability of electronic equipment in aircraft, missile and weapon systems.

The universal-tape programmed performance checking Robotester is versatile and flexible and is the basis of this forward-thinking Lavoie program.

The Robotester itself expands checkout capabilities and slashes 80% of final test time. Operational testing and production line check out is accomplished through continuous, high-speed sampling and comparison . . . split-second recognition, isolation and identification of abnormal functions.

Nominal circuit values and specified tolerances are tape-punched in minutes to accommodate voltages (AC and DC) from 0.5 to 500 volts; Hi Pot to 500 volts; resistances from 1 ohm to 9.99 megohms; and tolerances of 1%, 5%, 10% and 20% of nominal. A total in excess of 60000 tests possible . . . the Robotester will check any two circuit points at rates up to 100 tests per minute.

Write today for complete technical information and specifications on the New Robotester.



Write on company letterhead for "Lavoie Programmed Instrumentation" . . . please specify application.



*Lavoie Laboratories, Inc.*

MORGANVILLE, NEW JERSEY

DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT

CIRCLE 25 ON READER-SERVICE CARD

# Now Even Smaller



## New Sub-Miniature Size **FANSTEEL**

### STA Capacitors SOLID TANTALUM



Wires for MPM Bulletin 4-172 are new sub-miniature size capacitors.

CAPACITORS  
**FANSTEEL**  
RECTIFIERS

SPECIFICATIONS WITH TYPICAL VALUES

	Capacity Range	Capacity Tolerance	Working Voltage	Surge Voltage
.250	50A-127	±2	15	18
	50A-128	±5	15	18
	50A-129	±2	30	36
	50A-130	±2	40	48
.375	100-131	±2	10	12
	100-132	±4	15	18
	100-133	±2	30	36
	100-134	±2	40	48
.465	150-135	±2	10	12
	150-136	±4	15	18
	150-137	±2	30	36
	150-138	±2	40	48
.705	200-139	±2	10	12
	200-140	±4	15	18
	200-141	±2	30	36
	200-142	±2	40	48
290	250-143	±2	30	36
	250-144	±4	40	48
	250-145	±2	60	72
	250-146	±2	80	96

Standard Capacitor Construction and Test, page 275.

**FANSTEEL METALLURGICAL CORPORATION**  
North Chicago, Illinois, U.S.A.

RELIABLE TANTALUM CAPACITORS SINCE 1930

CIRCLE 26 ON READER-SERVICE CARD

# Traveling-Wave Tube List

**T**HE TENDENCY, and often the necessity, of building traveling-wave tubes to suit relatively specialized functions has resulted in a large number of different types. Here is a list of 242 tubes from 17 manufacturers which have been arranged according to major characteristics to simplify the problem of selection.

The list is extracted from the March microwave tube list published by Derivation and Tabulation Associates, Inc., West Orange, N.J. The listing is divided principally into two groups: that of traveling-wave tubes and that of backward-wave tubes. The first category includes forward wave amplifiers, whereas the latter includes both backward-wave oscillators and backward-wave amplifiers. The few backward-wave amplifiers present are identifiable by the notation of gain directly following the type number.

The tubes are arranged in order of

center frequency, power output, and type number. In the case of frequency multipliers (see legend), the input center frequency decides the order. Several types are noted as not being immediately available. In most cases, this means that the particular tube is a fairly specialized unit and as such is not carried in stock. Information on all the tubes listed, however, is available.

The characteristics of traveling-wave tubes are flexible to a certain degree. In the majority of types listed, one parameter can be improved at the expense of others. The characteristics given represent the operational limits under which the tube will most likely be used.

For more information on obtaining similar microwave tube lists, write to Derivation and Tabulation Associates, Inc., Dept. ED, 67 Lawrence Ave., West Orange, N.J., or turn to Reader-Service Card and circle 27.

## TRAVELING-WAVE TUBES

Type	Description (see legend)	Power Output (watts)	Frequency Range or Band (Mc)	Max. Beam voltage (volts)	Max. Cathode Current (Amp.)	Gain (db)	NF (db)
<b>Z-5092*</b>		200	60— 300			20	
<b>STP172*</b>	gr	2.0	240— 510	800	.645	35	
<b>HA34</b>	fq5		3000—		.010		
<b>GO2*</b>		.010	500— 1000				25
<b>GO20*</b>		.010	500— 1000				25
<b>GO20*</b>	pm	.010	500— 1000				25
<b>HA7</b>	gr	.010	500— 1000	120	2.5M	30	
<b>HA8</b>		1.0	500— 1000				
<b>DA3</b>	di		500— 1000	1000	1.4M	23	
<b>HA40</b>	gr 1n		500— 1000	120	.002	25	15
<b>STL171*</b>	gr	2.0	500— 1010	800	64.5	35	
<b>STL132</b>		3.0	500— 1010	800	.075	35	35
<b>X295*</b>		15	600— 960	1000	.125	33	
<b>X287*</b>	1n	.001	650— 1200	125	.50M	20	11
<b>X244D*</b>	.032	50K	950— 1225	20K	6.0	30	

### TRAVELING-WAVE TUBES

Type	Description (see legend)	Power Output (watts)	Frequency Range or Band (Mc)	Max. Beam voltage (volts)	Max. Cathode Current (Amp.)	Gain (db)	NF (db)
A1056*	1n	.001	1100— 1400	200	.15M	25	7
STL111		4.0	1100— 1600	800	.039	30	
STL114	.01	7000	1100— 1600	15K	5.0	34	
A1123*	pm 1n	.001	1000— 2000	500	.25M	20	10
A1139*	1n	.001	1000— 2000			25	10
6753		.010	1000— 2000	200	.004	35	
A1141*	pm 1n	.010	1000— 2000			25	15
GO5*		.010	1000— 2000				25
GO7*	1n	.010	1000— 2000				25
GO50*		.010	1000— 2000				25
GO50P*	pm	.010	1000— 2000				25
GO70*		.010	1000— 2000				12
HA5	gr	.010	1000— 2000	200	3.5M	30	
HA17	gr	.010	1000— 2000	190	1.5M	30	15
HA31	pm	.010	1000— 2000				
IW4006	pm	.010	1000— 2000	200	.004	35	
X276*		.100	1000— 2000	380	.014	30	
A1121*	gr	.200	1000— 2000	600	.007	35	
HA18		1.0	1000— 2000				
TW4007	pm	1.0	1000— 2000	600	.040		
TW4007AD	pm	1.0	1000— 2000	1100	.060		
X271*		1.0	1000— 2000	980	.050	30	
6752		2.0	1000— 2000	600	.055		
A1124*	pm	2.0	1000— 2000	1000	.020	35	
STL70	gr	2.0	1000— 2000	900	.040	55	25
TW620A	gr	2.0	1000— 2000	1100	.060		
TW538	.001	1000	1000— 2000	6500	2.5		
X277*	.1	100	1000— 2000	3500	.380	20	
DA2	di		1000— 2000	1000	.20M	24	
HA14	gr 1n		1000— 2000	190		30	10
STL121*		25	1000— 2000	1700	.140	46	
A1125*	1n	.001	1350— 1850			25	7
HA16	fq5		9000—	1100	.025		
A1094*	pm	.200	1700— 2300			35	
HA39		1.00	1600— 2600	950	.020	30	
A1093*	pm	15	1700— 2300	2000	.065	30	
HA19	gr 1n	.010	1600— 2600	200	1.5M	30	15
HA22		.010	1600— 2600	500	3.5M	30	
A1105*	1n	.001	2000— 2500	400	.15M	25	7
6997	.01	30	2000— 3300	2100	.25	30	
A1097*		5.0	2000— 3500			20	
A1077*	1n	.001	2700— 2900	400	.15M	25	7
6651		1000	2100— 3500			41	
BL851		1000	2100— 3500			41	
ST5113	.01	2000	2000— 3600	8500	2.8	34	
6658		2.0	1700— 4000	1000	.050	30	30
6868		10	1700— 4000	1200	.070	30	30
4008	1n	.001	2000— 4000	265	.25M	25	10
A1132*	pm 1n	.001	2000— 4000			20	10
4009	pm	.010	2000— 4000			35	
6493		.010	2000— 4000	400	.003	35	
A1143*	pm 1n	.010	2000— 4000			25	15
G10		.010	2000— 4000			30	25
G12	1n	.010	2000— 4000			30	12
G100		.010	2000— 4000			30	25

Legend: gr-gridded, pm-permanent magnet focused, di-dispersive amplifier, 1n-low noise amplifier, fq5-frequency multiplier, five times, number-duty cycle if not continuous wave, \*—not immediately available.

# FOR EASIER MOUNTING

## NEW

# FANSTEEL

## SILICON

## RECTIFIER STACKS



### SINGLE-PHASE

FULL WAVE BRIDGE CIRCUIT

1 amp. (resistive or inductive load)  
d-c output: up to 249 volts maximum



### SINGLE-PHASE

OPEN BRIDGE CIRCUIT  
(for magnetic amplifiers)

1 amp. (resistive or inductive load)  
d-c output: up to 249 volts maximum



### SINGLE-PHASE

FULL WAVE CENTER TAP CIRCUIT

1 amp. (resistive or inductive load)  
d-c output: up to 125 volts maximum



### THREE-PHASE

FULL WAVE BRIDGE CIRCUIT

1.5 amp. (resistive or inductive load)  
d-c output: up to 372 volts maximum

VOLTAGE REGULATOR CIRCUIT  
ALSO AVAILABLE

- PEAK REVERSE VOLTAGE: 32-400 VOLTS
- Formed Type 16 Silicon Surface used throughout
- For excellent conduction and low power requirements, with widest temperature range from -55°C to +150°C

Write for new Bulletin 6-77 or rectifier cards

CAPACITORS  
**FANSTEEL**<sup>®</sup>  
RECTIFIERS

FANSTEEL METALLURGICAL CORPORATION  
North Chicago, Illinois, U.S.A.

DEPENDABLE RECTIFIERS SINCE 1924

CIRCLE 28 ON READER-SERVICE CARD

# potter

GLASS  
ENCLOSED  
PLASTIC  
FILM

## CAPACITORS

# NEW IMPREGNATION



- $\frac{1}{3}$  the Power Factor Loss
- 2 Times the Insulation Resistance
- No Derating at 85°C or Less— $\frac{1}{3}$  Less Derating at High Temperatures

### TYPICAL APPLICATIONS:

- Low current power supply filters
- Oscilloscope, Geiger counter, electro-meter circuits
- Electronic computers
- Audio coupling and bypass
- High temperature AC and DC circuits, etc.

**CAPACITANCE:** Standard  $\pm 10\%$ , available at  $\pm 5\%$ . Other tolerances available on request.

**POWER FACTOR:** At 60 cycles is approximately 0.25% at 20°C, approximately 0.3% at 85°C.

**INSULATION RESISTANCE:** 20,000 megohms per mfd. or 20,000 megohms whichever is lesser, measured at 20°C with 500 VDC applied.

**TEST VOLTAGE:** 1 minute at  $1\frac{1}{2}$  times rated voltage at 25°C.

**TEMPERATURE RANGE:** Standard  $-60^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ .

**IMPREGNANT:** GSA capacitors are IQ160 impregnated and filled.

**CASE:** Metal ferrules are soldered to silver bands fused to each end of heavy walled glass tubes. The vacuum tight assembly is fungus proof.

Metal caps are embossed to insure a flush contact.

THE

# potter COMPANY

Specialists in Layer Wound Capacitors Since 1925  
1950 SHERIDAN ROAD, NORTH CHICAGO, ILL.

CIRCLE 29 ON READER-SERVICE CARD



## TRAVELING-WAVE TUBES

Type	Description (see legend)	Power Output (watts)	Frequency Range or Band (Mc)	Max. Beam voltage (volts)	Max. Cathode Current (Amp.)	Gain (db)	NF (c:b)
G100P	pm	.010	2000— 4000			30	25
G120	ln	.010	2000— 4000			30	12
HA1	gr	.010	2000— 4000	525	3.5M	30	25
HA11	gr ln	.010	2000— 4000	450	.002	30	15
HA29	pm	.010	2000— 4000				
TW4002	pm	.010	2000— 4000	400	.003	35	
6495	ln	.080	2000— 4000	500	.003		13
A1113*	pm	.200	2000— 4000	600	.007	35	
X258B*		.200	2000— 4000	600	.008	25	
7072	pm	1.0	2000— 4000	800	.040		
G11		1.0	2000— 4000			30	25
G110		1.0	2000— 4000			34	25
G110P*	pm	1.0	2000— 4000			30	25
HA2B		1.0	2000— 4000	950	.025	34	
HA12	gr	1.0	2000— 4000	950	.035	34	
HA30		1.0	2000— 4000				
PA4	gr .1	1.0	2000— 4000				
STS75		1.0	2000— 4000	700	.024	50	30
STS78	gr	1.0	2000— 4000	900	.030	50	25
TW956A	pm .01	1.0	2500— 3500	1000	.050		
4010	pm	2.0	2000— 4000			35	
6559		2.0	2000— 4000	800	.042		
TW534	gr .1	2.0	2000— 4000	1000	.040		
4006	pm	10	2000— 4000	2000	.060	25	
PA3	.1	10	2000— 4000	1100	.025	30	
STS110		20	2000— 4000	2400	.150	30	30
VA121	.01	40	2000— 4000	2500	.190	30	
4007	gr .1	100	2000— 4000	3400	.250	30	
A1050*	pm .05	100	2000— 4000	2200	.230	30	
6698	.001	1000	2000— 4000	7000	2.0		
6825	.01	1000	2000— 4000	7500	1.8	30	
6826	.01	1000	2000— 4000	7500	1.8	27	
6826A	.01	1000	2000— 4000	7500	1.8	40	
A1134*	pm	1000	2000— 4000			30	
D2001*	.01	1000	2000— 4000	7500	1.8	33	
DA1	di		2000— 4000	2300	.75M	25	
HA37	gr ln		2000— 4000	525	1.5M	25	10
MA5-1A	pm	1000	2000— 4000	7000	1.4	32	
6861	ln	.001	2700— 3500	500	.001	25	7
A1079*	ln	.001	2500— 4000	400	.15M	25	8
A1085*	ln	.001	3300— 3700	400	.15M	25	7
STC67		.600	2500— 5000	600	.015	50	30
A1088*	ln	.001	3500— 4300	400	.15M	25	7
A1129*	pm	1.0	4000— 5000			30	
X686		1	4000— 7000	2300	.018	50	30
A1110*	ln	.001	5400— 5900	900	.30M	20	8
Z-5160*		0.001	4000— 8000			25	10
A1144*	pm ln	.010	4000— 8000			25	15
G20		.010	4000— 8000			30	25
G200		.010	4000— 8000			30	12
G200P	pm	.010	4000— 8000			30	25
G220P*	pm	.010	4000— 8000				18
HA3B	gr	.010	4000— 8000	700	.002	30	
HA26	gr	.010	4000— 8000	850	2.2M	30	
HA28*	pm	.010	4000— 8000				
X281*		.100	4000— 8000	850	.008	25	
A1122*	pm	.200	4000— 8000			35	
RXB103401		.200	4000— 8000	1100	.010	40	30

## TRAVELING-WAVE TUBES

N <sub>f</sub> (c/b)	Type	Description (see legend)	Power Output (watts)	Frequency Range or Band (Mc)	Max. Beam voltage (volts)	Max. Cathode Current (Amp.)	Gain (db)	NF (db)
25	<b>G21</b>		1.0	4000—8000			32	25
12	<b>G210</b>		1.0	4000—8000			32	25
25	<b>G210P*</b>	pm	1.0	4000—8000			30	25
15	<b>HA6</b>		1.0	4000—8000	1500	.015	30	
	<b>X282*</b>		10	4000—8000	2700	.065	25	
	<b>A1136*</b>	pm	50	4000—8000			30	
13	<b>D2002*</b>	.01	1000	4000—8000	10K	2.1	33	
	<b>X283*</b>	.01	1000	4000—8000	9500	2.0	25	
	<b>DA4</b>	di		4000—8000	2400	.50M	20	
	<b>HA32*</b>	gr ln		4000—6000	700	2.0	25	15
25	<b>6867</b>		.10	8000—9600	1400	.010	25	
25	<b>6996</b>		10	8000—9600	3200	.050	30	
25	<b>D2004*</b>	.04	10	8000—9600	3200	.05	30	
	<b>X231D*</b>	ln	.0004	8000—10000	950	.40M	15	12
	<b>STX76</b>	gr	.500	7000—11000	1600	.009	57	30
	<b>STX77</b>	gr	10.0	7000—11000	4300	.045	40	30
	<b>D2003*</b>	.005	1000	7000—11000	9600	1.8	30	
30	<b>D92*</b>	.005	1000	8500—9600	10K	2.0	30	
25	<b>D95*</b>	.005	1000	8500—9600	10K	2.0	30	
	<b>X267C*</b>		1.0	7500—11000	2350	.190	28	
	<b>TW591</b>	.001	500	8000—10500	7500	1.5		
	<b>A1120*</b>	gr .05	50	7500—11200	6000	.110	35	
	<b>Z-5082*</b>		0.001	7500—11300			20	11
	<b>X263B*</b>		5.0	7500—11300	3000	.049	30	
	<b>HA20</b>	pm	.010	8000—11000	1300	1.8M	30	
30	<b>HA21</b>	pm	1.0	8000—11000	2400	.020	30	
	<b>HA9</b>	gr	1.0	8200—11000	2300	.020	30	
	<b>HA23</b>	gr ln		8200—11000	1250	.80M	30	10
	<b>TW613</b>		.005	8000—11500	1200	.001	35	
	<b>A1140*</b>	pm	.010	8000—12000			35	
	<b>7066*</b>		.05	8000—12000	1500	.005	35	
	<b>X301*</b>		.050	8000—12000	1600	.006	30	
	<b>A1133*</b>	pm	1.0	8000—12000			30	
	<b>7067*</b>	.04	5.0	8000—12000	4000	.050	30	
	<b>X302*</b>		5.0	8000—12000	4500	.060	20	
	<b>X306*</b>	.4	5.0	8000—12000	4500	.060	20	
10	<b>D2005*</b>		10	8000—12000	4000	.05	30	
	<b>7068*</b>	.005	1000	8000—12000	12K	2.0	25	
	<b>X296*</b>	.01	1000	8000—12000	11K	2.0	28	
7	<b>HA15</b>	gr ln	.010	8200—12400	1300	1.7M	25	15
8	<b>G40</b>		.100	8200—12400				25
7	<b>G400</b>		.100	8200—12400				25
30	<b>G400P</b>	pm	.100	8200—12400				25
7	<b>HA10</b>		.100	8200—12400	2100	.008	24	
	<b>G41</b>		1.0	8200—12400				25
30	<b>G410</b>		1.0	8200—12400				25
8	<b>PA5</b>	gr .1	1.0	8200—12400	2100			
10	<b>PA1*</b>	gr .1	2.0	8200—12400				
15	<b>G420*</b>			8200—12400				18
25	<b>HA4B</b>	gr	.010	7000—14000	1150	1.5M	30	
12	<b>HA33</b>	gr ln		8000—14000	1150	2.0	25	15
25	<b>HA24</b>	gr	.005	12400—15000	1250	2.5M	30	
18	<b>HA25*</b>	gr	.010	12000—18000				

Legend: gr-gridded, pm-permanent magnet focused, di-dispersive amplifier, ln-low noise amplifier, fq5-frequency multiplier, five times, number-duty cycle if not continuous wave, \*—not immediately available.

Available From Stock!

Additional New Features!

Moderately Priced!

# ERA's TRANSISTORIZED HIGH CURRENT REGULATED POWER SUPPLIES



Ratings  
up to 12 Amps!

## IDEAL FOR:

- **Battery Substitution**
  - Computers
- **Transistor Bias**
  - Motor and Relay Control
- **Television**
  - All High Current  
Laboratory and Industrial  
Applications

## SPECIFICATIONS

Models listed are designed for 105-125 VAC input, 60-400 cps. Continuously adjustable output. Line regulation is within  $\pm 0.5\%$ . Load regulation is within  $\pm 0.5\%$ . Frequency response of regulator extends into high audio frequencies. Ripple less than 0.05% or 5 mv. Current limiter control on front panel for full overload and circuit protection. Units are for bench or standard 19" rack mounting.

## FEATURES

- Continuously Variable Output
- Vernier Voltage Control
- Fast Transient Response
- Low Output Ripple
- Positive, Negative, Zero % Regulation Control
- Line Frequency Insensitive
- Remote Sensing
- Constant Current Overload Limit Control
- Positive or Negative Outputs Ungrounded
- Terminals On Front and Rear
- Hinged Panel For Full Accessibility
- High Efficiency
- Low Heat Dissipation
- Compact, Light Weight
- Instant Warm-up Time
- Moderately Priced

## TYPICAL STOCK MODELS

Model Number	Voltage VDC	Current Amps.	Output DC R (ohms)	Price FOB Factory
TR32-4	4-32	0-4	0.01	\$375.00
TR32-8	4-32	0-8	0.005	\$410.00
TR32-12	4-32	0-12	0.002	\$495.00

Additional stock models also available.

Special designs also made to customers specifications. Write for quotation.

## Pioneers in Semi-Conductor and Transistorized Products.

First Miniaturized Power Packs.  
First Transistorized Power Supplies.  
First Automatic Transistor Test Equipment.  
First Dual Output Tubeless Supplies.  
First Packaged Transistor Circuits.

First Transistor Application Power Supplies.  
First Constant Current Generators.  
First High Current Semi-Conductor Regulated Supplies.  
First "E" Core Transistorized Converters/Inverters.  
First High Power Semi-Conductor Frequency Changers.

Manufactured at ERA's New and Larger Facilities

# Electronic Research Associates, Inc.

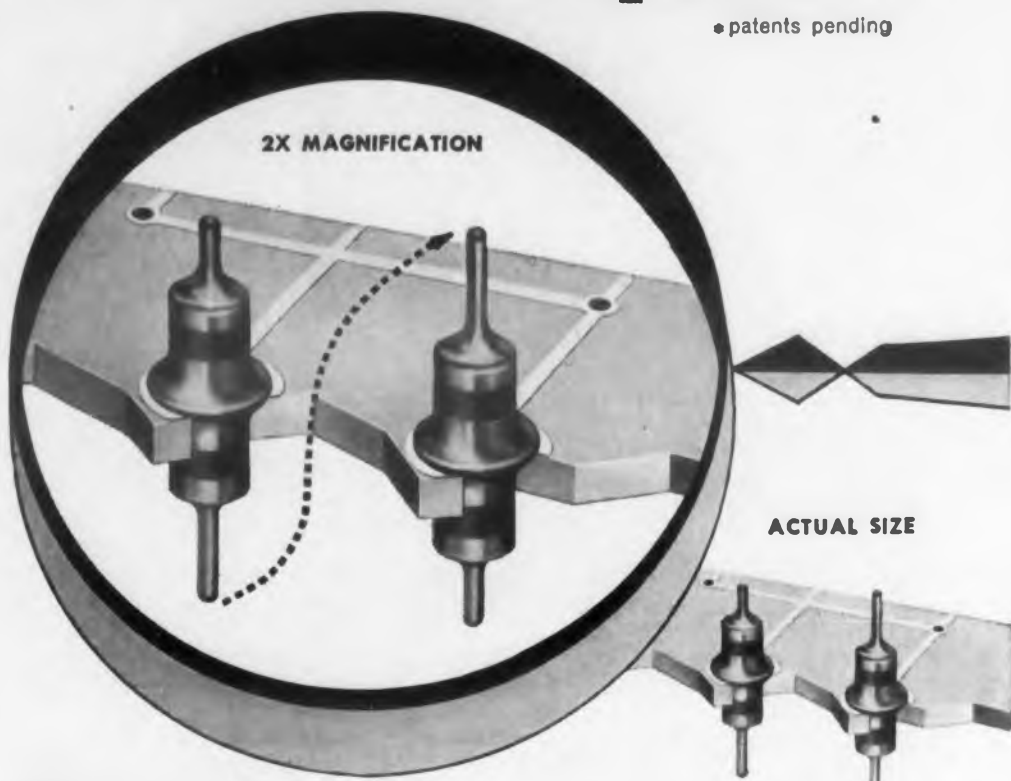
67 Factory Place, Cedar Grove, N. J.

CEnter 9-3000

CIRCLE 30 ON READER-SERVICE CARD

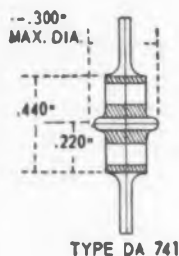
# Speed Production... Lower Assembly Costs with this New Symmetrical Feed-Thru Capacitor\*

\* patents pending



## Centralab's New DA-741 Hi-Kap,<sup>®</sup> the feed-thru you can't put in wrong

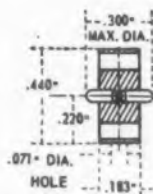
- ... can be inserted from either end ... a natural for machine insertion or other types of automation
- ... embodies a new metalizing technique that completely eliminates capacitance drop-off, silver migration, and silver burn-off during soldering operations
- ... will withstand soldering temperatures of 450°F for two minutes
- ... has a solder fillet around center ring eliminating need for solder preforms
- ... rugged 16 gauge tinned wire lead assures positive connections



TYPE DA 741

### SPECIFICATIONS:

- Capacitance: Available in values up to 1,000 mmf. GMV
- Power Factor: 3% maximum, measured at 1KC
- Voltage: 500 VDCW, 1300 VDCT; special units can be supplied for 900 V. RMS test
- Humidity: Meets EIA STD RS198, Class 2



TYPE DA 740

DA-740, with same electrical characteristics but without solder fillet or leads, can also be supplied.

For details write for Centralab Engineering Bulletin No. EP-556. For the most complete line of ceramic capacitors in the industry see your Centralab distributor.

# Centralab

A DIVISION OF GLOBE-UNION, INC.  
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In Canada: 804 Mt. Pleasant Rd. • Toronto, Ontario

VARIABLE RESISTORS • PACKAGED ELECTRONIC CIRCUITS • ELECTRONIC SWITCHES  
CERAMIC CAPACITORS • ENGINEERED CERAMICS • SEMI-CONDUCTOR PRODUCTS

CIRCLE 31 ON READER-SERVICE CARD

## BACKWARD-WAVE TUBES

Type	Gain	POWER Output (watts)	FREQUENCY Range or Band (Mc)	Max. Line voltage (volts)	Max. Cathode Current (Amp.)	
<b>X289*</b>	5 db	.050	650— 1200	1500	.025	
<b>X288*</b>			650— 1200	1500	.025	
<b>6699</b>		.035	1000— 2000	660	.042	
<b>CO315</b>		1.5	1000— 2000	1500	.070	
<b>QK546</b>		1.5	1000— 2000	1450	.070	
<b>X286*</b>		.050	1100— 2000	1400	.025	
<b>X285*</b>	5 db		1100— 2000	1380	.025	
<b>CO210</b>		1.0	1600— 3200		.070	
<b>QK544</b>		1.0	1600— 3200	1450	.070	
<b>CM710A</b>	20 db	250	2500— 3100	5100	.450	
<b>PAS-2</b>		.0005	2400— 3500	1500	.004	
<b>6496</b>		.035	2000— 4000	1680	.042	
<b>HO1A</b>		.050	2000— 4000	3400	.020	
<b>QK518</b>		1.0	2000— 4000	1500	.045	
<b>BA1</b>		17 db		2400— 3600	1500	.010
<b>CM708A</b>			210	2750— 3500		
<b>CM706A</b>			200	3000— 4000	5100	.380
<b>CO119</b>			.50	2400— 4800		.050
<b>QK533</b>			1.0	2400— 4800	1450	.050
<b>HO10</b>	.010		3700— 5900	2000	.009	
<b>OA4-8</b>	.010		3200— 9000	1750	.005	
<b>HO3A</b>	.050		3750— 7000	3400	.013	
<b>CO94</b>	.40	3600— 7200		.040		
<b>QK528</b>	.400	3600— 7200	1450	.045		
<b>BW623</b>	.010	4000— 8000	2400	.020		
<b>HO13</b>	17 db	.010	4000— 8000	3000	.010	
<b>HO11</b>		.010	5200— 8300	2000	.008	
<b>CO63</b>		.20	4800— 9600		.035	
<b>QK543</b>		.200	4800— 9600	1450	.035	
<b>OA7-10</b>		.100	6500—10500	1950	.015	
<b>CM740</b>		80	7800— 9500			
<b>OC6-12A</b>		.010	6000—11900	2000	.005	
<b>OB6-12A</b>		.050	6000—11900	2000	.012	
<b>CO43</b>		.15	7000—11000		.025	
<b>QK529</b>		.150	7000—11000	1500	.025	
<b>QK610</b>			6700—11400			
<b>CM730</b>		80	8500—10500	4600	.350	
<b>BCX10M</b>		.010	8000—12000	1500	.015	
<b>OB7-13A</b>		.010	6500—13200	2100	.005	
<b>OC7-13A</b>	.010	6500—13200	2100	.005		
<b>VA161</b>	.120	8200—12400	650	.030		
<b>BA2</b>	17 db		8200—12400	2400	.010	
<b>HO2B</b>		.010	7000—14000	3400	.012	
<b>QK535</b>		.150	7500—15000	1700	.025	
<b>CO42</b>		.100	8000—16000	1800	.018	
<b>BWK10M</b>		.005	12000—18000	1500	.010	
<b>BWK10MA</b>		.005	12000—18000	1500	.010	
<b>A1090*</b>		.050	12000—18000	2600	.010	
<b>BA4*</b>			12000—18000			
<b>LOU-2</b>		.035	12400—18000	1800	.008	
<b>HO4B</b>		.010	12400—18000	2000	.010	
<b>OA12-18</b>	.010	11000—19000	1850	.007		
<b>CO2012</b>	.100	15000—23500	2500	.025		
<b>QK536</b>		15500—24000				
<b>OX18-26</b>	.010	19000—32000	2100	.007		

### BACKWARD-WAVE TUBES

Type	POWER Output (watts)	FREQUENCY Range or Band (Mc)	Max. Line voltage (volts)	Max. Cathode Current (Amp.)
CO1308	.250	23500—37500	3000	.025
QK537		23500—37500		
X275*	.040	28000—35000	3000	.010
OA26-40	.010	26000—40000	2100	.005
CO08	.20	35000—41000		
TE57	.005	49000—59000	3000	.005
TE66	.005	61000—71000	3000	.005

### CROSS INDEX

BEN	Bendix Red Bank Div.	HGL	Huggins Labs.
BOM	Bomac Laboratories, Inc.	HUG	Hughes Products
CSF	Compagnie Generale De T.S.F.	RAY	Raytheon Manufacturing Co.
EIM	Eitel-McCullough, Inc.	RCA	Radio Corporation of America, Tube Div.
FTL	Federal Telecommunication Labs.	SEC	Stewart Engineering Co.
FTR	Federal Telephone & Radio Co.	SPY	Sperry Electronic Tube Div.
GEI	Geisler Labs.	SYL	Sylvania Microwave Tube Lab.
GEN	General Electric Co., Power Tube Dept.	VAR	Varian Associates, Inc.
		WHI	Roger White Electron Devices, Inc.

### INDEX

A1050	RCA	A1143	RCA	D92	FTR	G100	GEI	HA15	HGL	STX76	SPY
A1056	RCA	A1144	RCA	D95	FTR	G100P	GEI	HA16	HGL	STX77	SPY
A1077	RCA	BA1	HGL	D2001	FTR	G110	GEI	HA17	HGL	TE57	BEN
A1079	RCA	BA2	HGL	D2002	FTR	G110P	GEI	HA18	HGL	TW534	SYL
A1085	RCA	BA4	HGL	D2003	FTR	G120	GEI	HA19	HGL	TW538	SYL
A1088	RCA	BCX10M	WHI	D2004	FTR	G200	GEI	HA20	HGL	TW591	SYL
A1090	RCA	BL851	BOM	D2005	FTR	G200P	GEI	HA21	HGL	TW613	SYL
A1093	RCA	BW623	SYL	DA1	HGL	G210	GEI	HA22	HGL	TW620	SYL
A1094	RCA	BWK10M	WHI	DA2	HGL	G210P	GEI	HA23	HGL	TW956A	SYL
A1097	RCA	BWK10MA	WHI	DA3	HGL	G220P	GEI	HA24	HGL	TW4002	SYL
A1105	RCA			DA4	HGL	G400	GEI	HA25	HGL	TW4006	SYL
A1110	RCA	CM706A	CSF			G400P	GEI	HA26	HGL	TW4007	SYL
A1113	RCA	CM708A	CSF	GO2	GEI	G410	GEI	HA28	HGL	TW4007AD	SYL
A1120	RCA	CM710A	CSF	GO5	GEI	G420	GEI	HA29	HGL	VA121	VAR
A1121	RCA	CM730	CSF	GO7	GEI	HA1	HGL	HA30	HGL	VA161	VAR
A1122	RCA	CM740	CSF	GO20	GEI	HA2B	HGL	HA31	HGL	X231D	FTL
A1123	RCA	C008	CSF	GO20P	GEI	HA3B	HGL	HA32	HGL	X244D	FTL
A1124	RCA	C042	CSF	GO50	GEI	HA4B	HGL	HA33	HGL	X258B	FTL
A1125	RCA	C043	CSF	GO50P	GEI	HA5	HGL	HA34	HGL	X263B	FTL
A1129	RCA	C063	CSF	GO70	GEI	HA6	HGL	HA37	HGL	X267C	FTL
A1132	RCA	C094	CSF	G10	GEI	HA7	HGL	HA39	HGL	X271	FTL
A1133	RCA	C0119	CSF	G11	GEI	HA8	HGL	HA40	HGL	X275	FTL
A1134	RCA	C0210	CSF	G12	GEI	HA9	HGL	HO1A	HGL	X276	FTL
A1136	RCA	C0315	CSF	G20	GEI	HA10	HGL	HO2B	HGL	X277	FTL
A1139	RCA	C01308	CSF	G21	GEI	HA11	HGL	HO3A	HGL	X281	FTL
A1140	RCA	C02012	CSF	G40	GEI	HA12	HGL	HO4B	HGL	X282	FTL
A1141	RCA			G41	GEI	HA14	HGL	HO10	HGL	X283	FTL
								HO11	HGL	X285	FTL
								HO13	HGL	X286	FTL
								LOU2	HUG	X287	FTL
								MAS1A	HUG	X288	FTL
								OA4-8	SEC	X289	FTL
								OA7-10	SEC	X295	FTL
								OA12-18	SEC	X296	FTL
								OA26-40	SEC	X301	FTL
								OB6-12A	SEC	X302	FTL
								OB7-13A	SEC	X306	FTL
								OC6-12A	SEC	X686	EIM
								OC7-13A	SEC	Z5082	GEN
								OX18-26	SEC	Z5092	GEN
								PA1	HGL	Z5160	GEN
								PA3	HGL	4006	RCA
								PA4	HGL	4007	RCA
								PA5	HGL	4008	RCA
								PAS-2	HUG	4009	RCA
								QK518	RAY	4010	RCA
								QK528	RAY	6493	SYL
								QK529	RAY	6495	SYL
								QK533	RAY	6496	SYL
								QK535	RAY	6559	SYL
								QK536	RAY	6651	BOM
								QK537	RAY	6658	FTR
								QK543	RAY	6698	SYL
								QK544	RAY	6699	SYL
								QK546	RAY	6752	SYL
								QK610	RAY	6753	SYL
								RXB103401	BEN	6825	FTR
								STC67	SPY	6826	FTR
								STL70	SPY	6826A	FTR
								STL111	SPY	6861	RCA
								STL114	SPY	6867	FTR
								STL121	SPY	6868	FTR
								STL132	SPY	6996	FTR
								STL171	SPY	6997	FTR
								STP172	SPY	7066	FTR
								STS75	SPY	7067	FTR
								STS78	SPY	7068	FTR
								STS110	SPY	7072	SYL
								STS113	SPY		

# NEW! two Tung-Sol Tubes for 12-volt auto radios!

Tung-Sol's latest 12v auto-radio tube developments—12EZ6 and 12FA6—provide a gain figure substantially above that of any other similar types. With these new tubes, the car-radio designer can simplify circuitry, thereby cutting out possible trouble spots. Bandwidth and frequency-drift problems are minimized . . . overall radio reliability rises.

Compare for yourself the advanced Tung-Sol types with the tubes they replace! Electrical data below!

New  
12EZ6!  
Up to  
50% more  
gain than  
12AF6 and  
12BL6 it  
replaces!



New  
12FA6!  
Up to  
20% more  
gain than  
12AD6  
it replaces!



Improved Tung-Sol types increase gain . . . widen design flexibility

12EZ6	7-pin, miniature, sharp cutoff pentode for use as RF or IF amplifier. Capable of 50% more gain than old Types 12AF6 and 12BL6 . . . with but a slight drop in Rp.		
	NEW 12EZ6	OLD 12AF6	OLD 12BL6
heater	12.6	12.6	12.6
plate voltage	12.6	12.6	12.6
grid #3 voltage <sup>b</sup>	0	0	0
grid #2 voltage	12.6	12.6	12.6
grid #1 voltage	-0.7 <sup>d</sup>	0	-0.65 <sup>d</sup>
plate current	1.9	1.1	1.35
grid #2 current	0.7	0.45	0.5
plate resistance	0.20	0.35	0.5
transconductance	2 500	1 500	1 350
grid #1 voltage			
for G <sub>m</sub> <sup>c</sup> =50 μmhos	-2.8	-2.7	-6.0
12BL6 G <sub>m</sub> <sup>c</sup> =10 μmhos			
12AF6 G <sub>m</sub> <sup>c</sup> =40 μmhos			
grid #1 and grid #3 voltage			
for G <sub>m</sub> <sup>c</sup> =30 μmhos	-3.0	-3.5	-5.0
12BL6 G <sub>m</sub> <sup>c</sup> =10 μmhos			
12AF6 G <sub>m</sub> <sup>c</sup> =10 μmhos			

b connected to cathode at socket  
c from grid #1 to plate  
d average bias developed across a 2.2 megohm grid resistor

## 12FA6

7-pin, miniature, pentagrid converter for use as oscillator-mixer. Capable of 20% more conversion gain than old Type 12AD6.

Converter Service—Self Excitation**	NEW 12FA6	OLD 12AD6
heater voltage	12.6	12.6
plate voltage	12.6	12.6
grid #3 voltage	0.50 <sup>b</sup>	0
grid #2 & #4 voltage	12.6	12.6
grid #1 voltage (oscillator grid) rms	2.5	1.6
grid #1 resistance (oscillator grid)	33 000	33 000
plate resistance (approx.)	0.8	1
grid #1 current (oscillator grid)	60	50
conversion transconductance	320	260
plate current	450	450
grid #2 & #4 current	1 000	1 500
cathode current	1 500	2 000
grid #3 voltage for G <sub>c</sub> = 5 μmhos (approx.)	-3.5	-2.2
grid #3 voltage for G <sub>c</sub> =20 μmhos (approx.)	-3.0	-1.8

\*\*Screen feedback. G<sub>2-4</sub> to cathode voltage approximately 13% of G<sub>1</sub> to cathode voltage.

b Average contact potential developed across a 2.2 megohm resistor

Tung-Sol helped pioneer the 12v hybrid auto radio . . . makes a high-performance tube for virtually every other entertainment circuit need—radio, TV, hi-fi! For full data on the new 12EZ6 and 12FA6 . . . to fill any socket you have with a quality tube, write or phone us today! Commercial Engineering Dept., Tung-Sol Electric Inc., Newark 4, N. J.



# TUNG-SOL®

CIRCLE 32 ON READER-SERVICE CARD

# Quadratic Equation Nomogram

Paul Gheorghiu

Manson Laboratories, Inc.  
Stamford, Conn.

HERE IS a nomogram offering a brief solution for quadratic equations having the form

$$X^2 + PX + Q = 0$$

for values of  $P$  and  $Q$  between and including the values  $\pm 25$ . To determine the roots construct a straight line between the values of  $P$  and  $Q$  with the appropriate signs. Intersection of this line with curves  $X_1$  and  $X_2$  give the value of the roots.

If there is no intersection with curves  $X_1$  and  $X_2$  for an equation within the designated range of the nomogram, the roots are imaginary.

To extend the reading for decimal coefficients this guide may be used:

When $Q$ is multiplied by:	$P$ and $X^{1,2}$ are multiplied by:
.0001	.01
.01	.1
100	10
10,000	100

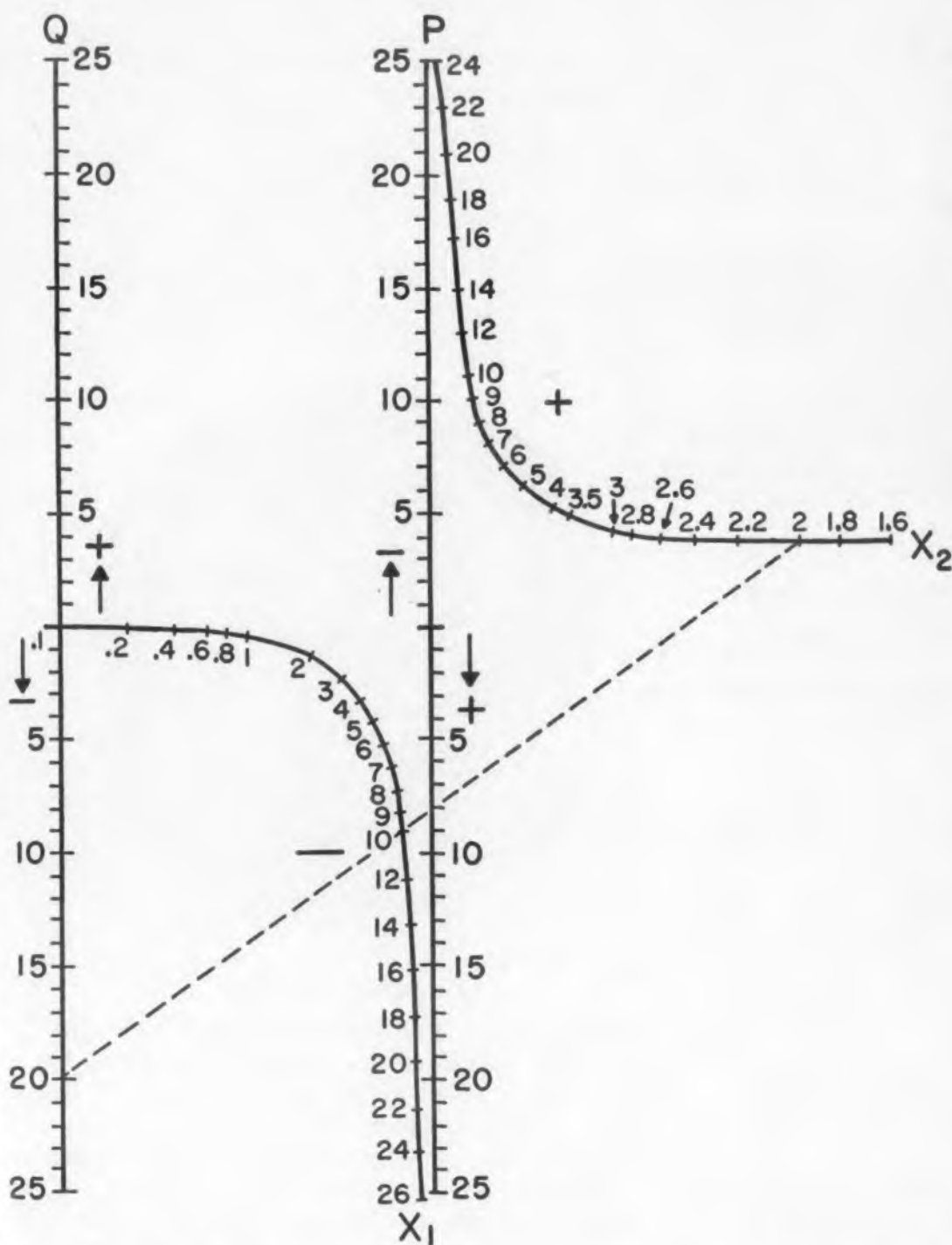
Example: Consider the equation

$$X^2 + 8x - 20 = 0$$

The roots are  $X_1 = 2$  and  $X_2 = 10$ . If now the equation read  $X^2 + .08 - .0020 = 0$ , the roots would be  $X_1 = .02$ ,  $X_2 = -.1$ . Similarly for  $X^2 + .8 - .20 = 0$ ,  $X_1 = 2$ ,  $X_2 = -1$ . For  $X^2 + 80X - 2,000 = 0$ ,  $X_1 = 20$ ,  $X_2 = -10$ . For  $X^2 + 800X - 20,000 = 0$ ,  $X_1 = 200$ ,  $X_2 = -1,000$ .

For a reprint of this nomogram circle 100 on the Reader-Service card.

## Quadratic Equation Nomogram



**Nomogram for solving quadratic equations** for values of P and Q between and including  $\pm 25$ .



# From One Dependable Source

**PRECISION**



**DEFLECTION SYSTEMS**

**AND COMPONENTS**



*Designed for ITV and Broadcast cameras and other special Cathode Ray Tube applications*

## Send for this brochure today!

Whatever your deflection component requirements, whether special or standard, whether for military or commercial use, you'll find RCA a convenient and dependable source. The brochure illustrated above provides helpful information on RCA's equipment designed for all makes of Image Orthicons, Vidicons, TV Monitors, Resolvers and PPI Scanning Yokes. Use the coupon to send for your free copy.

RCA's leadership and broad experience in television and radar are reflected in the high quality of these components. All are expertly engineered and manufactured under rigid standards of quality control to assure maximum reliability and performance.

*Inquiries for the development of deflection systems and components for special applications are invited.*



Tmk(s) ©

**RADIO CORPORATION of AMERICA**

INDUSTRIAL ELECTRONIC PRODUCTS  
CAMDEN 2, N.J.

Radio Corporation of America  
Industrial Electronic Products  
Dept. GD-292, Building 15-1, Camden, N.J.

Please send me free copy of your brochure "Precision Deflection Systems and Components."

NAME \_\_\_\_\_ TITLE \_\_\_\_\_

COMPANY \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_

Have RCA representative call \_\_\_\_\_

CIRCLE 33 ON READER-SERVICE CARD

# NEW PRODUCTS

To provide a complete coverage of ALL new products generally specified when designing electronic original equipment, the New Product section has been extended. To include the largest number of items, products which are best suited to a brief description have been noted at the end of the section.



## TANTALUM CAPACITORS

For use at up to 125 C, these solid tantalum capacitors withstand significantly warmer ambients than most tantalum types. The Kemet line of capacitors are available in ratings from 5 to 120  $\mu\text{f}$  at working voltages from 6 to 30 v at 85 C. They can take vibration of up to 40 g at frequencies of 2000 cps.

Kemet Co., Div. of Union Carbide & Carbon Corp., Dept. ED, Box 6067, Cleveland 1, Ohio.

CIRCLE 34 ON  
READER-SERVICE CARD



## SAMPLING SWITCH

Measuring 1-1/4 in. in diameter, the Miniplexer sampling switch has sixty contact pins for thirty channels of break-before-make operation. The miniature size of the switch is principally due to the development of contact pins of very high durability and low friction coefficient. The small diameter of the assembly results in lower peripheral wiper speeds and therefore provides longer life. The switch permits service free operation of 500 hrs at 30 rps and operates under ambients of  $-55$  to 125 C and under vibration conditions of up to 2000 cps at 25 g.

Applied Science Corporation of Princeton, Dept. ED, P.O. Box 44, Princeton, N.J.

CIRCLE 35 ON READER-SERVICE CARD



### DISTANCE INDICATING SYSTEM

Using gamma radiation, this indicating system provides an accurate method of scoring the miss distance of ground to air missiles against drone targets. The system consists of a radioactive source and a scintillation type radiation detector (shown). The radioactive source, weighing less than an ounce, is placed in the missile. As the missile nears its target drone, the distance from the drone is measured by the counting rate of the detector placed in the drone.

Topp Industries, Inc., Dept. ED, Beverly Hills, Calif.

CIRCLE 36 ON READER-SERVICE CARD



### FILM CAPACITORS

Practically zero temperature coefficient over the temperature span of  $-10$  to  $+80$  C is featured in the Isofarad series of film capacitors. They are useful in such applications as synchroguide circuits in color TV receivers, test equipment, and high stability amplifiers. Capacitor sections are of the extended-foil type. The units are housed in pre-molded phenolic shells with plastic-resin end seals for protection against moisture. The units are presently available only in 500 v ratings. Insulation and dielectric absorption are between that of polyester and polystyrene types.

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

CIRCLE 37 ON READER-SERVICE CARD

First in  
Performance  
Reliability  
and Quality

# KEPCO

for the most complete line of POWER SUPPLIES



0.1%  
REGULATION  
and  
STABILITY



\*Two units mounted in Rack Adapter RA-2

(TUBELESS)  
**TRANSISTORIZED**  
SHORT CIRCUIT PROTECTED



Model SC-18-4-M

### \* VOLTAGE REGULATED POWER SUPPLIES

MODEL	OUTPUT VOLTS DC	OUTPUT AMPERES DC	OUTPUT IMPEDANCE		SIZE			PRICE
			DC-1KC	1KC-100KC	W	H	D	
SC-18-0.5	0-18	0-0.5	.04	.4	8 1/8"	4 1/8"	13 5/8"	\$195.00
SC-18-1	0-18	0-1	.02	.2	8 1/8"	4 1/8"	13 5/8"	250.00
SC-18-2	0-18	0-2	.01	.1	8 1/8"	4 1/8"	13 5/8"	295.00
SC-18-4	0-18	0-4	.005	.05	19"	3 1/2"	13"	395.00
SC-36-0.2	0-36	0-0.2	.1	1.0	8 1/8"	4 1/8"	13 5/8"	275.00
SC-1836-0.5	18-36	0-0.5	.08	.8	8 1/8"	4 1/8"	13 5/8"	250.00
SC-1836-1	18-36	0-1	.04	.4	8 1/8"	4 1/8"	13 5/8"	295.00
SC-1836-2	18-36	0-2	.02	.2	19"	3 1/2"	13"	395.00
SC-3672-0.5	36-72	0-0.5	.15	1.0	8 1/8"	4 1/8"	13 5/8"	295.00
SC-3672-1	36-72	0-1	.08	.8	19"	3 1/2"	13"	395.00

Patent Pending

A 0.01% SERIES IS AVAILABLE IN 13 NEW MODELS  
KEPCO OFFERS MORE THAN 120 STANDARD VOLTAGE REGULATED POWER SUPPLIES COVERING A WIDE RANGE OF MAGNETIC, TUBE AND TRANSISTOR TYPES. MOST MODELS AVAILABLE FROM STOCK.  
SEND FOR BROCHURE B-585



## KEPCO LABORATORIES, INC.

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

INDEPENDENCE 1-7000

CIRCLE 38 ON READER-SERVICE CARD

- REGULATION (for line or load) 0.1% or 0.003 Volts (whichever is greater)
- RIPPLE: 1 mv. rms.
- RECOVERY TIME 50 microseconds
- STABILITY (for 8 hours) 0.1% or 0.003 Volts (whichever is greater)
- TEMPERATURE COEFFICIENT 0.05% per °C. Ambient operating temperature 50°C maximum. Over-temperature protection included. Unit turns off when over-temperature occurs.
- 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.
- REMOTE PROGRAMMING at 1000 ohms per volt.
- REMOTE ERROR SIGNAL SENSING to maintain stated regulation directly at load.
- Suitable for square wave pulsed loading.
- Continuously variable output voltage without switching.
- Either positive or negative can be grounded.
- Units can be series connected.
- Power requirements: 105-125 volts, 50-65 cycles. 400 cycle units available.
- Terminations on front and rear of unit.
- High efficiency. Low heat dissipation.
- Compact, light weight for bench or rack use.
- Color: grey hammertone.

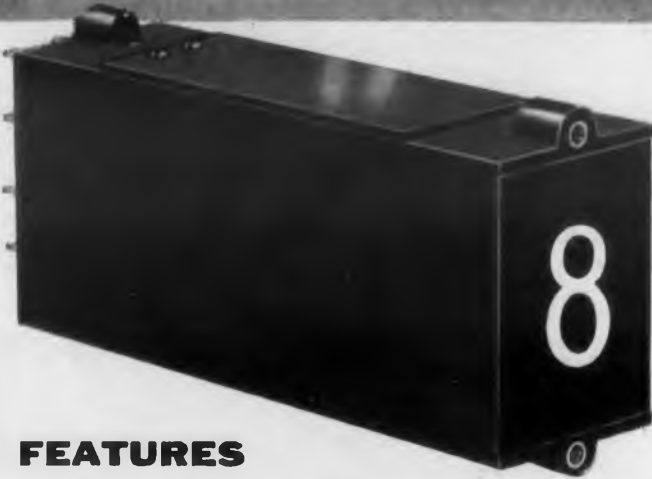
#### ORDERING INFORMATION:

Units without meters use model numbers indicated in table. To include meters add M to the Model No. (e.g. SC-18-1-M) and add \$30.00 to price.

\*Rack adapter for mounting any two 8 1/8" x 4 1/8" units is available. Model No. RA2 is 5 1/4" h x 19" w, is \$15.00

*new...Improved*

# IN-LINE DIGITAL DISPLAY with One-Plane Presentation



## FEATURES

- Recently developed high-contrast viewing screen for utmost visual sharpness!
- Digit style of your choice!
- Colored digits of your choice! Suitable to environmental ambient room light.
- Digital presentation complementing manufacturer's original equipment!

Here's a new type of In-Line Digital Display. All numbers and/or characters appear on the front surface of the unit, and are of uniform size and intensity. In addition to being faster and easier to read, the numbers may be quickly seen from any angle of viewing.

The In-Line Display is available as a single unit, or in assembled groups of two, three, four, etc., ready for panel mounting. The viewing screen extends the full width of the individual unit so that final assembly presents a continuous surface for fast, easy reading.

PRICE  
PER UNIT  
**\$15<sup>50</sup>**

QUANTITY  
PRICES  
ON REQUEST

## HOW THE



## IN-LINE DIGITAL DISPLAY OPERATES

The In-Line Display works on a rear-projection principle. When the lamp (A) at rear of the unit is lighted, it projects the corresponding character on the condensing lens (B) through a projection lens (C) onto the viewing screen (D) at the front of the unit.

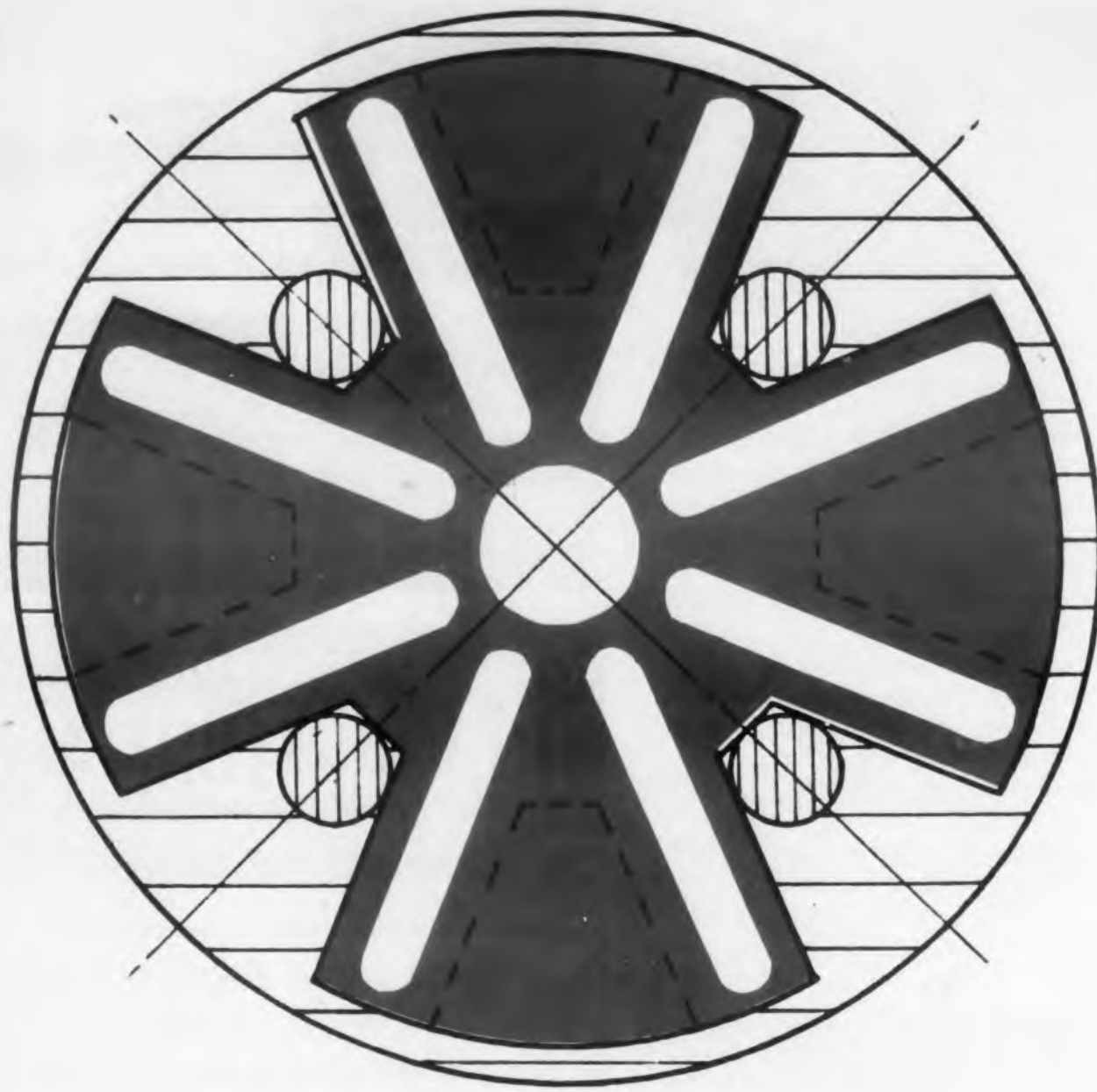
WRITE TODAY FOR COMPLETE DETAILED SPECIFICATIONS  
Representatives in principal cities



**INDUSTRIAL ELECTRONIC ENGINEERS**

Engineers and Manufacturers  
of Fully Automatic Systems and Machines  
3973 Lankershim Blvd., North Hollywood, Calif.

CIRCLE 39 ON READER-SERVICE CARD



*For higher power radar*



## Megawatt TWT

**W**ITH a peak output of two megawatts over a half-power bandwidth of more than 10 per cent centered at 2800 mc, this new twt gives the radar designer a simple, versatile, power amplifier. No continuous pumping is needed, and the ruggedness of the tube compares with high power klystrons.

Use of the tube will result in increased flexibility and versatility in high power radars with no sacrifice in definition or range for wide bandwidth. Heavy radars will be able to change

operating frequency over the S band rapidly: jamming is made more difficult and more costly. Mutual interference between friendly radars can be eliminated by the same programming that is used to avoid countermeasures.

Manufactured by Varian Associates, 611 Hansen Way, Palo Alto, Calif., the new traveling wave tube uses many klystron parts to make its production compatible with Varian's line of klystrons. The VA-125 is designed to fit interchangeably into the focusing magnet now used by Varian's mw radar klystron amplifier. X-ray shielding is included in the package.

Clearly to make the broadband device interchangeable with former units a certain sacrifice in performance was required. The twt is somewhat shorter than optimum length; operating gain as a result is on the order of only 30 db—compared to the higher gain but narrower bandwidth of the klystron. Efficiency is 30 per cent. If a given application requires better gain than is available from the VA-125, a third segment can be added without changing the basic performance of the tube. The designer pays in terms of magnet size and weight.

Field use will offer no new problems: operation is like that of any high power klystron. Maintenance personnel and installers will use the same techniques as with the klystron.

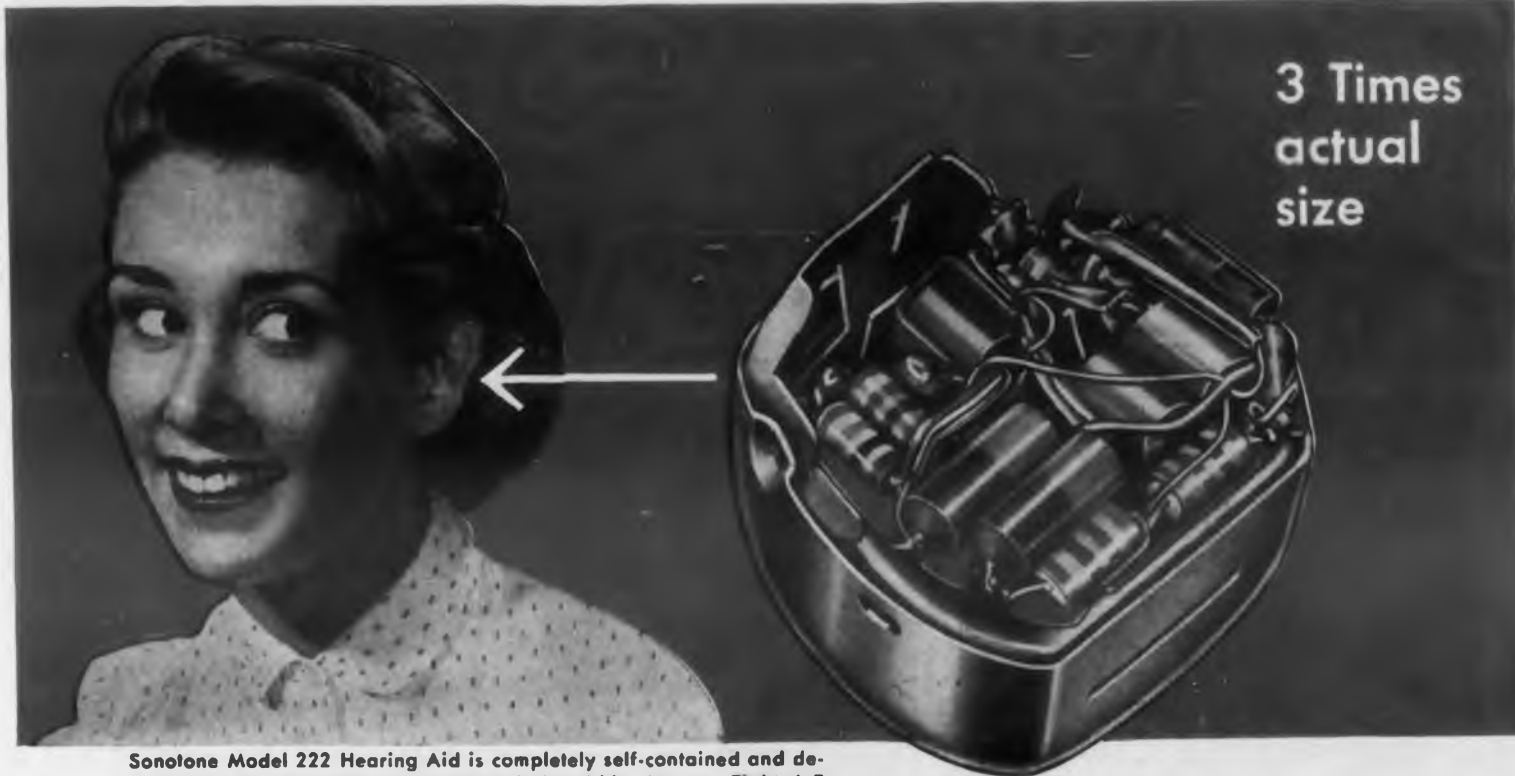
Equipment designers should find that cost, reliability and operating life fall into the present klystron pattern. To compensate for the lower gain, of course, an additional driver tube will be needed. In this way, any existing klystron focusing magnet may be used. A number of such drivers are obtainable; their reliability and operating simplicity have been proven out in a number of applications.

#### Operation

The cross-sectional view shows tube structure. Propagation of energy inside the VA-125 follows the pattern of any twt. Because the resonant elements are strongly coupled together the pass-band of the wave tube structure can be many times greater than that of the individual resonant cavities of a klystron. Gain remains reasonably high because of the continuous interaction between the e-m wave and the electron beam.

The new twt consists of two segments. Each is made up of the resonant elements—and are separated by a short gap region containing microwave attenuator materials. This is to prevent positive feedback, which would result in oscillation—the feedback would arise from reflections at the output end, returning unattenuated to the input to cause regeneration.

For further information on this high-power wide-bandwidth twt, turn to the Readers Service card and circle 40.



Sonotone Model 222 Hearing Aid is completely self-contained and designed to be worn and supported entirely within the ear. Eight A-B Type TR, 1/10-watt resistors are used in the three-transistor amplifier.

## SPACE PROBLEM SOLVED

### with ALLEN-BRADLEY Hot Molded Resistors

Your space problem may seem impossible, but—try Allen-Bradley Type TR resistors. You'll be able to trim space requirements *way* down . . . with *no* sacrifice in quality or reliability. These unbelievably small composition resistors are made by the same basic hot molding process as is used for the larger Allen-Bradley resistors . . . assuring complete freedom from catastrophic failures. The Type TR resistors have an insulating coating that will withstand a continuous maximum voltage of 200 volts d.c.

Where higher ratings are needed . . . and quality is important . . . it's still Allen-Bradley! These larger sizes have an insulating jacket that eliminates the need for impregnation . . . yet provides reliable protection against long periods of high humidity.

Allen-Bradley makes other space-saving components, too . . . including hermetically sealed resistors, variable resistors, capacitors, and filter elements . . . all built to Allen-Bradley's *quality* standards. For detailed specifications and application data send for Publication 6024.

Allen-Bradley Co., 1344 S. Second St., Milwaukee 4, Wis.  
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

**ALLEN-BRADLEY**  
QUALITY  
**ELECTRONIC COMPONENTS**



CIRCLE 41 ON READER-SERVICE CARD

#### Actual Sizes

1/10-Watt resistor

1/8-Watt resistor hermetically sealed

1/4-Watt resistor

1/4-Watt resistor hermetically sealed

Bare disc ceramic capacitors

SMFO feed-thru filter

Type G—1/2-watt variable resistor

Type F—1/4-watt variable resistor



## Sylvania develops cast germanium and silicon discs for more efficient infrared detection systems

**G**ERMANIUM AND SILICON LENSES, ground from optical blanks cast by Sylvania, are finding wider application in the infrared detection systems in today's missiles and aircraft. These semiconductor materials are transparent to wave lengths above 7 microns where other materials, such as quartz, are opaque.

Sylvania's Chemical & Metallurgical Division now offers cast discs of polycrystalline germanium in sizes as large as 8½ inches in diameter and 6 inches thick. Even larger sizes are being developed to meet the needs of detection system manufacturers. Cast sili-

con discs, too, are available for infrared use. Silicon, which weighs less than germanium, is finding growing acceptance in airborne systems. Other factors, such as the maintenance of infrared transmission characteristics at higher temperatures are of particular interest.

Through constant research and close cooperation with industry, Sylvania is continually improving its products to meet the needs of all areas of electronics. This is a basic reason why Sylvania has become a leading source for both silicon and germanium for all applications.

TUNGSTEN • MOLYBDENUM • CHEMICALS • PHOSPHORS • SEMICONDUCTORS



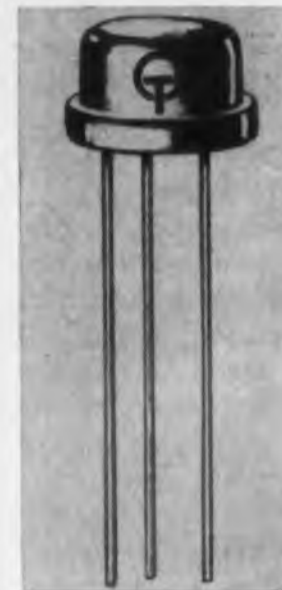
# SYLVANIA

SYLVANIA ELECTRIC PRODUCTS INC.  
Chemical & Metallurgical Div.  
Towanda, Penna.

LIGHTING • TELEVISION • RADIO • ELECTRONICS • PHOTOGRAPHY • CHEMISTRY-METALLURGY

CIRCLE 42 ON READER-SERVICE CARD

## NEW PRODUCTS



### Transistors

For medium and high speed switching applications

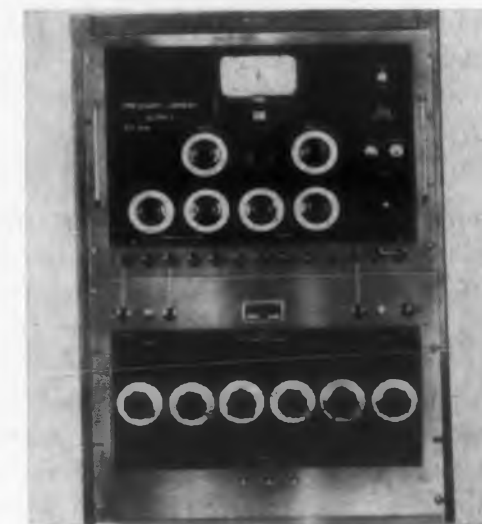
Five germanium alloyed junction transistors have been designed for medium and high speed switching applications. Two pnp types 2N592 and 2N593, and three npn types 2N594, 2N595 and 2N596 are available in JETEC 30 package. These units offer a collector to base voltage range of 20 to 40 v, and an alpha cut-off frequency range of 1.5 to 5.0 mc.

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

CIRCLE 43 ON READER-SERVICE CARD

### Standard Potentiometer

Accuracy of 0.0015 per cent



Incorporating a standard cell reference, a voltage divider, and resistance standards, this instrument achieves an accuracy of 0.0015 per cent in voltage measurement and 0.003 per cent in current measurement. The standard cell reference, accurate to 0.001 per cent, and the voltage divider, accurate to 0.0001 per cent may be separately used.

Julie Research Laboratories Inc., Dept. ED, 556 West 168th St., New York 32, N.Y.

CIRCLE 44 ON READER-SERVICE CARD

## System Analyzer

Modular design



Automation testing of continuity, leakage, resistance, inductance, and voltage is performed by this system analyzer. The Add-A-Unit concept makes it adaptable to a few up to several hundred pairs of circuits, and to simple or involved tests. Capabilities include: single or combined comparison of resistance, capacitance and inductance; adjustable hi-pot and leakage testing — includes search feature for fault points; indiscriminate testing of voltage percentage regardless of voltage, frequency and polarity; visual digital read-out or tape print-out; remote control, and plug-in construction.

Technical Electronics Corp., Dept. ED, 4060 Ince Blvd., Culver City, Calif.

CIRCLE 45 ON READER-SERVICE CARD

## Counter

3000 counts per min



Model C combines reliable high speed counting with long life. Rated speed is 3000 counts per minute with dependable accuracy. The photocell and light source are permanently assembled so that vibration will not jar them out of focus.

Veeder-Root, Inc., Electronic Controls Div., Dept. ED, 70 Sargeant St., Hartford 2, Conn.

CIRCLE 46 ON READER-SERVICE CARD

CIRCLE 47 ON READER-SERVICE CARD

# SILICON RECTIFIERS

designed and  
manufactured to meet

# THE NEW JAN SPECIFICATIONS For AXIAL LEAD TYPES

JAN  
**1N538**  
(MIL-E-1/1084A)

JAN  
**1N540**  
(MIL-E-1/1085A)

JAN  
**1N547**  
(MIL-E-1/1083A)

now from

# AUTOMATIC

Maximum Values for AUTOMATIC Military Type Silicon Rectifiers  
designed to meet the new JAN MIL-E-1 Specification

Type No.	Peak Reverse Voltage (VDC)	DC Output Current @ 25° C. Ambient (MA)	DC Output Current @ 150° C. Ambient (MA)	Maximum Reverse Current* (MA)	Mounting	MIL-E-1 Technical Spec. Sheet No.
JAN 1N538	200	750	250	0.350	Axial lead	1084A
JAN 1N540	400	750	250	0.350	Axial lead	1085A
JAN 1N547	600	750	250	0.350	Axial lead	1083A

\*Averaged over 1 cycle for inductive or resistive load with rectifier operating at full rated current at 150° C. ambients.

PRODUCTION QUANTITIES OF ALL TYPES AVAILABLE FOR FAST DELIVERY

Naturally, you can get these new axial lead JAN types direct from AUTOMATIC, and from authorized distributors throughout the country — and at prices that reflect General Instrument's years of volume production experience.

Together with the earlier JAN type stud mount group, AUTOMATIC now covers the entire medium power silicon rectifier field for the requirements of every military application.

More information? A complete set of data sheets is yours for the asking. Please write us today.



MASS PRODUCERS OF  
ELECTRONIC COMPONENTS

AUTOMATIC MANUFACTURING DIVISION OF GENERAL INSTRUMENT CORPORATION  
65 GOUVERNEUR STREET, NEWARK 4, N. J.

GENERAL  
INSTRUMENT  
SEMICONDUCTORS



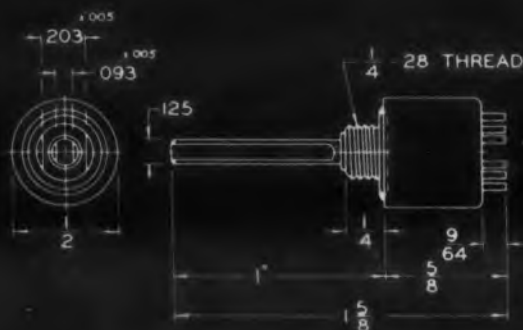
General Instrument Corporation  
also includes:  
F. W. Sickles Division,  
Radio Receptor Co., Inc., and  
Micamold Electronics Manufacturing  
Corporation (Subsidiaries)

# The smallest rotary switch ever made!

*Daven's New Series G Sub-Miniature Switch... 1/2" Diameter!*

A new sub-miniature rotary selector switch, developed by DAVEN, is specifically suited for application in missiles, aircraft, handy talkies, field pack sets, frog-man communication equipment, and all types of mobile apparatus. This explosion-proof, waterproof switch has the same reliability as its bigger brothers... but in a fraction of the space. It meets applicable military specifications on temperature, humidity, corrosion, vibration, acceleration, shock and immersion.

This unit is available as a single pole, 10 position switch and can be obtained with up to four poles on a single deck.



Write today for comprehensive technical report on the new Series G Sub-Miniature Rotary Switch.

**Contact Resistance:** Less than .008 ohm.

**Contact Rating:** 1 ampere, 250V D. C. into resistive load.  
350 MA, 100V D. C. into inductive load.

**Insulation Resistance:** 200,000 megohms between any two terminals or between any terminal and shell.  
Measured at 25° C., 50% RH, at sea level.

**Life Expectancy:** 50,000 cycles minimum  
Shaft and case: Stainless steel  
Panel and hub: Glass filled epoxy  
Contacts and terminals: Silver alloy  
Rotors: Rhodium plated beryllium copper



**D**

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

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

## NEW PRODUCTS

### Waveform Analyzer

Frequency range of 50-20,000 cps



Waveform analyzer type A-321 is a superheterodyne type and measures directly the relative levels of the components of a complex waveform to a value -75 db below the fundamental over a frequency range of 50-20,000 cps. The input level of the fundamental can be any value between -20 db and +20 db relative to 1.0 mw into 600 ohm.

Wayne Kerr Instruments, Dept. ED, P.O. Box 801, Philadelphia 4, Pa.

CIRCLE 49 ON READER-SERVICE CARD

### Power Supply

Handles 100 transducers



Type 2-200 will provide 100 transducers with up to 5 amp of current at any regulated voltage between 0 to 15 v. Operating over a temperature range of 30 to 120 F, the supply is designed for applications where a large number of bridge-type transducers must be powered from one stable source.

Neff Instrument Corp., Dept. ED, 2211 E. Foothill Blvd., Pasadena, Calif.

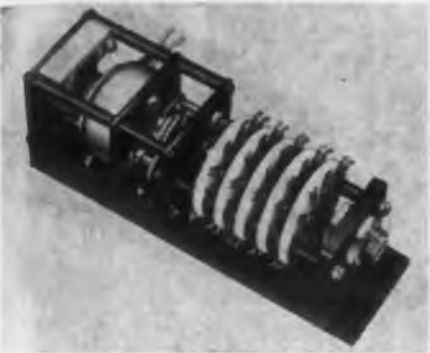
CIRCLE 50 ON READER-SERVICE CARD

◀ CIRCLE 48 ON READER-SERVICE CARD



## Stepper Control

Programs automated equipment



This programming stepper is available for projects such as automated production systems, machine tools, and industrial products. Open or sealed, it operates under high temperatures and altitudes and severe vibration or shock. The unit carries 9-12-18 or 24 points sealed or unsealed, and up to 16 wafers and unlimited switching arrangements.

Guardian Electric Mfg., Programming Div., Dept. ED, 1621 West Walnut St., Chicago 12, Ill.

CIRCLE 51 ON READER-SERVICE CARD

## DC Amplifier

Has power gain of 120,000



Model 100C3 low level dc amplifier features power gain greater than 120,000. Input power of only 0.5  $\mu$ w will drive output to full linear scale. The device is supplied in voltage gains of 250, 500 and 1000. Gain stability of  $\pm 1/4$  per cent or better is achieved with variations in line voltage of  $\pm 10$  per cent and frequency of  $\pm 5$  per cent.

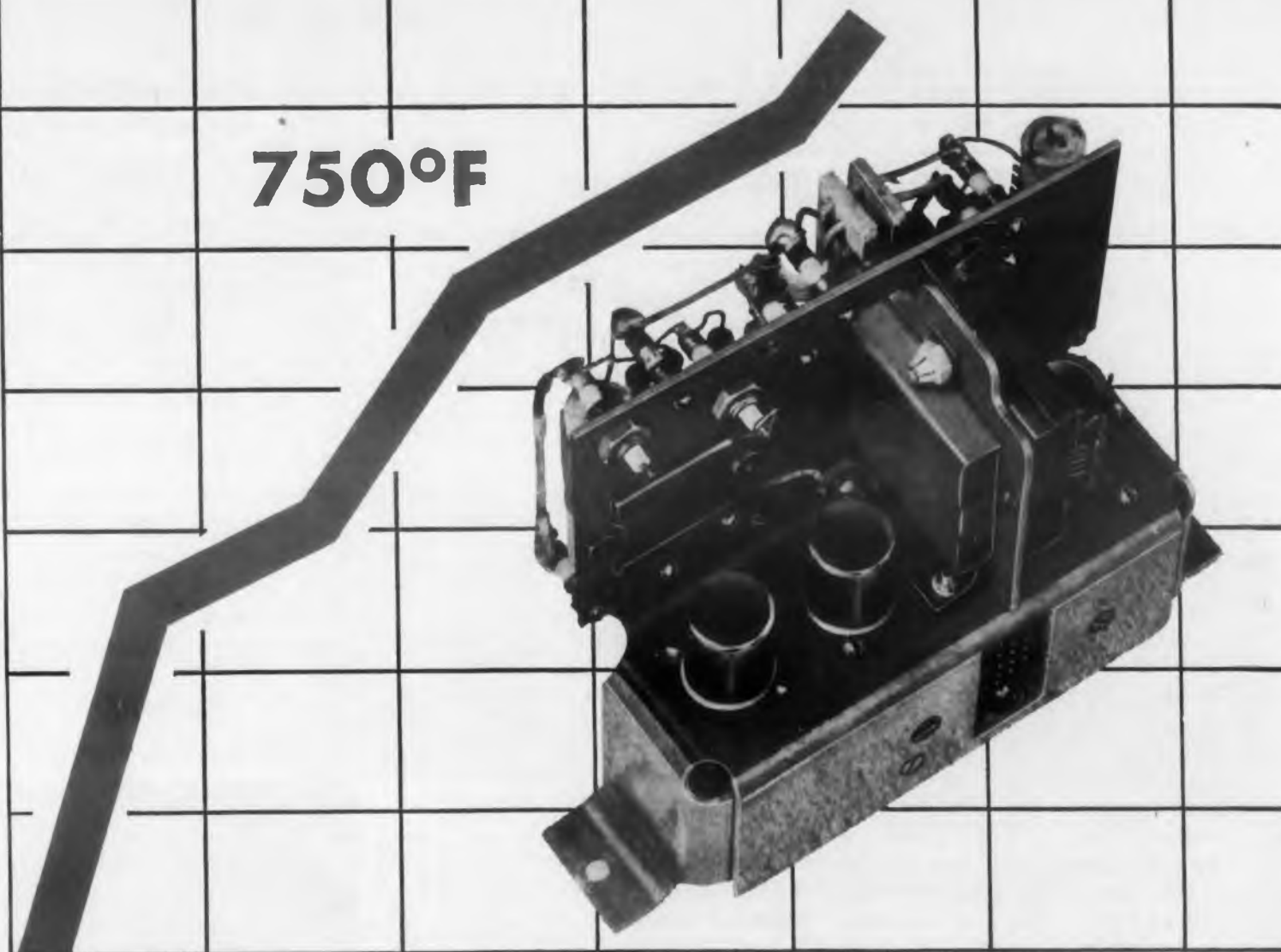
Calif. Magnetic Control Corp., Calmag Div., Dept. ED, 11922 Valerio St., North Hollywood, Calif.

CIRCLE 52 ON READER-SERVICE CARD

CIRCLE 53 ON READER-SERVICE CARD

700°F  
600°F  
500°F  
400°F  
300°F  
200°F

750°F



This General Electric designed and developed amplifier operates without the use of refrigerants at ambient temperatures from  $-67^{\circ}\text{F}$  to  $750^{\circ}\text{F}$ .

# High-temperature, Radiation Tolerant Electronic Equipment—Without Refrigerants

## GENERAL ELECTRIC HAS PROVEN ABILITY TO MEET YOUR REQUIREMENTS

Here's important news for you if your systems project dictates the need for temperature and radiation tolerant electronic equipment. The General Electric Company stands ready to undertake the design, development, manufacture and evaluation of your equipment where your specifications call for successful operation up to  $750^{\circ}\text{F}$ , without refrigerants. And General Electric's ability to meet your high-temperature requirements is backed by

notable successes.

**FOR EXAMPLE** General Electric has already developed airborne amplifiers which have been successfully operated over an ambient temperature range from  $-67^{\circ}\text{F}$  to  $750^{\circ}\text{F}$ . Special circuit designs and packaging techniques permitted this without the use of heavy, complex refrigerating equipment.

**FOR INFORMATION** on how General Electric can help you solve your high-temperature electronic equip-

ment problems, contact your G-E Missile and Ordnance Systems Department Field Sales Office or mail the coupon below.

FOR MORE INFORMATION  
ON HOW TO MEET YOUR  
HIGH-TEMPERATURE REQUIREMENTS

GENERAL ELECTRIC COMPANY  
Section D222-6  
Lakeside Avenue  
Burlington, Vt.

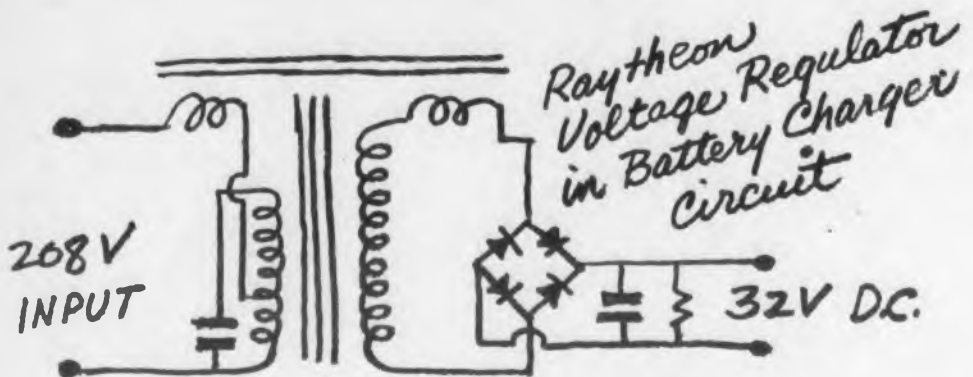
- Please send me bulletin MPB-32, "High-Temperature Electronic Equipment."  
 I would appreciate a discussion of my equipment requirements with General Electric High-Temperature Engineering Specialists.

NAME.....  
TITLE.....  
COMPANY.....  
ADDRESS.....  
CITY..... STATE.....

*Progress Is Our Most Important Product*

GENERAL  ELECTRIC

# IS CONSTANT VOLTAGE POSSIBLE IN THESE CHANGING TIMES?



...Basically, the problem is a classical one of semantics. Higher minds than ours have pondered this question for centuries.

As a practical exercise, let us examine the case of voltage regulation reference source in the power supply circuit shown above. This passive network corrects input voltage changes of more than  $\pm 15\%$  of rated outputs and controls them to within  $\pm \frac{1}{2}\%$ ...a feature that is highly important in keeping storage batteries alive longer.

The point is that constancy is a relative term understood only against a background of change. The answer then to the initial question is "yes"...constant voltage is possible.



You can get the **Complete Story** about voltage

regulators from the higher minds at Raytheon by writing to:

VOLTAGE REGULATOR MAN  
Raytheon Manufacturing Company  
Magnetic Components Department  
Section 6120  
Waltham 54, Massachusetts

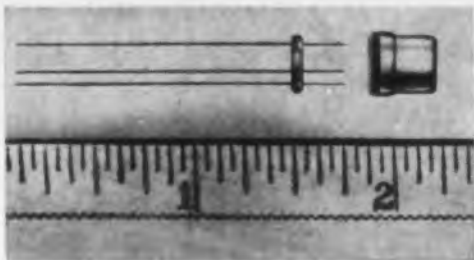


CIRCLE 54 ON READER-SERVICE CARD

## NEW PRODUCTS

### Diode and Transistor Bases

Two, three, and four lead types



This standard line of diode and transistor bases and cases includes strain-free solderable types, compression weldable types, and compression solderable types. Two, three, and four lead types are available. Diode closures are supplied in a wide range of shapes and sizes.

Electrical Industries, Dept. ED, 691 Central Ave., Murray Hill, N.J.

CIRCLE 55 ON READER-SERVICE CARD

### Switches

Rated at 5 amp at 6 v dc



Series 100 phenolic switches are rated at 5 a at 6 v dc, 100 ma at 110 v ac, make and break, resistive load. Current carrying capacity is 5 a.

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

CIRCLE 56 ON READER-SERVICE CARD

### Calorimeter Bridge

Measures 10 kw full scale



This direct reading calorimeter bridge can be used with any water load. It measures 10 kw full scale. Water flow is 4 gallons per min. Accuracy of ac wattmeter is 1 per cent.

Electro Impulse Laboratory, Dept. ED, 208 River St., Red Bank, N.J.

CIRCLE 57 ON READER-SERVICE CARD

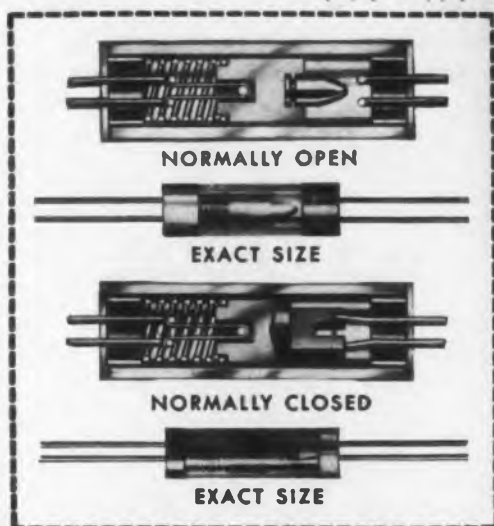
## MINIATURE THERMAL RELAYS

with  
99.99% Plus

Reliability

SERVICE-FITTED  
SERVICE-TESTED  
SERVICE-APPROVED

*Our complete environmental testing laboratory samples and certifies daily production.*



**New NORMALLY CLOSED RELAYS NOW AVAILABLE.** They both meet or exceed requirements for guided missiles and complex electronic gear.

They are hermetically sealed by bonding metal headers to high thermal, shock resistant glass housings.

They open or close a circuit positively in 0.1 second or other delay times.

They can also be safely used as a "squib" or timing mechanism.

#### Typical Characteristics

Temperature:  $-100^{\circ}\text{F. to } +450^{\circ}\text{F.}$   
Vibration: 20-3000 CPS at 40 G's  
Shock: 250 G's

*Brochure containing complete characteristics and specifications available upon request.*

## NETWORKS ELECTRONIC CORPORATION

14806 OXNARD ST., VAN NUYS, CALIF.

*Original designs for highest reliability in glass housed miniature Relays and Resistors for all purposes*

CIRCLE 58 ON READER-SERVICE CARD

**NEW**

*wire-wound*

**RESISTORS\***

**Crafted with Precision  
for Reliability**



*For critical military and industrial applications.*

Hermetically sealed by bonding glass-kovar headers to high thermal, shock resistant glass housings. 100% humidity-proof.

NETWORKS' new, truly accurate, precision Resistors are available in 1/4, 1/2, 1 and 2 watt ratings at 105°C ±0.1 to 1%. Units for 125°C available on special order. Lug types or flexible leads. Test results prove substantial improvement over MIL specs. They combine remarkable stability, under load and on the shelf, with exceptionally low temperature coefficient.

\*Patented

**Reliability  
Conservative Ratings  
Stable Characteristics**



*Engineering Bulletin with complete specifications available upon request.*

**NETWORKS  
ELECTRONIC  
CORPORATION**

14806 OXNARD ST., VAN NUYS, CALIFORNIA

CIRCLE 200 ON READER-SERVICE CARD

# Reliability

## IS THE COMMON DENOMINATOR OF ALL NETWORKS MAGNETIC COMPONENTS



### CURRENT TRANSDUCTORS

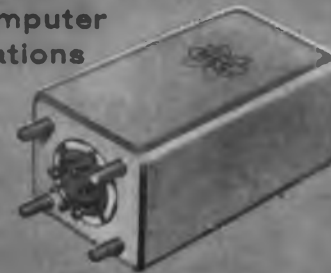
For plating and other high current applications

Function as DC current transformers for metering large DC currents without conventional shunts and to isolate DC bus from metering circuit. Units rated for bus currents from 100 to 2000 amps with 2500 to 1 current ratio. Accuracy from ± 1/2 to 2% depending on current rating.



### OVER AND UNDER CURRENT SWITCHES

For computer applications



Combination magnetic amplifier and transistor switching device with extreme sensitivity and reliability. 3 to 5 milliohm insertion resistance. Switch is NC (conducting) and opens with incremental current change of 40 ma or more from preset values. Current ranges 100 ma to 10 amps available. Temperature range -55°C to +85°C.



### FREQUENCY SENSITIVE RELAYS

For guided missile applications

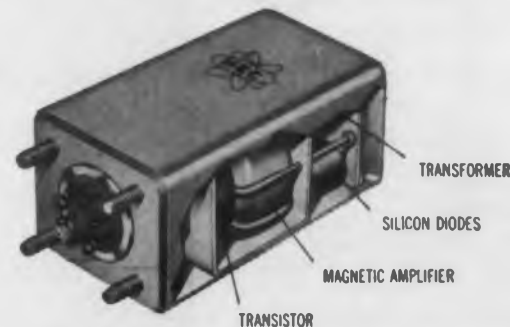


DPDT contacts actuated when frequency of supply varies ± 1% from 400 cps; will tolerate line voltage variation of ± 20%. Other center frequency values available. Temperature range -55°C to +85°C. Nominal voltage input 115V ± 20%. Other voltage ranges available. Withstand vibration up to 20g from 20 to 2000 cps. Shock of 400g for 1 millisecond in all planes.



### SENSITIVE ELECTRONIC SWITCHES

For general applications



Both current and voltage sensitive versions available. Sensitivities of control circuit as low as 750 microwatts. Control resistance from 3 milliohms to 2500 ohms. No moving parts. Switch circuit handles up to 40 V DC at 2 amps. Temperature range -55°C to +85°C. Meet or exceed all applicable military specifications.

- Patents Pending -

COMPLETE SPECIFICATIONS AVAILABLE UPON REQUEST

*Concepts of proven reliability—yesterday... today... tomorrow.  
Standard or custom designs for airborne and ground applications.  
Engineers, Designers and Manufacturers of All-Magnetic Components.*



## NETWORKS ELECTRONIC CORPORATION

14806 OXNARD STREET • VAN NUYS, CALIFORNIA • STate 5-8805

CIRCLE 196 ON READER-SERVICE CARD

## NEW PRODUCTS

### Pulse Transformer

Serves as magnetron mounting



NYT #40200 pulse transformer assembly is designed around the 4J52 and 6543 magnetrons. Using a rugged cast housing, it permits direct mounting of the magnetron without the need for auxiliary brackets. The floating studs simplify magnetron insertion, alignment, and mounting.

The unit is designed to deliver 15,000 v pulses, 0.3 to 3.2  $\mu$ sec long with good spectrum characteristics and max side lobe attenuation. This design permits the assembly to safely handle 40,000 v pulses such as occur during magnetron misfiring conditions. This assembly also contains isolation and filament transformers, an rf line filter, a pulse current metering circuit, and by-pass capacitors.

New York Transformer Co., Inc.,  
Dept. ED, Alpha, N.J.

CIRCLE 59 ON READER-SERVICE CARD

### Cooling Unit

Weights 11.5 lb

A liquid cooling unit has been developed that measures 11.8 in. long by 5.35 in. high and weighs 11.5 lb. It has a heat rejection capacity of 1.5 kw with 2 gal per min flow, fluid inlet temperature of 150 F, and air inlet temperature of 125 F, under ambient sea level pressure. A variety of fluids, including electronic cooling fluids, can be accommodated.

Garrett Corp., AiResearch Div.  
Dept. ED, 9851 Sepulveda Blvd.  
Los Angeles 45, Calif.

CIRCLE 60 ON READER-SERVICE CARD

CIRCLE 61 ON READER-SERVICE CARD ➤

PIONEERS OF THE THERMAL FRONTIER

**Eastern**  
COOLING ELECTRONIC  
SYSTEMS FOR MISSILES

**Monsanto**

NEW FLUIDS FOR THE MISSILE AGE



advanced  
system of **COOLING**  
**ELECTRONICS**  
extends missile performance

**EASTERN AVIONIC COOLING SYSTEM IS LIGHTER . . .  
SMALLER . . . MORE RELIABLE**

Electronic equipment is vulnerable to the fantastic heat encountered by missiles. Eastern liquid cooling and refrigeration systems maintain safe avionic operating temperature limits even in the 800°F. environment present at five times the speed of sound.

**MINIATURIZING ALL COMPONENTS**

In addition to efficient, reliable operation, Eastern cooling systems are miniaturized to meet the most rugged missile requirements for space and weight. By using Monsanto Coolanol 45\* fluid, a 24,000RPM hydraulic pump no bigger than a fist can be used. Coolanol 45 keeps the high-speed

pump lubricated, as well as providing a coolant with outstanding qualities. The high boiling point of Coolanol 45 permits a smaller system since temperature maintained can be higher. Coolanol 45 is an excellent heat-transfer medium with good dielectric properties. Adequate viscosity assures long life of precision hydraulic pumps. Systems are easily sealed to prevent contaminating air leakage, and the low foam tendency of Coolanol 45 minimizes circulation troubles.

**DESIGNS TO MATCH MISSILE PERFORMANCE**

Using a basic liquid cooling system, or by adding refrigeration cycle, cold plates, or evaporative cooling as needed, Eastern can protect electronic equipment under the severest temperature conditions. Come to the leader in the field for complete and creative help.



**LIQUID COOLING SYSTEM**  
(model shown weighs 10 lbs. —  
measures 10-1/2" x 6" x 7-3/4")

*Eastern subsystems and systems for missiles and aircraft*

AVIONIC COOLING • REFRIGERATION • HYDRAULIC POWER PACKS • PRESSURIZATION-DEHYDRATION

For bulletin 0-123 on Coolanol 45, write



**MONSANTO CHEMICAL COMPANY**  
Aviation Fluids Dept. AV-2  
Lindbergh and Olive Street Road,  
St. Louis 24, Mo.

\*Coolanol 45: Monsanto trademark (formerly OS-45)

For aviation bulletin 350, write



**EASTERN INDUSTRIES, INC.**  
100 Skiff Street  
Hamden 14, Conn.

**Vibration Pickups**  
Ranges from 15 to 2000 cps



Operable from -65 to +500 F, these small, reliable pickups known as types 4-121, 4-122, and 4-123, will monitor vibrations up to 2000 cps. Type 4-123, with its 45 to 2000 cps operating range, is ideal for jet engine monitoring where the lowest frequency encountered is about 50 cps.

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

CIRCLE 62 ON READER-SERVICE CARD

**Test Set**

Tests solid state rectifiers



Model 2-38A rectifier test set has been designed to evaluate the dynamic characteristics of germanium and silicon rectifiers. The unit employs a special circuit which permits selecting any forward current or reverse voltage independently of each other. The unit tests average forward current ratings between 0.25 and 50 a half-wave, and reverse voltage ratings to 2 kv peak.

Wallson Assoc., Ltd., Dept. ED,  
35 E. Runyon St., Newark 12, N.J.

CIRCLE 63 ON READER-SERVICE CARD

◀ CIRCLE 61 ON READER-SERVICE CARD

How the man from Tensolite cuts assembly costs



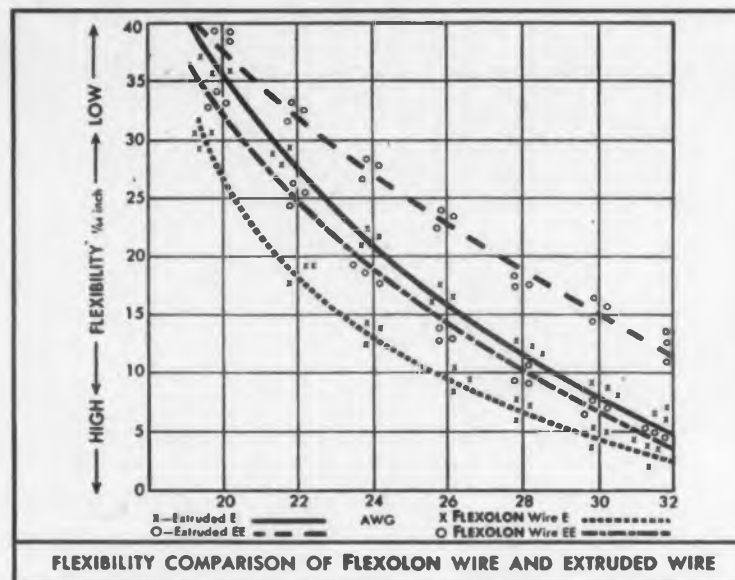
Westinghouse Aero 13 Armament Control System, mounted in nose of Navy F4D Douglas carrier-based interceptor, is typical of systems using FLEXOLON wire for faster assembly, lower production costs.

## FLEXOLON wire's greater flexibility speeds up wiring of Westinghouse control unit

Greater flexibility of new FLEXOLON high temperature hook-up wire makes an easier job of wiring intricate harnesses for Westinghouse Air Arm's armament control systems. Meeting the flexibility requirements of Westinghouse engineers, Tensolite's new wire helps reduce production time and assembly costs.

FLEXOLON wire's greater flexibility was proven in a recent series of tests on the new hook-up wire and wires of other construction. In test after test FLEXOLON wire, insulated with DuPont "Teflon,"<sup>®</sup> proved consistently more flexible than all other high temperature hook-up wires tested.

Exceeding the requirements of MIL-W-16878B . . . and providing greater dielectric strength and higher average concentricity . . . new FLEXOLON hook-up wire is another example of Tensolite's continuous leadership in miniature wire development.



Plot of flexibility as recorded in tests proves greater flexibility of FLEXOLON wire. For complete testing data, call the man from Tensolite, or write for free FLEXOLON hook-up wire bulletin.

**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 Tensolite Insulated Wire Co., Inc.

## NEW PRODUCTS

### Record Amplifiers

For airborne use



For in-flight use with tape instrumentation, these amplifiers and power supply will operate at temperatures up to 100 C. Four interchangeable modules are designed to provide analog, analog with voice, pulse duration modulation or frequency modulation recording on tape. Two record amplifier cases (14 channels) may be stacked with the type 3-135 power supply which will operate all 14 amplifiers. Shockmounts are not required for the units.

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

CIRCLE 65 ON READER-SERVICE CARD

### Blowers

For use in military transmitters



A typical centrifugal unit in this line is this 2 hp unit capable of delivering 5000 cfm at 0.4 in. static pressure. The V-belt driven blower measures approximately 40 x 15 in. and weighs 90 lb.

American Standard, American Blower Div., Dept. ED, Detroit 32, Mich.

CIRCLE 66 ON READER-SERVICE CARD

◀ CIRCLE 64 ON READER-SERVICE CARD

## Frequency Meter

Range from 10 kc to 3000 mc



This vhf frequency meter is accurate to one part per million over a range of 20 to 3000 mc. The instrument which will measure frequencies as low as 10 kc is capable of generating frequencies over the entire 10 kc-3000 mc range.

Lavoie Laboratories, Inc., ED, Matawan-Freehold Rd., Morganville, N.J.

CIRCLE 67 ON READER-SERVICE CARD

## Mercury Switch

Resistant to oil and water



This nylon-enclosed mercury switch is made of materials which are resistant to the effects of water, oil, alkalis, and acids. A synthetic rubber embedment material protects the switching unit from shock and seals the lead entrance.

Micro-Switch Div., Minneapolis-Honeywell Regulator Co., Dept. ED, Freeport, Ill.

CIRCLE 68 ON READER-SERVICE CARD

## Relay Sockets

Design assures ease of installation



This micro-miniature 8 and 10 contact relay socket is available in four styles of mountings to assure ease of installation in any design. Also available are 8 and 10 contact sockets.

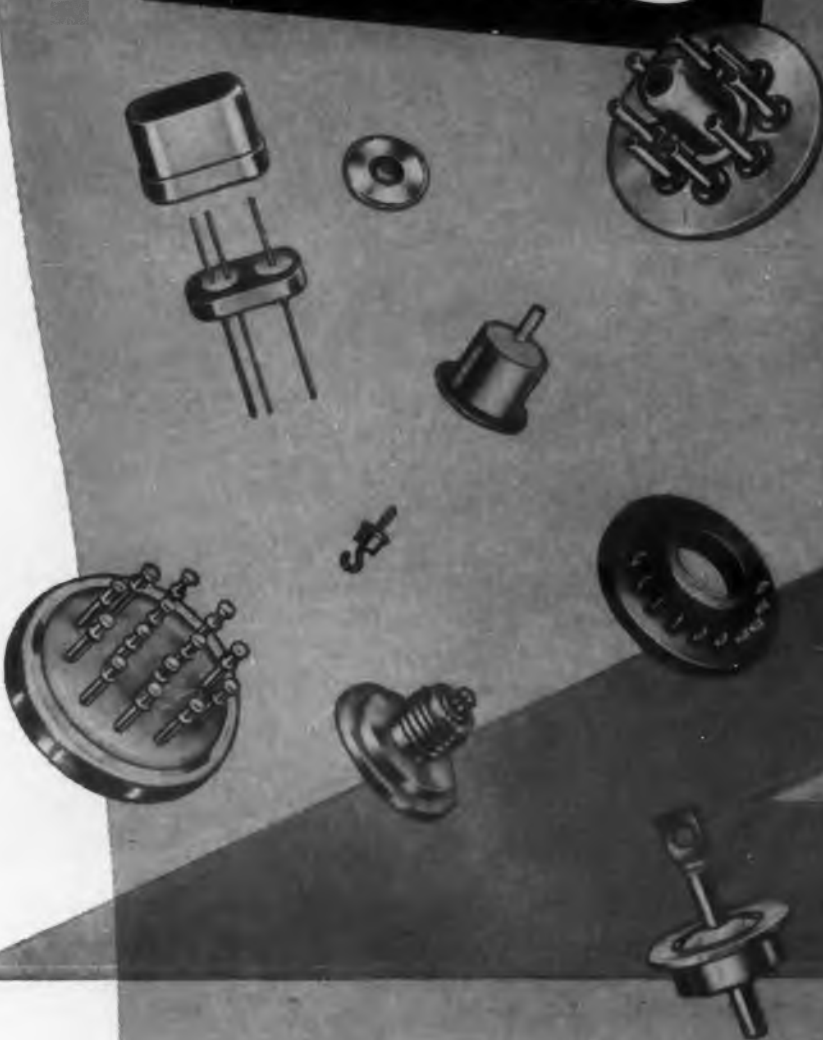
Viking Industries, Inc., Dept. ED, 21343 Roscoe Blvd., Canoga Park 3, Calif.

CIRCLE 69 ON READER-SERVICE CARD

# Versatility in Application

... makes **E-I** the Designer's Line!

## GLASS-TO-METAL SEALS\*



Application-tested E-I hermetic terminals feature ruggedized compression construction for complete reliability in severe environments in military and commercial service. The economical E-I standard line offers designers every type terminal from single leads to sub-miniature closures. If your problem involves the use of special seals, E-I will produce custom designs to specifications; or seal components of your own manufacture. Ask E-I engineers for a recommendation on your specific seal application, today!

\*Manufactured under Canadian Patent 523,390, United Kingdom Patent 734,583 and Licensed under U.S. Patent 2561520

Designers and Engineers!

Request complete catalog containing helpful installation data—just call or write E-I.



## ELECTRICAL INDUSTRIES

A Division of Philips Electronics, Inc.

MURRAY HILL • NEW JERSEY

CIRCLE 197 ON READER-SERVICE CARD





# INTER- RUPTED!

## if a priceless audience switches channels

This situation has happened all too often in the past. But now it seldom occurs, because most of the vast transmission and control networks are designed on a modular basis.

Circuitry is arranged so that essential elements or sub-assemblies can be disconnected quickly... and spare parts inserted... while parts in trouble are checked when convenient.

How about your system or product? Do your customers encounter loss of time, loss of equipment use, loss of production because of hard-to-follow wiring or transference of control elements? Perhaps the reliability of your products could be improved through the use of Cannon Plugs modular units. Cannon makes **over 27,000** different plugs—can engineer them to meet your requirements in modular "black-box" unit assemblies to minimize interruptions and make it possible to correct them, if they should occur, in a matter of seconds. Cannon will design and make the plugs and assemblies you need. Write today for brochure "The Modular Concept" which explains how modular designs can save dollars. Please refer to Dept. 143.

Cannon Electric Company, 3208 Humboldt Street,  
Los Angeles 31, California.

**CANNON**



**PLUGS**

*Where Reliability  
for Your Product  
is Our  
Constant Goal*



## NEW PRODUCTS

### Clutches

Improved torque and response time



Model FCX-59 clutch and FBX-59 brake is the first unit available in a series of clutches. The comparative specifications of this unit against the company's standard FC-59 and FB-59 models, are as follows: torque has been increased from 4 oz-in. to 8 oz-in. minimum; control wattage has been decreased from as high as 2-1/2 w to 1.1 w maximum; response time has been decreased from 8 msec to approximately 0.9 msec to the first time constant of maximum torque. Other characteristics have been retained: stationary coil, with no slip rings or brushes; class 5 instrument bearings throughout, and rotor construction featuring clean actuation.

Magtrol, Inc., Dept. ED, 240 Seneca St., Buffalo 4, N.Y.

CIRCLE 71 ON READER-SERVICE CARD

### Temperature Controller

Range from  $-6$  to  $+124$  C



Model 71 YSI Thermistemp temperature controller can be set from  $-6$  to  $+124$  C within an accuracy

◀ CIRCLE 70 ON READER-SERVICE CARD

of  $\pm 0.5$  C. Sensitivity is better than  $\pm 0.05$  C, and control to  $\pm 0.01$  can be achieved. The controller has a double pole double throw relay capable of handling 10 a loads.

Yellow Springs Instrument Co.,  
Dept. ED, Yellow Springs, Ohio.

CIRCLE 72 ON READER-SERVICE CARD

### Microwave Test Set

2700 to 3000 mc range



Model 1000 basically covers the 2700-3000 mc range. Measurement of antenna and cable systems, other microwave measuring instruments, and vswr of transmission line components and other line characteristics is provided.

Amerac, Inc., Dept. ED, Dunham Rd., Beverly, Mass.

CIRCLE 73 ON READER-SERVICE CARD

### DC Motor

High-torque low-current type



Type 800 dc motor has output speeds ranging from 900 rpm to 2 rpd with gear train, and from 960 to 3000 rpm without gear train, providing maximum torque of 30 oz-in. and 0.6 oz-in. respectively.

Cramer Controls Corp., Dept. ED, Centerbrook, Conn.

CIRCLE 74 ON READER-SERVICE CARD

CIRCLE 75 ON READER-SERVICE CARD

# NEW T/I diffused junction 3 AMP 600 VOLT silicon rectifiers



(ACTUAL SIZE)

TI diffused junction silicon rectifiers give you full 3-ampere output at 50°C with PIV ratings to 600 volts.

The TI diffusion process assures you of complete uniformity of characteristics and provides either anode-to-stud or cathode-to-stud polarity. Quick easy wiring into production assemblies is additionally facilitated by the eyelet on the top lead. All welded, rugged construction with glass-to-metal seal provides high resistance to shock and vibration.

Check the characteristics below and specify economically priced TI rectifiers for all your medium power applications.

Anode-to-stud units denoted by "R" suffix to type number.

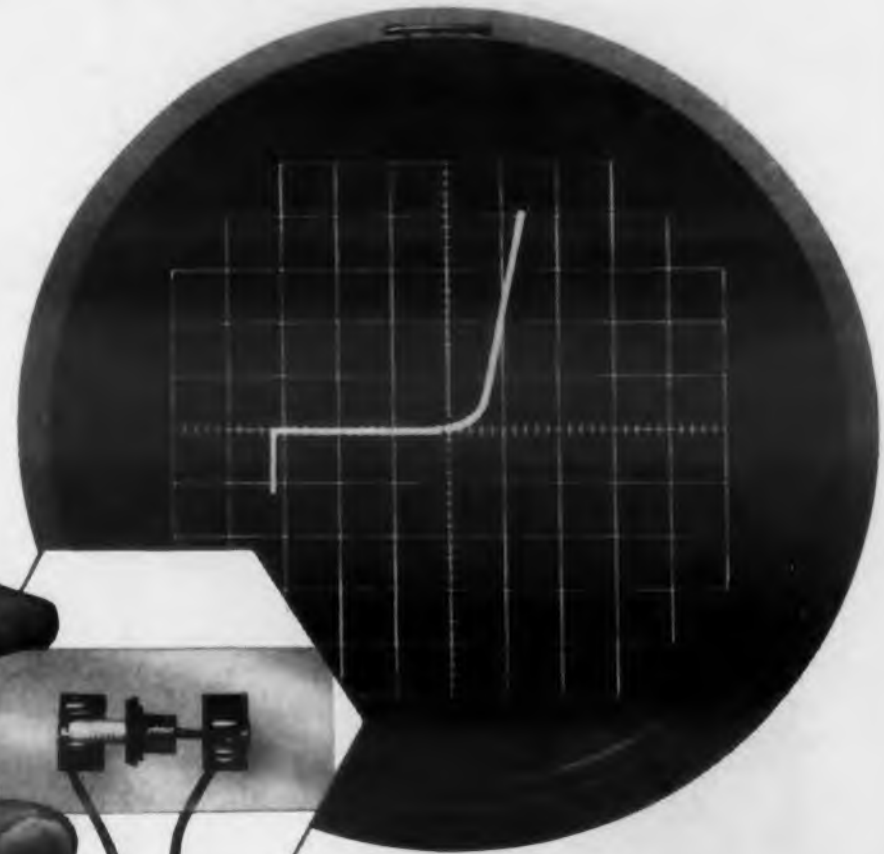
#### maximum ratings

	1N1124 1N1124R	1N1125 1N1125R	1N1126 1N1126R	1N1127 1N1127R	1N1128 1N1128R	unit
Peak Inverse Voltage at $-65^{\circ}\text{C}$ to $+150^{\circ}\text{C}$	200	300	400	500	600	V
*Average Rectified Forward Current at $+50^{\circ}\text{C}$	3	3	3	3	3	Amp
*Average Rectified Forward Current at $+150^{\circ}\text{C}$	1	1	1	1	1	Amp
*Recurrent Peak Forward Current at $+50^{\circ}\text{C}$	10	10	10	10	10	Amp
Surge Current, 1 Cycle at 60 Cycles at $+50^{\circ}\text{C}$	25	25	25	25	25	Amp
Operating Temperature, Ambient	-65 to +150					$^{\circ}\text{C}$

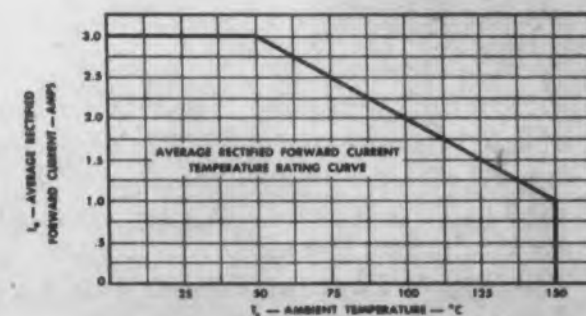
#### specifications

	1N1124 1N1124R	1N1125 1N1125R	1N1126 1N1126R	1N1127 1N1127R	1N1128 1N1128R	unit
Max. Full Cycle Avg. Reverse Current at $+150^{\circ}\text{C}$	0.3	0.3	0.3	0.3	0.3	mA
Max. Reverse Current at PIV at $+25^{\circ}\text{C}$	10	10	10	10	10	$\mu\text{A}$
Max. Forward Voltage Drop at $I_b = 1$ Amp at $+25^{\circ}\text{C}$	1.1	1.1	1.1	1.1	1.1	V

\* Rectifier mounted on 2" x 2" Heat Sink, 1/16" aluminum.



available now with either anode or cathode to stud



also immediately available in production quantities

#### TI 1500 VOLT RECTIFIERS

Single junction reliability assures the high reliability your circuits require.

	Peak Inv Voltage V	Avg Rect Fwd Current mA	Recurrent Peak Current
1N1130*	1500	300	1A
1N1131†	1500	300	1A
1N588	1500	25	150 mA
1N589	1500	50	250 mA

\* cathode-to-stud      † anode-to-stud

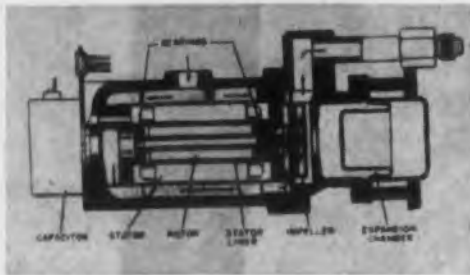
TEXAS INSTRUMENTS  
INCORPORATED  
SEMICONDUCTOR - COMPONENTS DIVISION  
POST OFFICE BOX 312 • DALLAS, TEXAS



Contact your nearest TI sales office or distributor for detailed silicon diode and rectifier data sheets

## NEW PRODUCTS

### Airborne Pumps Solve shaft leakage problem



Shaft leakage within these airborne pumps is prevented because the pump and pump motor are sealed within the same case. Cooling and lubrication are accomplished by channeling the fluid, being pumped through and around the metal stator case to immerse the rotor and stator.

Pacific Scientific Co., Dept. ED, 6280 Chalet Dr., Bell Gardens, Calif.

CIRCLE 76 ON READER-SERVICE CARD



### Pulse Height Analyzer 0.5 per cent linearity

Model PHA/20 pulse height analyzer consists of a 100-channel analog-to-digital converter plus twenty channels of glow transfer tube storage capacity. The linearity of the unit is 0.5 per cent; the deadtime is 500  $\mu$ sec.

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

CIRCLE 77 ON READER-SERVICE CARD



### Analog Computer Comprises 48 amplifiers

The MC-5800 analog computer comprises 48 operational amplifiers; eight relay amplifiers with relays; 24 free diodes; 72 scale factor po-

To help you design more reliable technical applications with

## HAND OPERATED SWITCHES AND ASSEMBLIES



• "HOP" carefully considers all applications from a "human engineering" standpoint, beforehand, in order

to reduce human failure to a minimum. Some typical examples of "HOP" products are . . .

### Toggle Actuated Switches



Maintained or Momentary with variations for Single-Pole to Triple-Pole.

	Maintained	Momentary
Single-Pole	A3-20	A3-14
Double-Pole	A3-8	A3-15
Triple-Pole (shown)	A3-27	.....

Bushing size, above models:  $\frac{1}{4}$ " x 40. (Also available in  $\frac{1}{32}$ " x 32 bushing.)

### Push-Button Actuated Switches



Single-Pole	A4-18
Double-Pole	A4-7
Triple-Pole (shown)	A4-14

Bushing size, above models:  $\frac{1}{32}$ " x 32. (Also available in  $\frac{1}{4}$ " x 40 bushing.) Wide Range of Pushbutton Actuators for All Applications.

### Rotary Gang Switches



6-Pole assembly A9-7 (shown)  
Also available in a wide range of other pole arrangements.

### Lighted Push-Button Switches



C-6 Series — Combines two-piece, color coded push-button, pilot-light and switching unit in one space-saving component, panel mounted. Use singly or stacked.

C-8 Series—Combines 3-color monitoring and switching in one compact, modular unit, panel mounted. Ten-second replacement of lamp modules from front of panel. Variety of colors available.



TAKE ADVANTAGE OF THIS  
NEW SERVICE NOW

Telephone

CHICAGO  
VAn Buren  
6-3100

Just Ask for "HOP"

# HAND OPERATED PRODUCTS GROUP

"HOP" is a group of skilled Electro-Snap specialists who know hand-operated switches and assemblies, their limitations, advantages and specifications to fit any application. Their service is available to you for . . .

problem analysis, design development and modifications, testing and practical application of hand operated devices for specified conditions.

"HOP" personnel have broad practical ability, basic experience and modern application knowledge which is particularly valuable in helping to solve your problems at lower overall cost to you.

Whether your problem concerns technical application details on standard products or custom "specials" engineered to your specifications, this new service can give you *dependable* answers, quickly. Just ask for "HOP" by telephone, wire or letter.



## ELECTRO-SNAP SWITCH & MFG. CO.

4216 West Lake Street, Chicago 24, Illinois  
Telephone: VAn Buren 6-3100  
TWX No. CG-1400

### Hand Operated Assemblies to Meet Any Specifications



C3-4—Fire Control Switch assures proper sequence during emergency fire conditions. Eliminates pilot error by controlling all functions when single handle is pulled.



C3-8 — Vibration-free, positive detent-action, cut-off switch with potted wire leads in D.P.D.T. with simultaneous action.



C3-11 — Mechanical override assembly. Will convert from automatic function to manual operation of control surfaces.



C3-13—High current, manually-operated cut-off switch. Will simultaneously interrupt 4 circuits of 40 amps, 30 V DC—or much higher voltages with lower amperages. Has 8 separate circuits available in one control device.

CIRCLE 78 ON READER-SERVICE CARD

tentiometers, each equipped with a polarity selector switch; four precision servos; two servo multipliers; two servo resolvers; a removable problem patch board; a monitor and control panel including a high sensitivity vtvm, and an aural/visual amplifier overload alarm system. The console is housed in a metal enclosure measuring 4 x 2 x 6-1/2 ft.

Mid-Century Instrumatic Corp., Dept. ED, 611 Broadway, New York, N.Y.

CIRCLE 79 ON READER-SERVICE CARD

### Digital Converter

Provides unambiguous conversions



Model 1520 digiverter is a photoelectronic system which translates a vertical decimal display directly to an in-line display. The unit is easily attached to the front of a decade counter unit and then secured by two metal bands. It is powered from a 115-120 v, 50-60 cps power line and draws approximately 0.6 w per decade.

Radio Frequency Laboratories, Inc., Dept. ED, Powerville Rd., Boonton, N.J.

CIRCLE 80 ON READER-SERVICE CARD



### VTVM

Range from 100  $\mu$ v to 1 kv dc

MV-57A dc vtvm measures voltages from 100  $\mu$ v to 1 kv dc. Its input impedance is 6 meg on low ranges, 60 meg from 1 v up. Precision measurements are made through automatic comparison of accurate calibration signals, taken from a standard cell-controlled 1 kv dc supply, with the unknown voltage.

Cohu Electronics, Inc., Millivac Instruments Div., Dept. ED, P.O. Box 997, Schenectady, N.Y.

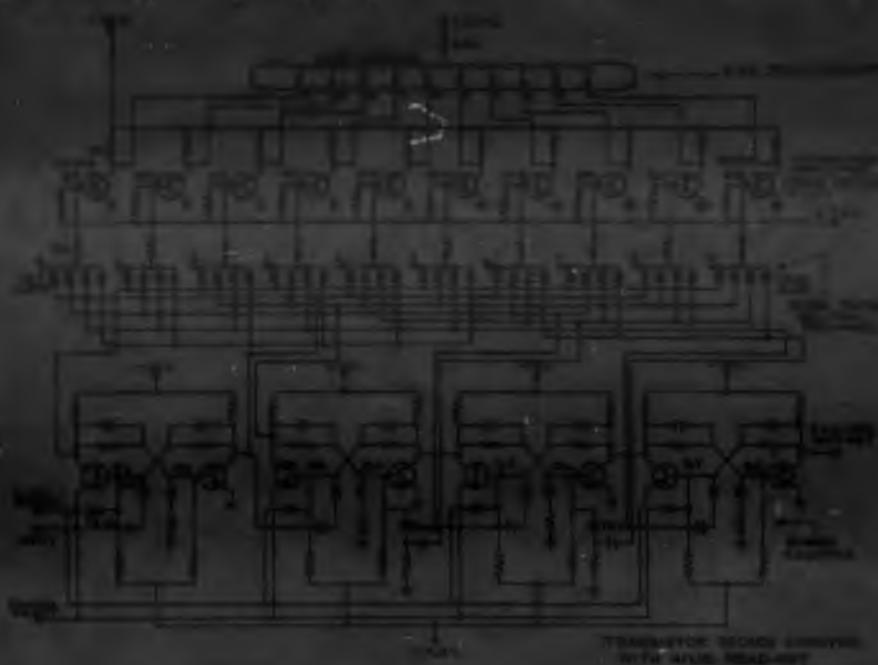
CIRCLE 198 ON READER-SERVICE CARD

are you a victim of

# ENGINEERING HYSTERISTOR?\*



Transistor action, 25 µA, designed a high speed decade counter requiring minimal to low voltage, to the best of possible benefit Transistor and it added like this.



TRANSISTOR DECADE COUNTER WITH NIXIE READ-OUT

He could have utilized eighteen 112 transistors and forty two diodes with one 111 beam Switching Tube like this.



BEAM SWITCHING TUBE DECADE COUNTER WITH NIXIE READ-OUT

\* EPIDEMIC SYMPTOMS:  
HYSTERICAL  
TOTAL USE OF TRANSISTORS

**ANALYSIS:** Transistors like ordinary tubes or diodes are essentially binary devices.

**REMARKS:** One 2-decade counter like beam switching tube in perform a decade function.

**LIVING PROOF:**

Burrage's Decade Counter Type DC-125 with 112 tubes, 111 beam switching tube, 111 diodes, 111 resistors, 111 capacitors, 111 switches and cost less than 1 dollar. — Q227 2142

**THE BEAM SWITCHING TUBE'S SWITCHING THREE BEAMS:**

A single electron controls an electron beam in any one of 10 different current outputs each of which has individual 2-able beam locking and high impedance switching.

You will find Beam Switching Tubes being used regularly in subcarrier, other components wherever there is distributing, switching, multiplying, sampling, coding, timing, gating, controlling, memory, dividing, decoding, converting, or presenting.



FOR NEW CATALOGUES ON 111 BEAM SWITCHING TUBE, 111 DECADE COUNTER, 111 NIXIE TUBE, 111-112-113-114-115-116-117-118-119-120-121-122-123-124-125-126-127-128-129-130-131-132-133-134-135-136-137-138-139-140-141-142-143-144-145-146-147-148-149-150-151-152-153-154-155-156-157-158-159-160-161-162-163-164-165-166-167-168-169-170-171-172-173-174-175-176-177-178-179-180-181-182-183-184-185-186-187-188-189-190-191-192-193-194-195-196-197-198-199-200-201-202-203-204-205-206-207-208-209-210-211-212-213-214-215-216-217-218-219-220-221-222-223-224-225-226-227-228-229-230-231-232-233-234-235-236-237-238-239-240-241-242-243-244-245-246-247-248-249-250-251-252-253-254-255-256-257-258-259-260-261-262-263-264-265-266-267-268-269-270-271-272-273-274-275-276-277-278-279-280-281-282-283-284-285-286-287-288-289-290-291-292-293-294-295-296-297-298-299-300-301-302-303-304-305-306-307-308-309-310-311-312-313-314-315-316-317-318-319-320-321-322-323-324-325-326-327-328-329-330-331-332-333-334-335-336-337-338-339-340-341-342-343-344-345-346-347-348-349-350-351-352-353-354-355-356-357-358-359-360-361-362-363-364-365-366-367-368-369-370-371-372-373-374-375-376-377-378-379-380-381-382-383-384-385-386-387-388-389-390-391-392-393-394-395-396-397-398-399-400-401-402-403-404-405-406-407-408-409-410-411-412-413-414-415-416-417-418-419-420-421-422-423-424-425-426-427-428-429-430-431-432-433-434-435-436-437-438-439-440-441-442-443-444-445-446-447-448-449-450-451-452-453-454-455-456-457-458-459-460-461-462-463-464-465-466-467-468-469-470-471-472-473-474-475-476-477-478-479-480-481-482-483-484-485-486-487-488-489-490-491-492-493-494-495-496-497-498-499-500-501-502-503-504-505-506-507-508-509-510-511-512-513-514-515-516-517-518-519-520-521-522-523-524-525-526-527-528-529-530-531-532-533-534-535-536-537-538-539-540-541-542-543-544-545-546-547-548-549-550-551-552-553-554-555-556-557-558-559-560-561-562-563-564-565-566-567-568-569-570-571-572-573-574-575-576-577-578-579-580-581-582-583-584-585-586-587-588-589-590-591-592-593-594-595-596-597-598-599-600-601-602-603-604-605-606-607-608-609-610-611-612-613-614-615-616-617-618-619-620-621-622-623-624-625-626-627-628-629-630-631-632-633-634-635-636-637-638-639-640-641-642-643-644-645-646-647-648-649-650-651-652-653-654-655-656-657-658-659-660-661-662-663-664-665-666-667-668-669-670-671-672-673-674-675-676-677-678-679-680-681-682-683-684-685-686-687-688-689-690-691-692-693-694-695-696-697-698-699-700-701-702-703-704-705-706-707-708-709-710-711-712-713-714-715-716-717-718-719-720-721-722-723-724-725-726-727-728-729-730-731-732-733-734-735-736-737-738-739-740-741-742-743-744-745-746-747-748-749-750-751-752-753-754-755-756-757-758-759-760-761-762-763-764-765-766-767-768-769-770-771-772-773-774-775-776-777-778-779-780-781-782-783-784-785-786-787-788-789-790-791-792-793-794-795-796-797-798-799-800-801-802-803-804-805-806-807-808-809-810-811-812-813-814-815-816-817-818-819-820-821-822-823-824-825-826-827-828-829-830-831-832-833-834-835-836-837-838-839-840-841-842-843-844-845-846-847-848-849-850-851-852-853-854-855-856-857-858-859-860-861-862-863-864-865-866-867-868-869-870-871-872-873-874-875-876-877-878-879-880-881-882-883-884-885-886-887-888-889-890-891-892-893-894-895-896-897-898-899-900-901-902-903-904-905-906-907-908-909-910-911-912-913-914-915-916-917-918-919-920-921-922-923-924-925-926-927-928-929-930-931-932-933-934-935-936-937-938-939-940-941-942-943-944-945-946-947-948-949-950-951-952-953-954-955-956-957-958-959-960-961-962-963-964-965-966-967-968-969-970-971-972-973-974-975-976-977-978-979-980-981-982-983-984-985-986-987-988-989-990-991-992-993-994-995-996-997-998-999-1000

# Burroughs Corporation



ELECTRONIC TUBE DIVISION

Plainfield, New Jersey

## NEW PRODUCTS

### Zener References

For miniaturized printed circuit systems



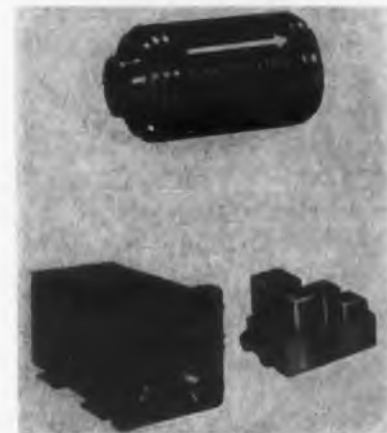
This line of silicon junction Zener reference elements have been designed specifically for miniaturized printed circuit systems where low dc voltage must be held constant under extreme environmental conditions. Operating voltage of the 1N1530 and 1N1530A is about 8.4 v.

Hoffman Electronics Corp., Semiconductor Div., 930 Pitner Ave., Evanston, Ill.

CIRCLE 82 ON READER-SERVICE CARD

### S-Band Beacons

Frequency of 2700-2900 mc



These high sensitivity S-band beacons have been designed for guided missile and drone-control applications. Performance data of the receiver-transmitter includes: over-all triggering sensitivity of 65 dbm; receiver frequency of 2700-2900 mc; and receiver frequency stability of 2 mc.

Telerad Manufacturing Corp., Dept. ED, 1440 Broadway, New York, N.Y.

CIRCLE 83 ON READER-SERVICE CARD

CIRCLE 81 ON READER-SERVICE CARD

## Film Resistors

Full load at 200 C



Types HTC, HTF, and HTH precision film resistors are available in three wattage ratings of 1/2, 1, and 2 w at  $\pm 1$  per cent tolerance. These resistors can operate continuously at full load in 200 C ambient. Their sizes correspond to RN20, RN25, and RN30 as specified in MIL-R-10509B. The HT series uses a carbon alloy film. Its inherent stability permits continuous high temperature operation without resorting to hermetic sealing techniques.

International Resistance Co., Dept. ED, 401 N. Broad St., Philadelphia 8, Pa.

CIRCLE 84 ON READER-SERVICE CARD

## Multiplexer

Sample-hold type



The sample-and-hold feature of model EM-51S makes possible the simultaneous sampling within 0.2  $\mu$ sec of any number of channels of highly dynamic data. The unit time multiplexes five separate voltage inputs to a single voltage output. Several of these 5-channel modules can be inter-connected to produce a single voltage output. The maximum multiplexing rate from channel to channel is 25 kc.

Epsco, Inc., Dept. ED, 588 Commonwealth Ave., Boston 15, Mass.

CIRCLE 85 ON READER-SERVICE CARD

CIRCLE 86 ON READER-SERVICE CARD

A COMPLETELY NEW *Concept* IN

# BOBBINLESS RESISTORS

New Subminiature Precision Wirewound Bobbinless Resistors feature exceptional stability, reliability and performance

General Transistor has developed a new concept for precision bobbinless resistors incorporating these exclusive features . . . the bobbinless construction eliminates wire stress and strain . . . a special viscous medium is used providing extreme shock and vibration resistance . . . welded case for positive hermetic sealing . . . the temperature coefficient of resistance of the finished resistor is the same as the wire and is not affected by the container. This insures repeatability and minimum hysteresis of resistance characteristics with temperature cycling.

These positive hermetically sealed units are designed for printed circuit boards and subminiature assemblies for airborne and missile applications.

The quality of materials and production superiority of these resistors is the same that has made General Transistor the Fastest Growing Name in Transistors.

Write today for complete technical information.

\* PAT. PENDING

### SPECIFICATIONS

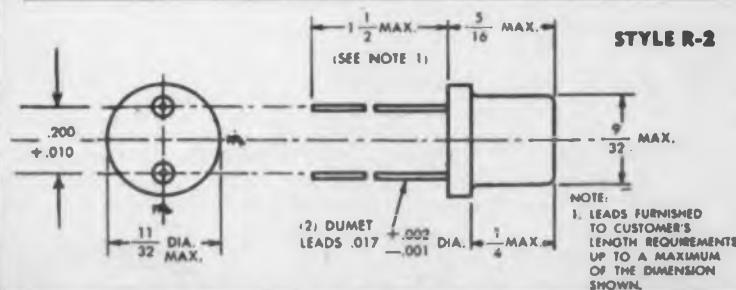
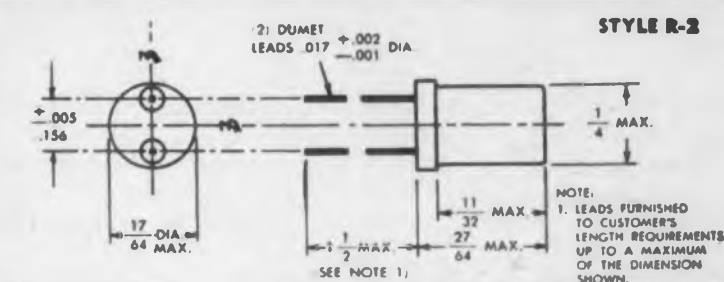
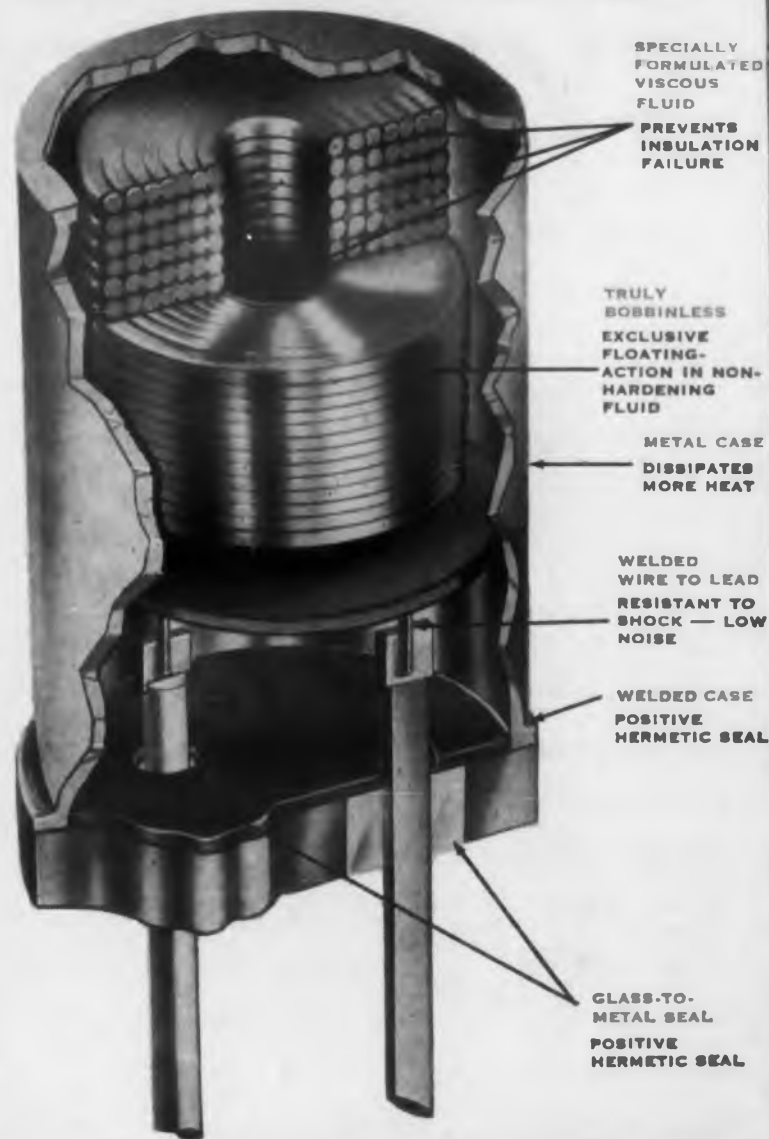
	Style R-2	Style R-5
Resistance Range	0.1 $\Omega$ to 750K $\Omega$	0.1 $\Omega$ to 750K $\Omega$
Resistance Tolerance	$\pm 0.05\%$ min. at 25°C	$\pm 0.06\%$ min. at 25°C
Power Rating	1/4 watt continuous in free air (increased dissipation possible with heat sink)	1/2 watt continuous in free air (increased dissipation possible with heat sink)
Temperature Range	-65°C to +125°C	-65°C to +125°C
Maximum Operating Voltage	250V, DC	500V, DC
Temperature Coefficient of Resistance	$\pm 20$ parts per million/°C	$\pm 20$ parts per million/°C
Dielectric Strength	500V rms, winding in case	1000V rms, winding to case

Construction - Terminations - Welded



ACTUAL SIZE

another QUALITY PRODUCT FROM GENERAL TRANSISTOR



## GENERAL TRANSISTOR

C O R P O R A T I O N  
91-27 138TH PLACE JAMAICA 35, NEW YORK

IN CANADA: DESSEP E-E LTD., 441 ST. FRANCIS XAVIER, MONTREAL 1, QUEBEC  
FOR IMMEDIATE DELIVERY FROM STOCK, CONTACT YOUR NEAREST AUTHORIZED GENERAL TRANSISTOR DISTRIBUTOR  
OR GENERAL TRANSISTOR DISTRIBUTING CORP., 98-27 BUTHIN BLVD., JAMAICA 98, NEW YORK  
FOR EXPORT: GENERAL TRANSISTOR INTERNATIONAL CORP., 91-27 138TH PLACE, JAMAICA 35, NEW YORK



# MONTROSE DIVISION SYNCHROS

MIL-S-16892 • SIZE 11 • 26 VOLT 115 VOLT  
ACTUAL SIZE



## STOCK DELIVERY

	26V 11TR4a	26V 11TX4a	26V 11CDX4a
Primary Voltage (Nominal)	26 volts	26 volts	10.2 volts
Energizing Primary Current (Max)	280 milliamps	280 milliamps	155 milliamps
Energizing Power (Max)	1.2 watts	1.2 watts	.35 watts
Transformation Ratio $\pm 2\%$	.454	.454	1.154
Max. Temp. Rise Under Load (Max)	60°C.	60°C.	—
No Load Temp. Rise (Max)	—	—	30°C.
Torque Gradient (Min)	.0079 oz-in/deg	.0079 oz-in/deg	—
Electrical Error (Max)	—	$\pm 7$ min.	—
Receiver Error (Max)	$\pm 60$ min.	—	—
Electrical Error (Rotor Max)	—	—	$\pm 10$ min.
(Stator Max)	—	—	$\pm 10$ min.
Synchronizing Time 30° Max	1.5 sec.	—	—
179° Max	2.5 sec.	—	—
Minimum Voltage Total (Max)	—	19 millivolts	26 millivolts
Fund. Component of Min. Voltage (Max)	—	12 millivolts	17 millivolts
Friction Torque Max. Room Temp. at 3 RPM	—	.055 oz-in	.055 oz-in
ZRo (Nom) 14.4 + J 107	14.4 + J 107	14.4 + J 107	19.6 + J 87.4
ZSo (Nom) 4.5 + J 19.1	4.5 + J 19.1	4.5 + J 19.1	16.5 + J 84
Outline Drawing	AY-1104-0	AY-1107-0	AY-1137-0

### OTHER SYNCHRO TYPES AVAILABLE

**SIZE 11**  
CT4b, CX4b, TR4a, TX4a, 26V-CT4b, 26V-CX4a

**SIZE 15**  
CX6-XN, CDX6-XN

**SIZE 18**  
CX6-XN, CDX6-XN

**SIZE 23**  
CDX4a, CT4, CT4a, CX4a, CX4, TDR4a, TDX4a, TR4, TR4a, TX4, TX4a, CT6, CT6a, TR6, TR6a, CX6, CX6a, TX6, TX6a

**SIZE 30**  
TXB6-XN, TRB6-XN, TXB4-XN, TRB4-XN

**SIZE 31**  
TR4a, TX4a, TR4-XN, TX4-XN, TDX4-XN, TDR4-XN, TDR6-XN, TDX6-XN, TR6-XN, TX6-XN

**SIZE 37**  
TX4-XN, TR6-XN, TX6-XN, TDX6-XN

**TYPE 1**  
HCT, HDG, F, HG

**TYPE 3**  
HG, HDG, HCT, F

**TYPE 5**  
HG, HDG, HCT, F

**TYPE 6**  
HG, HDG

West Coast Sales and Service Office, 117 East Providencia Avenue, Burbank, California  
Canadian Affiliate—Aviation Electric Limited, 200 Laurentien Blvd., Montreal, Quebec  
Export Sales and Service—Bendix International Division, 205 East 42nd Street, New York 17, New York

Montrose Division

SOUTH MONTROSE, PA.



CIRCLE 87 ON READER-SERVICE CARD



## NEW PRODUCTS

### Relay

Sensitivity of 40 mw



Designated as model R-9800, this double-pole double-throw model weighs 2 oz, is hermetically sealed and has an operating temperature range of  $-65$  to  $+125$  C. The relay has a coil sensitivity of 40 mw, a switching capability of 5 a resistive, and 3 a inductive load.

Hi-Spec Electronics Corp., Dept. ED, 7328 Ethel Ave., North Hollywood, Calif.

CIRCLE 88 ON READER-SERVICE CARD

### Cores

Have 1  $\mu$ sec switching time



These ferrite switching cores have a switching time of approximately 1  $\mu$ sec, at a rise time of approximately 0.3  $\mu$ sec, and a squareness ratio of 0.85. Maximum remanent flux density is 2200 gauss with maximum permeability of 1150.

Thermo Materials, Inc., Dept. ED, 4040 Campbell Ave., Menlo Park, Calif.

CIRCLE 89 ON READER-SERVICE CARD

### Impedance Meter

Serves several functions



Model D-22 regmeter will measure internal impedance of any voltage power supply or source

Trans Electronics, Inc.

DESIGNERS  
MANUFACTURERS

power supplies  
semiconductor test equipment

POWER  
SUPPLIES

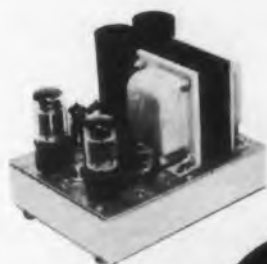
Transistor or Hard Tube

AC or DC	Regulated or Unregulated	Voltage regulated or current regulated	Variable or Fixed
----------------	--------------------------------	---	-------------------------

MODEL RS110

IMMEDIATE  
DELIVERY

Modular for easy substitution  
Floating output  
Carefully engineered  
For bench or rack use  
Barrier type terminal strip  
For breadboard or original equipment  
55-400 cycle operation



RS110  
0-110VDC  
at 0-100 MA

Rack mounted \$128.00  
Rack mounted with meters \$156.00

103<sup>00</sup>

\*Supplies with other ranges or modifications of these units also available.

#### SPECIFICATIONS:

Filament Output: 6.3 volts CT AC @ 3 amperes (unregulated).  
Current Range: 0-100 milliamperes, continuous duty; floating output.  
Ripple and Noise: 3 millivolts peak-to-peak maximum.

D.C. Voltage Range: 0-110 volts, continuously adjustable.  
Transient Response: Less than 50 millivolts no load to full load.

Input Voltage: 105-125 volts, 55-400 cps, AC.

Internal Impedance: Less than 1 ohm.

Load Regulation: 0.1%

Line Regulation: 0.1%

Dimensions:

7 1/4" x 5 1/2" x 5 3/4" height overall

Note: We welcome opportunities to discuss your special power supply requirements.

Trans Electronics, Inc.

7349 Canoga Avenue  
Canoga Park, California

CIRCLE 90 ON READER-SERVICE CARD

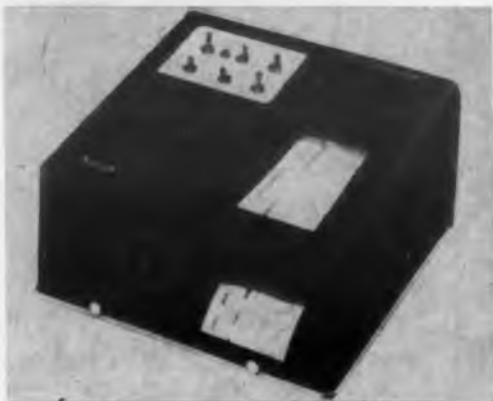
giving an output of 0 to 500 v dc. The instrument provides nine impedance ranges from 0.1 to 1000 ohm full scale. When used as an ac voltmeter, the D-22 has twelve ranges from 0.001 to 300 v full scale and is accurate over the frequency range of 6 cps to 500 kc.

Alto Scientific Co., Inc., Dept. ED, 855, Commercial St., Palo Alto, Calif.

CIRCLE 91 ON READER-SERVICE CARD

## Oscillograph

Speeds of 625 and 1250 mm per sec



This two-channel direct writing oscillograph features extra high chart speeds of 625 and 1250 mm per sec. Whenever signals are changing too rapidly for accurate analysis at conventional chart speeds, this instrument stretches out recording for better chart interpretation and permits precise time correlation between two phenomena on adjacent channels.

Brush Instruments, Div. of Clevite Corp., 1405 Perkins Ave., Cleveland 14, Ohio.

CIRCLE 92 ON READER-SERVICE CARD

## Balun

Solves impedance matching problems



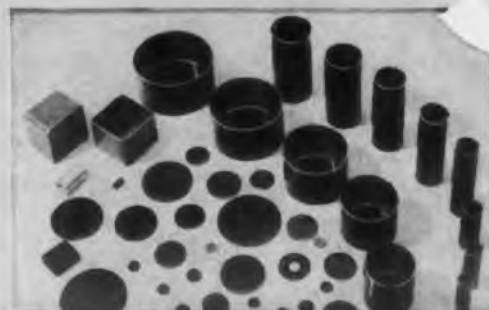
Model 725 balun solves the problem of impedance matching on any multiband type antenna having a 300 ohm feed point. Frequency coverage is 1.5 to 30 mc with an impedance of 75 ohm unbalanced to 300 ohm balanced. Maximum power rating 1 kw on cw and a-m (100 per cent modulated), 4 kw p.e.p. on ssb.

Barker & Williamson, Inc., Dept. ED, Canal St. & Beaver Dam Rd., Bristol, Pa.

CIRCLE 93 ON READER-SERVICE CARD

# THESE 5 FORMS OF EPOXY

*will solve any component encapsulation problem!*



**E-CASE SHELLS AND SLEEVES**—Available from stock in standard sizes. These molded epoxy cases can be machined to special configurations.



**EPOXY SHEET**—Molded epoxy sheets in a variety of thicknesses. When heated to 125°F this material can be formed and cut. Ideal for prototype packaging and short runs.



**E-FORM CASTING POWDERS**—Premixed resin and hardener ideally suited for prototype or short runs. Melts as low as 85°C or as high as 145°C for fast curing.



**E-FORM PELLETS**—All casting powders can be compressed into pre-metered pellets for production applications. Many pellet sizes available.



**EPOXY LIQUID AND HARDENER**—If application will not tolerate elevated temperatures, liquid resin and hardeners will cure at room temperature.

Shells, sheeting, powder, pellets, liquid—EPOXY PRODUCTS can provide the right form of epoxy to solve your component encapsulation problem. Using these 5 basic forms (the widest line available today) we custom-build an epoxy unit that is just the right size, shape and quality for your component. Once the right encapsulating unit is developed, it can be produced in quantity immediately and placed on your production line. In short, no matter what type of component you are encapsulating, no matter what your facilities are now, there is an epoxy form and method just for you—from EPOXY PRODUCTS! Write today for complete technical data and literature.

*Test epoxy encapsulation in your own lab!*

*A special kit containing generous samples of all 5 forms of epoxy resin, plus instructions, is available. Use it to test epoxy encapsulation on your own products—right in your own lab! Only \$9.93 from your distributor.*



# EPOXY PRODUCTS, INC.

*A Division of Joseph Waldman & Sons*  
137 Coit Street, Irvington 11, New Jersey

CIRCLE 199 ON READER-SERVICE CARD



## Now! Solve any DC measurement problem—with a proven KIN TEL instrument

MEASURE MICROVOLTS TO KILOVOLTS, MICRO-MICROAMPS TO AMPS WITH STABILITY, ACCURACY, SIMPLICITY!

From research and development to production line testing...one of these versatile DC measuring instruments can meet your most exacting requirements.

All units incorporate KIN TEL's proven chopper-stabilized circuitry for rock-solid measurement of microvolt level DC signals. All have zero center meters for instant polarity indication.

KIN TEL's microvoltmeters feature high input impedance and can be used as stable DC amplifiers. The model 301 both measures and supplies DC from 1 to 501 volts with 0.02% accuracy - provides 20 ma output as a supply.

One of these instruments can solve *your* DC measurement problem. And remember - reliable, accurate performance is assured by KIN TEL's experience in manufacturing more than 10,000 instruments.

Instrument	Model 203	Model 202B	Model 204A	Model 301	Model 203AR
DC Voltage Ranges (Full Scale)	±100 $\mu$ v to ±1000V 15 ranges	±300 $\mu$ v to ±1000V 14 ranges	±10 $\mu$ v to ±10V 7 ranges	1 to 501 volts* 7 ranges	±100 $\mu$ v to ±1000V 15 ranges
DC Current Ranges (Full Scale)	±100 $\mu$ ma to ±100ma 10 ranges	None	±0.001 $\mu$ a to ±1ma 7 ranges	Not Applicable	±0.001 $\mu$ a to 1 amp 19 ranges
Input Impedance	10 megohms below 10mv-30 megohms at 30mv-100 megohms above 30mv	10 megohms below 10mv-30 megohms at 30mv-100 megohms above 30mv	10,000 ohms	Infinite at null	10 megohms at 30mv and below 100 megohms above 30mv
Measurement Accuracy	3%	3%	3% on 2 lower ranges, 4% above	0.02%	3%
Max. Output as Amplifier	1 volt across 1000 ohms	1 volt across 2000 ohms	1 volt across 1000 ohms	Not Applicable	1 volt across 500 ohms
Equiv. Input Drift (Max. Long Time)	10 $\mu$ v	15 $\mu$ v	<2 $\mu$ v	0.01% stability	10 $\mu$ v
Price	\$550	\$350	\$325	\$625	\$550

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

Write for detailed literature - 5725 Kearny Villa Rd., San Diego 11, Calif. Representatives in all major cities.



Model 203. Measure 10 microvolts to 1 kilovolt, 100  $\mu$ ma to 100 ma. 25 ranges. This is the ONE universal meter.



Model 202B. Wide range, DC microvoltmeter-amplifier. Zero center meter gives instant polarity indication.



Model 204A. Electronic galvo. Transistorized. Sensitive, rugged DC null detector, amplifier, microvoltmeter, micro-microammeter.



Model 301. Calibrated null voltmeter and DC standard. Instantly measure and supply DC from 1 to 501 volts at 0.02% accuracy.



Model 203AR. Measure 0.001 $\mu$ a to 1 amp, 100  $\mu$ v to 1000 volts. Zero center meter. Compact, 19-inch rack mount design.

CIRCLE 201 ON READER-SERVICE CARD

## NEW PRODUCTS

### Power Supplies

Output voltages between 1 and 25 v dc



TPC-8 power supplies are available with any specified outputs between 1 and 25 v dc. Output current is rated at 350 ma with 1 per cent regulation over the entire load and input voltage range.

Southwestern Industrial Electronics Co., Dept. ED, 2831 Post Oak Rd., P. O. Box 13058, Houston 19, Tex.

CIRCLE 94 ON READER-SERVICE CARD

### DC Amplifier

Features floating input



This low-level dc amplifier, named the Fitgo (floating input to grounded output), has a floating input, which isolates the input from the rest of the amplifier and allows only the desired signal to go through. The Fitgo amplifier is used to amplify signals from thermocouples, strain gages, pressure transducers and other sensing elements of this type.

Beckman Instruments, Inc., Systems Div., Dept. ED, 325 N. Muller Ave., Anaheim, Calif.

CIRCLE 95 ON READER-SERVICE CARD

## Silicon Rectifier

20 amp, 400 piv



This small unit is rated for continuous service at 20 amp dc at 400 v piv. High temperature range is 150 C.

Fansteel Metallurgical Corp., Dept. ED, 2200 Sheridan Rd., N. Chicago, Ill.

CIRCLE 96 ON READER-SERVICE CARD

## Pressure Switch

• Weighs 3-1/2 oz

This low-cost general purpose pressure switch weighs 3-1/2 oz and encompasses pressure ranges from 2 to 3000 lb per sq in. Suitable for use with air, gas, oil, or fuel. Design permits minor changes in setting to be made in the field.

Consolidated Controls Corp., Dept. ED, Bethel, Conn.

CIRCLE 97 ON READER-SERVICE CARD

## Strain Gage Supply

Has adjustable 10 v output



This 72 channel strain gage power supply has a resistance to ground of more than 10,000 meg, and internal noise level with respect to ground is less than 5  $\mu$ v peak to peak. The nominal output of 10 v is adjustable by means of a 10 turn potentiometer. Used with a regulated power source, the output voltage varies less than 0.1 per cent.

Western Gear Corp., Dept. ED, P.O. Box 182, Lynwood, Calif.

CIRCLE 98 ON READER-SERVICE CARD

CIRCLE 99 ON READER-SERVICE CARD



1K20 Series X and K Band Klystron (left)  
1K125CA C Band Klystron (right)

## Eimac Announces...

### Five New Ceramic Reflex Klystrons

Two important frequency ranges in the C, X and K bands are now covered by Eimac reflex klystrons. Eimac's advanced stacked ceramic design gives these tubes exceptional ruggedness and frequency stability.

The four new tubes of the 1K20 series cover 8500 to 11,700 Mc., at power levels up to 50 milliwatts. They are specifically designed for use in the severe environment of air-borne and missile radar systems. They will withstand vibration levels of 15G in any reference plane, with less than 100 kilocycle frequency deviation. Low beam voltage requirement and simple radiation cooling minimize the weight and complexity of associated equipment.

A new C-band tube, the 1K125CA covers 3700 to 4400 Mc. Power levels up to 2 watts make this tube ideal for reliable broadband point-to-point communication. Tuning by dielectric slug rather than variable RF gap avoids sensitivity to shock and vibration. Integral-finned cooler and higher operating temperature ratings minimize cooling requirements.

Eimac know-how in the field of ceramic-metal tube design now brings compactness, ruggedness, high performance and reliability to these important microwave frequencies.

More information on Eimac reflex klystrons is available from our Application Engineering Department

**EITEL-McCULLOUGH, INC.**  
SAN BRUNO · CALIFORNIA  
*Eimac First with ceramic tubes that can take it*



#### GENERAL CHARACTERISTICS

Type	Freq. Range Mc.	Beam Voltage	Power Output Range	Reflector Voltage
1K125CA	3700-4400	1000 Vdc	1.5 to 2.0 W	0 to -1000 Vdc
1K20XS	8500-9300	300 Vdc	25 to 50 mW	0 to -250 Vdc
1K20XK	9200-10,000	300 Vdc	25 to 50 mW	0 to -250 Vdc
1K20XD	10,000-10,800	300 Vdc	25 to 50 mW	0 to -250 Vdc
1K20KA	10,700-11,700	300 Vdc	25 to 50 mW	0 to -250 Vdc

Additional Frequency Coverage to be announced soon

# A Stand OUT

## IN PRODUCTION NOW - COMMERCIAL QUANTITIES THE 1802 HYDROGEN THYRATRON, WITH UNPRECEDENTED PERFORMANCE AND RUGGEDNESS, CERAMIC-ENVELOPED AND FAR SMALLER

The new EG&G Hydrogen Thyatron, Model 1802, delivers 30 megawatts peak power in a smaller package than any comparable unit. It supersedes many older types, and surpasses the performance of the Type 5948/1754 on all counts, in less than 1/7th the size. The new 1802 is air-cooled by convection and will tolerate ambient temperatures up to 100° C. Yet its warm-up time is only 5 minutes. Other comparisons with the 5948, 1754:

	1802	5948/1754
Input trigger power	250 v at 400 ohms max.	650 v at 250 ohms max.
Delay time	0.5 $\mu$ s rated (average is 0.25 $\mu$ s)	1 $\mu$ s
Jitter	.002 to .005 $\mu$ s	.02 $\mu$ s
Reservoir Range	$\pm 10\%$	$\pm 5\%$
Filament Power	90 watts	200 watts
Ambient Temp. Max.	100° C	75° C

The hydrogen thyatron was invented by K. J. Germeshausen, President of EG&G. Advanced research continues to keep this company in the forefront of hydrogen thyatron development. For specific data on the 1802, and for the most authoritative information on gas-discharge tube types and MILLI-MIKE\* CRT's, TW oscilloscopes and systems, write to us on your company letterhead.

\*Trademark

### EDGERTON, GERMESHAUSEN & GRIER, INC.



160 Brookline Avenue, Boston, Mass. 1622 South "A" Street, Las Vegas, Nev.

CIRCLE 101 ON READER-SERVICE CARD

## NEW PRODUCTS

**CONNECTOR.**—A quick disconnect type is available with six coax contacts and thirteen no. 20 contacts.

Deutsch Co., Dept. ED, 7000 Avalon Blvd., Los Angeles 3, Calif.

CIRCLE 102 ON READER-SERVICE CARD

**LEAD BENDER.**—Model 700 component leads bending block is an improved version available for bending component lead wires so they will accurately register with the holes in printed circuit boards. It can be adjusted to component body lengths up to 1 3/4 in. long.

By-Buk Co., Dept. ED, 4314 W. Pico Blvd., Los Angeles 19, Calif.

CIRCLE 103 ON READER-SERVICE CARD

**POTENTIOMETERS.**—Two units, called Trim-Tite and the Trim-Tite Jr., measuring 1/2 and 3/8 in. diam respectively, have been added to the potentiometer line. Resistance ranges are 50 K and 25 K.

Fairchild Controls Corp., Components Div., Dept. ED, 225 Park Ave., Hicksville, N.Y.

CIRCLE 104 ON READER-SERVICE CARD

**PANEL AND SLIDE.**—Includes panel, handles, and Chassis-Trak completely assembled ready for rack mounting.

Western Devices, Inc., Dept. ED, 600 W. Florence Ave., Inglewood, Calif.

CIRCLE 105 ON READER-SERVICE CARD

**POTENTIOMETER.**—50 ohm, 15 K, 50 K, and 100 K resistance values have been added to the Aceset wirewound potentiometer line.

Ace Electronics Associates, Inc., Dept. ED, 99 Dover St., Somerville, Mass.

CIRCLE 106 ON READER-SERVICE CARD

**CRYSTALS.**—Units which will take vibration up to 2000 cps are now available in ranges from 4 kc to 125 mc.

Bliley Electric Co., Dept. ED, Union Station Building, Erie, Pa.

CIRCLE 107 ON READER-SERVICE CARD

**GALVANOMETERS.**—Types 7-350, 7-352, 7-354, 7-355, 7-381, and 7-382 are for use with the type 5-122 recording oscillograph. They withstand temperatures to 175 F.

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

CIRCLE 108 ON READER-SERVICE CARD

**SWITCHES.**—A special rotor which will break up to 5 amp ac resistive load at 115 v is now available on all the company's standard single pole switches.

Daven Co., Dept. ED, Livingston, N.J.

CIRCLE 109 ON READER-SERVICE CARD

**SWITCHES.**—Series 810 have ratings of 10 a, 125 v ac and 5 a 250 v ac.

Alcor Manufacturing Co., Dept. ED, 4444 W. Roosevelt Rd., Chicago 24, Ill.

CIRCLE 110 ON READER-SERVICE CARD

## STRAITS TIN REPORT

New developments in  
the production, mar-  
keting 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. 13F, 1029 Connecticut Ave., Washington 6, D.C.

CIRCLE 111 ON READER-SERVICE CARD

FOR...

Slip-On Insulation,  
Instrument Tubing,  
Bundle Sheathing,  
Medical Tubing,  
Pigtails...



USE  
**SPAGHETTI  
SLEEVING**

MADE FROM

**TEFLON\***

PF Spaghetti sleeving has these important advantages:

1. Good dielectric strength (500 to 2000 volts/mil)
2. Excellent electrical properties at high temperatures (500°F) and a wide frequency range
3. Low coefficient of friction. It slips on easily in long lengths of wire up to 3 ft.
4. Eliminates the need for silver coated wire
5. Zero moisture absorption
6. Unaffected by any commercial chemical
7. Stress relieved for negligible shrinkage

25 sizes, 2 wall thicknesses, 10 colors in stock, 100% inspected and controlled dimensionally are available.

Write, wire or call for full details, competent engineering assistance and information on special sizes and walls. PF Teflon® flexible tubing, heavy-walled tubing and rod stock are also available.

**PENNSYLVANIA FLUOROCARBON CO., INC.**

1115 N. 38th Street, Phila. 4, Pa. EVergreen 6-0603

\*Teflon—DuPont trade name for Tetrafluoroethylene resin

CIRCLE 112 ON READER-SERVICE CARD

**VARIABLE TRANSFORMER.**—Delivers voltages at 120, 240 or 480 v, single and three phase, with ratings from 2.6 to 8.5 constant-current load up to 12.5 constant-impedance load.

Superior Electric Co., Dept. ED, Bristol, Conn.

CIRCLE 113 ON READER-SERVICE CARD

**POWER PENTODES.**—For use as vertical deflection output amplifiers, models 6DT5 and 12DT5 have high zero bias plate current.

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

CIRCLE 114 ON READER-SERVICE CARD

**STOP NUTS.**—Self-tapping nylon stop nuts lock, seal and insulate. Available in standard sizes nos. 4, 6, 8, 10, 1/4, 5/16, 3/8 and 1/2 in.

Byrd Plastics, Inc., Dept. ED, 2953 W. 12th St., Erie, Pa.

CIRCLE 115 ON READER-SERVICE CARD

**KNOBS.**—Series 50 is available either unskirted, plain skirted, or dial skirted round and is designed for 1/8-in. shafts.

Raytheon Manufacturing Co., Commercial Equipment Div., Dept. ED, Waltham 54, Mass.

CIRCLE 116 ON READER-SERVICE CARD

**TRANSISTOR TESTER.**—Accurate to within 3 per cent and direct reading, this tester is applicable to any program requiring quick evaluation of npn or pnp transistors.

Western Instruments, Dept. ED, P.O. Box 621, Ridgecrest, Calif.

CIRCLE 117 ON READER-SERVICE CARD

**TRANSFORMERS.**—This series is designed to meet the requirements of MIL-T-27A class R and S grade 2 or 4. Reliable life is 10,000 hr min.

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

CIRCLE 118 ON READER-SERVICE CARD

**FIXED NETWORKS.**—Tapped fixed networks, series 1030, 1031, and 1032, have been redesigned to provide tamper-proof methods of adjusting or setting the gain by means of soldered connections.

Daven Co., Dept. ED, Livingston, N.J.

CIRCLE 119 ON READER-SERVICE CARD

**FLOW TRANSDUCER.**—Features housings with welded steel flanges in all nominal pipe sizes, and extends the application of the Mark V transducer series to cover many industrial flow requirements.

Ramapo Instrument Co., Inc., Dept. ED, 8 1st St., Bloomington, N.J.

CIRCLE 120 ON READER-SERVICE CARD

**TERMINAL.**—For use with no. 26 to no. 22 wire. Grips firmly and evenly when crimped on a conductor.

Thomas & Betts Co., Dept. ED, 36 Butler St., Elizabeth, N.J.

CIRCLE 121 ON READER-SERVICE CARD

**UHR\***  
**MISSILE-GRADE  
CAPACITORS**

**WEST-CAP**

**\*(ULTRA HIGH RELIABILITY)**  
**PAPER, PAPER-PLASTIC,  
HERMETICALLY SEALED**

HIGH RELIABILITY begins with selected, premium materials, continues with manufacture, inspection and testing under the most stringent quality control procedures. Complete isolation from other company manufacturing lines is maintained in a separate, new building equipped with temperature, humidity, and air filtration control.

**TWO SERIES:**  
RXM, to MIL-C-14157A  
Specs  
RXV, to USAF 26244  
Specs  
Send for New Spec Sheets

**WEST-CAP DIVISION  
SAN FERNANDO ELECTRIC MANUFACTURING CO.**  
1509 First Street, San Fernando, California Telephone: EMpire 1-8681  
Teletype: San Fernando Cal 7264

CAPACITORS FILTERS POTENTIOMETERS  
CIRCLE 122 ON READER-SERVICE CARD

**...AND MAKE  
IT SNAPPY!**

**ORDER TODAY...  
GET 'EM TODAY!**

from local distributors

Need resistors in a hurry for a production emergency, a prototype or what not? That's what Stackpole local distributors are for! Over 50 of them in leading centers carry complete industrial stocks. Write, wire or 'phone for name of nearest one!

**NEW  
STACKPOLE  
Coldite 70+  
FIXED COMPOSITION  
RESISTORS**

A major resistor development designed for the most stringent requirements . . . at ordinary resistor prices.  
Distributors' Division, STACKPOLE CARBON CO.  
26 Rittenhouse Place, Ardmore, Pa.

**TYPE RC-20 • TYPE RC-32 • TYPE RC-42**  
(1/2 watt) (short-length 1 watt) (2 watts)

**RUSH!**

CIRCLE 123 ON READER-SERVICE CARD

**Reeves**  
INSTRUMENT CORPORATION

*achieves*

# DRAMATIC REDUCTION IN GYRO DRIFT...



## CONDENSED PERFORMANCE DATA

Trimmed drift rate:  
0.1°/hr. rms  
0.3°/hr. max.

Mass unbalance:  
5.0°/hr./g

Anisoelastic constant:  
0.025°/hr./g<sup>2</sup> rms

Maximum command turning rate:  
over 20°/sec.

Dimensions:  
2" dia., 4" long

## IN NEWEST DESIGN 20 IG INTEGRATING GYROS

Representing a major breakthrough by Reeves' gyro research laboratories, these advanced instruments show a small fraction of the drift rate hitherto considered low for high-performance units in this class.

Other characteristics are also outstanding, including extremely low anisoelastic constant and high command turning rate.

Of equal importance is the fact that these instruments measure up in every way to well-known Reeves standards of precision, ruggedness and **RELIABILITY** in regular production models. They are now available, and we invite your inquiries for detailed information.

Other Reeves Gyros and Accelerometers meeting equally exacting standards for performance and reliability include a comprehensive series of 10 IG, 20 IG and HIG 5 Integrating Gyros; 20 PIG Pendulous Integrating Gyros and 10A and 20A Linear Accelerometers. Technical information on request.

**Reeves**  
INSTRUMENT CORPORATION

**REEVES INSTRUMENT CORPORATION**  
A Subsidiary of Dynamics Corporation of America  
Roosevelt Field, Garden City, New York

REAC Analog  
Computers



Precision  
Floated  
Gyros



Precision  
Resolvers and  
Phase Shifters



Servo  
Mechanical  
Parts



CIRCLE 206 ON READER-SERVICE CARD

## NEW MATERIALS

### Magnet Wire Flexible ceramic-coated type



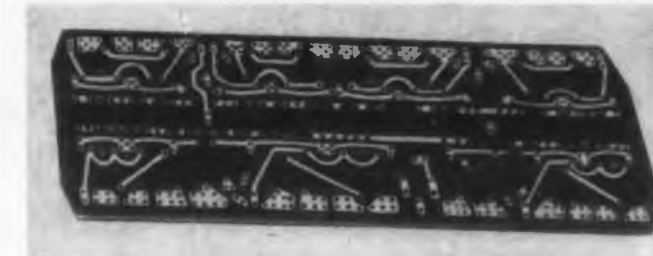
Called Ceramtemp, this flexible ceramic coated magnet wire has a duty rating of 1000 F for continuous operation. The insulation exhibits high abrasion and cut-through resistance. Its flexibility is such that it will not crack when wrapped around a mandrel just three times its own diameter. Nickel clad copper conductors are being coated in single and heavy thicknesses, in sizes 20 to 30 awg. The coating is an inorganic insulating material called Ceramacite, developed by Consolidated Electrodynamics Corp., Pasadena, Calif.

Hitemp Wires, Inc., Dept. ED, 1200 Shames Dr., Westbury, N.Y.

CIRCLE 124 ON READER-SERVICE CARD

### Epoxy Glass Base Laminate

High strength at 150 C



Grade G-11-861 epoxy bonded fiber glass laminate retains 70 to 80 per cent of its original flexural strength when tested at 150 C after conditioning for one hour at that temperature. The laminate is also made as copper clad phenolite grade G-11-861-1, for printed circuit applications. Bond strength is 10-15 lb; dip solder resistance greater than 30 sec at 500 F, and surface resistivity and arc resistance are excellent.

National Vulcanized Fibre Co., Dept. ED, Maryland Ave., & Beech St., Wilmington 99, Del.

CIRCLE 125 ON READER-SERVICE CARD

## Wire and Cable

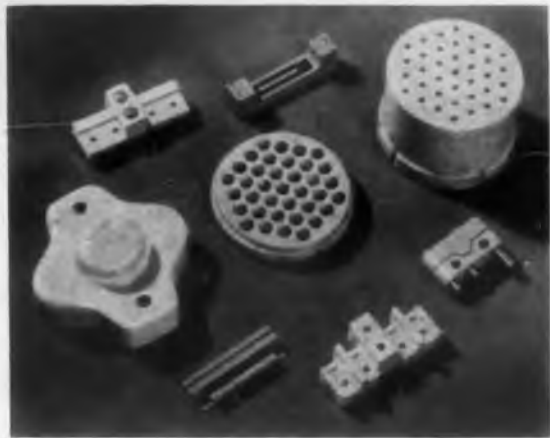
Teflon insulated

A line of Teflon insulated wire and cable, Tef-wire, is available. The wire is being manufactured to Mil Spec W-16878B in type E, with a wall thickness of 0.01 rated at 600 v, and type EE, with a wall thickness of 0.015 rated at 1000 v. Stock sizes will cover the AWG range from 16 to 30 gauge.

Stretch-Wire Corp., Dept. ED, P.O. Box 893, New Rochelle, N.Y.

CIRCLE 126 ON READER-SERVICE CARD

## Insulating Compound Withstands high temperature



Two materials withstand continuous exposure up to 500 F. Designated DIALL FS-4, the first is a long fiber, glass-filled molding compound which at 500 F shows a flexural strength of 6700 psi, a compressive strength of 6500 psi, and a tensile strength of 4270 psi. The second, DIALL FS-5, is a short fiber glass-filled compound which at 500 F has a flexural strength of 2000 psi, a compressive strength of 6000 psi, and a tensile strength of 4500 psi. Both materials are considerably stronger at 300 F, and up to 5 times stronger at 80 F. Electrical and chemical properties are reportedly excellent.

Mesa Plastics Co., Dept. ED, 11751 Mississippi Ave., Los Angeles 25, Calif.

CIRCLE 127 ON READER-SERVICE CARD

## Cable End Seals

Vacuum tight

A line of vacuum tight ceramic-to-metal cable end seals capable of standing temperatures of 1400 F and pressures of 2000 psi are available. The increased temperature and pressure ratings are due to a pre-brazing coating of molybdenum which becomes an integrally fused part of the metal.

Advanced Vacuum Products, Inc. Div., General Ceramics Corp., Dept. ED, Keasbey, N.J.

CIRCLE 128 ON READER-SERVICE CARD

# TRANSFORMERS

FOR ELECTRONICALLY  
REGULATED POWER SUPPLIES



• ONE UNIT PROVIDES PLATE AND FILAMENT POWER FOR ENTIRE SUPPLY.

• RATINGS BASED ON D.C. OUTPUT OF SUPPLY.

• APPLICATION BULLETIN WITH EACH UNIT.

2K SERIES	Cat. No.	Supply Rating	High Voltage Secondary AC Volts	DC MA	Rectifier Fil.		Pass Tube Fil.		Regulator Fil.		Auxiliary Fil.		Overall			Mtg. Dim. ML	Rec. Mtg. Screw	Weight Lbs.	List Price	
					V	A	V	A	V	A	V	A	L	W	H					
PLATE AND FILAMENT TRANSFORMERS	2K6	300 / 250VDC 400MADC	550-480-0 480-550V	440			Use with 2K20			Use with 2K20			6	4 1/2	5 1/2	4 1/2	3 1/2	#10	19	\$28.00
	2K8	300 / 250VDC 300MADC	540-475-0 475-540V	340	5	6	6.3	6	6.3	1.2	6.3CT	6	6 1/2	4 1/2	5 1/2	4 1/2	3 1/2	#10	20	32.75
	2K10	300 / 250VDC 200MADC	500-440-0 440-500V	240	5	3	6.3	3	6.3	1.2	6.3CT	6	5	4 1/2	5 1/2	3 1/2	3 1/2	#10	14	26.75
	2K12	300 / 250VDC 100MADC	540-465-0 465-540V	140	5	3	6.3	3	6.3	1.2	6.3CT	3	4 1/2	4 1/2	5 1/2	3 1/4	3 1/2	#10	12	23.00
	2K13	150 / 100VDC 400MADC	370-310-0 310-370V	440			Use with 2K20			Use with 2K20			4 1/2	4 1/2	5 1/2	3 1/4	3 1/2	#10	12	23.00
	2K14	150 / 100VDC 300MADC	375-320-0 320-375V	340	5	6	6.3	6	6.3	1.2	6.3CT	6	5 1/2	4 1/2	5 1/2	4	3 1/2	#10	16	27.00
	2K15	150 / 100VDC 200MADC	355-300-0 300-355V	240	5	3	6.3	3	6.3	1.2	6.3CT	6	4 1/2	4 1/2	5 1/2	3 1/4	3 1/2	#10	12	23.00
	2K16	150 / 100VDC 100MADC	350-310-0 310-350V	140	5	3	6.3	3	6.3	1.2	6.3CT	3	4 1/2	3 1/2	4 1/2	3 1/4	3	#8	10	20.00
	2K17	300 / 250VDC 600MADC	565-500-0 500-565V	640			Use with 2K20			Use with 2K20			6 1/2	4 1/2	6	4 1/2	3 1/4	#10	22	41.20
	2K18	300 / 250VDC 800MADC	580-520-0 520-580V	840			Use with 2K21			Use with 2K21			6	6 1/2	7 1/4	4	4 3/4	1/4	33	54.00
2K19	300 / 250VDC 1.0 Amp.	590-525-0 525-590V	1040			Use with 2K21			Use with 2K21			7 1/2	6 1/2	7 1/4	5 1/2	4 3/4	1/4	48	76.00	
2K20	(Filament Transformer for 400MA and 600MA Supplies)					5	6	6.3	6	6.3	1.2	6.3CT	6	3 1/2	3 1/2	4 1/2	2 3/4	#8	7.5	17.00
2K21	(Filament Transformer for 800MA and 1 Amp. Supplies)					5	10	6.3	10	6.3	2	6.3CT	10	4 1/2	3 1/2	4 1/2	3 1/4	#8	12	23.50

NOTES  
1. All Primaries 115 Volts, 50 / 60 Cps.  
2. Ratings Based On Capacitor Input Filters  
3. Dielectric Test Voltages:  
Primaries: 1500 V. RMS  
All Secondaries: 2500 V. RMS.

Our industrial and government custom department is noted for its ability to solve special problems. No run is too small. Write for Typical Circuit and Complete Catalog

**STERLING**  
TRANSFORMER  
CORPORATION

297 North 7th St.  
Brooklyn 11, N. Y.  
STagg 2-4200

CIRCLE 129 ON READER-SERVICE CARD

## 10 power FLAW FINDER

Quick-focusing illuminated magnifier—removable handle is a pocket flashlight. \$8.95—with leather case, \$12.45



up to 60 power magnification  
**RIGHT IN YOUR POCKET!**  
for inspection anywhere

40-50-60 power

## "PEN" MICROSCOPE

Pen size precision instrument with magnification equal to large lab models. With leather case, \$17.50

Orders shipped immediately

WRITE TODAY for illustrated literature.



Since 1927—manufactured in the U.S.A. by—

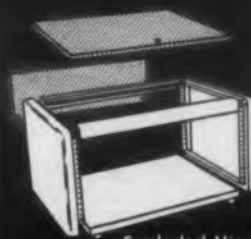
## E. W. PIKE & CO., INC.

577 Penna. Ave., Elizabeth, N.J.

Elizabeth 2-0630

CIRCLE 130 ON READER-SERVICE CARD

Introducing  
the Aristocrat  
of CABINET  
RACKS!



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OR SEND  
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NO. S-108



## PREM-O-RAK<sup>®</sup> by PREMIER

AVAILABLE IN 20 DIFFERENT SIZES—  
FROM 7" to 35" PANEL SPACES  
BOTH 15 1/4" and 18" DEEP FOR  
STANDARD 19" PANELS

- Both front and rear of top have attractive ball corners.
- Shipped knocked down for easy assembly.
- Handsomely finished in two-tone Hammetone.
- Panels may be mounted on both front and rear
- Interlocking removable top and rear panels made of perforated metal and held by captive screws.
- Panels fit into 1/2" recess. Base supplied with 4 rubber feet.
- Components may be mounted on base before assembly of rack
- Screws not visible from outside.

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CIRCLE 131 ON READER-SERVICE CARD



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## WESCON 1958 — in Los Angeles America's 2nd Largest Electronic Market

Well over half of the nation's aircraft and missile contracts are held by Southern California firms. Supporting them are hundreds of manufacturers of electronic equipment and components up and down the coast.

WESCON attracts more than 30,000 interested electronic engineers, scientists, and businessmen—and you can alert these men to your booth and products *before the show* in *Electronic Design's* pre-show issue.

*Electronic Design* has more circulation among manufacturers on the West Coast than any other electronic publication. WESCON has become one of America's greatest electronic industry events. Sell harder at WESCON beginning August 6th by reserving space now in *Electronic Design*. Final closing date is July 7th.



a HAYDEN publication

830 Third Avenue, New York 22, N.Y., Telephone PLaza 1-5530

## NEW LITERATURE

### Instrument Components

134

A new catalog, No. BED-A90 featuring special data and engineering information for electronic design engineers has been announced. Linear data, definitions, resolution curves, power rating curves, applications, operation, and other valuable data about components are included. Also included is a complete list of "Tech Reps" and jobbers for easy location in any area. Borg Equipment Div. of The Geo. W. Borg Corp., 120 S. Main St., Janesville, Wis.

### End Seals and Mounts

135

The availability of Catalog No. 657D describing its complete line of end seals, crystal holders and mounts, and transistors and diode closures has just been announced. This 16-page folder contains complete physical dimensions and line drawings of over 1000 different styles and sizes of Military and RETMA type hermetic seals and their appropriate part numbers. It also offers specific illustrations and information about custom design engineering service on all types of glass-to-metal seals. Hermetic Seal Corp., 29 S. Sixth St., Newark 7, N.J.

### Rotary Switches

136

A four-page data sheet, with information on sealed subminiature assemblies and a "V3" version, is available. These rotary selectors are available with as many as 20 basic switching units. Photographs, dimension drawings, electrical ratings, characteristics, and price information are included. Micro Switch, Div. of Minneapolis-Honeywell Regulator Co., Freeport, Ill.

### Panel Fasteners

137

Two technical bulletins containing complete engineering specifications and qualification test data for a quick-action stressed panel fastener have been issued.

A three-page illustrated brochure contains a complete description of the fastener, instructions for operation and complete dimensional specifications. Typical installations, with illustrations of both flush-type and protruding-head type fasteners, information about sheet preparation, available materials and finishes, and instructions for parts specification are also featured.

A nine-page illustrated bulletin is devoted to the results of a series of qualification tests conducted. Waldes Kohinoor, Inc., 47-16 Austel Place, Long Island City 1, N.Y.

**YOU can't  
BURN  
it out!**

**HICKOK**

**Volt-Ohm  
Milliammeter**

- Exclusive overload cut-out system.
- Protects meter and entire electrical circuit against accidental burn-outs.

**MODEL 455A**

This new portable multimeter incorporates a new technique that protects both meter and entire internal circuit against accidental burn-outs. In fact, any high voltage or current may be applied directly across any function, including ohms, without danger to the meter movement or associated components. Has a sensitivity of 20,000 ohms per volt DC or AC. Has 5-inch meter and full-wave bridge type rectifier circuit. Test leads are included. **\$66.50**

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CIRCLE 140 ON READER-SERVICE CARD

**BOOST INSTRUMENT SENSITIVITY...  
with MIN-AMP**

HIGH INPUT IMPEDANCE  
LOW NOISE LEVEL  
STABILIZED GAIN (x10, x100)  
WIDE FREQUENCY RANGE  
HI- and LO-PASS FILTERS  
AC LINE OPERATION



Miniature, low-noise pre-amplifier (Model 201 illustrated) extends oscilloscope and voltmeter sensitivity by factors of 10 or 100. Two-stage amplifier readily removed from power unit and "plugged-in" to instrument input terminals without wiring, connecting links or other accessories. Compact assembly requires minimum bench space. Normal frequency range; 5 cycles to 1 mc. Switch-controlled filter circuits limit amplifier pass band; improve signal/noise ratio. Wide dynamic range; over 10 volts maximum output.

Write for technical bulletin: MIN-AMP

PRICE - \$125.00

**ELECTRONICS, INC.**  
MOUNTAIN LAKES, NEW JERSEY

CIRCLE 141 ON READER-SERVICE CARD

### Pressure Transducers 142

A bulletin describing the complete line of Model H series high pressure transducers has been issued. The transducers are designed to provide very accurate measurement of pressures in corrosive fluids while exposed to extreme environmental conditions. Servonic Instruments, Inc., 640 Terminal Way, Costa Mesa, Calif.

### Magnetic Components 144

A company has assembled data on many standard models of magnetic components. A reference order form is included in this 22-page illustrated brochure. Varo Manufacturing Co., Inc., 2201 Walnut St., Garland, Tex.

### Selenium Rectifiers 146

Bulletin EPD 3116-1 catalogs a line of rectifiers made from grain-oriented selenium. In this material the crystals are oriented for the most effective rectification. Illustrated with photographs, charts, drawings, and performance curves, the 48-page booklet gives details on performance, construction, and dimensions. It also suggests applications and gives installation instructions. Vickers Incorporated, Electric Products Div., 1815 Locust St., St. Louis 3, Mo.

## NEW MINIATURE AGASTAT® time delay relay

for missile, aircraft and  
electronic applications



INSTANTANEOUS RECYCLING... reset time—less than .020 seconds  
UNAFFECTED BY VOLTAGE VARIATIONS... time delay remains constant from 18 to 30 volts DC  
ADJUSTABLE... time delays from .030 to 120 seconds  
CHOICE OF OPERATION... for either energizing or de-energizing  
SMALL... height—4 5/8"... width—1 13/16"... depth—1 1/2"  
LIGHT... maximum weight—15 ounces  
MEETS ENVIRONMENTAL REQUIREMENTS OF MIL-E-5272A

This new AGASTAT time delay relay is an externally adjustable, double-pole, double-throw unit. It incorporates the basic AGASTAT timing principle, proved by a half-century of reliable operation on automatic aids to navigation, in a space-saving miniature unit built to withstand the rugged environmental conditions of missile and aircraft applications.

For specific information on the new AGASTAT relay for your application, write to Dept. A-30-624.

AGA

ELASTIC STOP NUT CORPORATION OF AMERICA

1027 Newark Avenue, Elizabeth, New Jersey  
Pioneers in pneumatic timing

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**marion**  
advancement  
in instrument  
design



**SEALED  
RUGGEDIZED  
PANEL METERS**

The "Original"  
MIL-M-10304-A  
Instrument

HERMETICALLY SEALED... GLASS-TO-METAL

MIL 2 1/2" (MR26) and MIL 3 1/2" (MR36) sizes. Also 1 1/2" Ruggedized and 4 1/2" Sealed Models. ua, ma, amp, mv, volt, KV, AC rectifier types for voltage, decibel and VU measurement. Standard ranges. Bulletin on request. Marion Electrical Instrument Co., Manchester, N. H., U. S. A.

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**marion**

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**meters**



CIRCLE 147 ON READER-SERVICE CARD



Direct-Reading  
Output-Power Meter  
for Audio Frequencies  
**0.2 mw  
to 100 Watts**

- ★ Auxiliary db scale, with multiplier, reads -10 to +50 db above 1 mw reference level
- ★ Indicated power is accurate to within ±0.25 db at full scale
- ★ Forty discrete impedances over range of 2.5 to 20,000 ohms
- ★ Over-all frequency characteristic of power indication flat to ±0.5 db from 20 c to 10 kc; within ±0.75 db to 15 kc
- ★ Input impedance within ±2% of indicated value over most of range

Type 783-A Output-Power Meter: \$370

Write for Complete Data

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In CANADA: 99 Floral Parkway, TORONTO 15

CIRCLE 148 ON READER-SERVICE CARD

Where can you use this new idea in

# Dipping Resins?

A new product for quick, reliable, and economical encapsulation of electrical components by dipping: "SCOTCHCAST" Resin No. 253...

Now you can get all the time-tested sure-protection benefits of epoxy resin encapsulation, combined with all the time-saving cost-cutting benefits of dip coating! "SCOTCHCAST" Resin No. 253 lets you use conventional dipping and heat-curing methods—either automatic-conveyor or hand—to get a uniformly thick, mechanically tough, thermosetting encapsulation. This resin, though new, has already enabled one major manufacturer to meet the exacting MIL-T-27A transformer specification.

#### FACTS ABOUT "SCOTCHCAST" NO. 253

This new dipping epoxy offers several important production advantages:

1. Long pot life—2-4 days at room temperature.
2. 100% solids resin; thermosetting with a normal bake cycle.
3. A "thixotropic" material... no run-off or drip during curing.



TRANSFORMER MEETING MIL-T-27A SPECIFICATIONS is shown above. This was impregnated using "SCOTCHCAST" Resin #241 and then dip-coated using new "SCOTCHCAST" Resin No. 253. There is no limit to the sizes or shapes of components that can be dip encapsulated with this heat-curing resin material.

4. Coating thickness can be controlled.
5. Coating is flexible... has excellent mechanical and thermal shock characteristics.
6. Is compatible with other "SCOTCHCAST" flexible resins.

(NOTE: For special high heat applications, new "SCOTCHCAST" Dipping Resin No. 252 meets or exceeds Class H requirements.)

#### USES FOR NO. 253

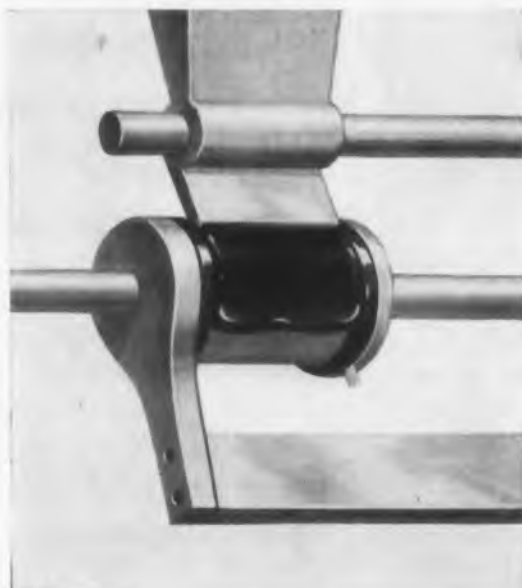
Among the encapsulating uses for which new "SCOTCHCAST" Resin No. 253 has been used are:

- Transformers
- Solenoid Coils
- Motor field coils
- Printed circuits
- Capacitors
- Electronic components

#253 can be used for specialized applications of brush, spray or extruded coatings.

#### WHAT IS YOUR ENCAPSULATING PROBLEM?

There may be a real opportunity for you to solve it with new "SCOTCHCAST" Resin No. 253. We'll be glad to send complete technical data upon request. Or, we can provide one of our trained field engineers to work with you in testing the resin. No cost or obligation involved; just write on your letterhead to: 3M Co., 900 Bush Ave., St. Paul 6, Minn., Dept. ON-68.



#### Mechanized RESIN WRAP!

"SCOTCHCAST" Brand Resin No. 253 may be "wrapped" on bobbin-wound coils and similar shaped pieces by means of extrusion processes. This method saves mold investment costs as well as production costs.

Because of the unique handling and curing properties of "SCOTCHCAST" Brand Resin No. 253, special equipment can also be designed to accommodate other shapes and conditions of manufacture. Write for specific information.

"SCOTCHCAST" IS A REGISTERED TRADEMARK OF 3M CO., ST. PAUL 6, MINN. EXPORT: 99 PARK AVE., NEW YORK 16, CANADA; LONDON, ONTARIO.

**MINNESOTA MINING AND MANUFACTURING COMPANY**

... WHERE RESEARCH IS THE KEY TO TOMORROW



CIRCLE 149 ON READER-SERVICE CARD

## NEW LITERATURE

### Russian-English Glossary

A modern Russian-English Solid State Glossary, 90 pages long, with over 4000 terms from the most recent issues of Soviet physics journals has been published. It is priced at \$10.00. Included are terms in solid-state theory, crystallography, physics of metals, metallurgy, ferromagnetism, semiconductors, and general quantum theory. The Solid State Glossary is part of a series of 8 interim glossaries on specialized fields of physics.

The Glossary text is clearly reproduced by the multilith process from varityped copy, and stapled bound in durable paper covers; the Dictionary will be case-bound and indexed. Consultant Bureau, Inc., Dept. ED, 227 W. 17th St., New York 11, N.Y.

### Glass Fabricating

This 8-page illustrated catalog, 80-23, discusses fabrication, materials, tolerances, and the many applications of precision glass products. Fischer & Porter Co., 691 Jacksonville Rd., Hatboro, Pa.

### Electrical Connectors

Several lines of electrical connectors are catalogued in the 62 pages of Bulletin 1252-1. Covered with specifications, pictures, selection data, and other details are environment resistant, circuit breaking, and delayed action connectors. The catalog also offers assembly and installation instructions. Pyle-National Co., 1334 N. Kostner Ave., Chicago 51, Ill.

### High Alumina Ceramics

A file folder on high alumina ceramic standard and special products may be had on request. It contains individual catalog sheets and gives information on the physical properties and characteristics of the material. Diamonite Products Mfg. Co., 1232 Cleveland Ave. N.W., Canton 3, Ohio.

### Use of Delay Lines

Bulletin No. 18, a 12-page booklet with detailed compilation of data for the proper use and installation of different delay line types, is now available. Divided into four major sections, mechanical and electrical terminations, mounting and test procedures are discussed in this well-illustrated booklet. Columbia Technical Corp., 61-02 31st Ave., Woodside 77, N.Y.

### Rotary Switch 154

A 2-page illustrated data sheet announces a miniature, high-speed, motor-driven rotary switch for sampling and telemetering. The sheet lists specifications and performance data and describes typical applications and design features. Instrument Development Labs., Inc., 67 Mechanic St., Attleboro, Mass.

### Solenoid Valves 155

No. 505 stock list contains prices, valve ratings, flow diagrams, illustrations and engineering data for a line of solenoid valves. Ordering information for these two, three and four way solenoid valves is also included in the 8-page stock list. Automatic Switch Co., Hanover Rd., Florham Park, N.J.

### High Temperature Equipment 156

"High Temperature Electronic Equipment" describes the successful operation of electronic equipment at ambient temperatures of  $-67$  to  $750$  F, without the use of refrigerants. This bulletin summarizes the programs that resulted in this achievement. The bulletin, MPB-32, contains 4 illustrated pages. General Electric Co., Lakeside Ave., Burlington, Vt.

### Ultrasonic Delay Lines 157

Facilities for designing and making specialized ultrasonic solid delay lines are outlined in a 4-page brochure. The bulletin lists major equipment and covers the range of work in which the company has had experience. The main types of delays manufactured are illustrated and described. Andersen Labs., Inc., 501 New Park Ave., W. Hartford, Conn.

### Variable Resistors 158

Two stock sheets list variable resistors for immediate delivery. In Stock Sheet 163 there are 108 military wire-wound types certified to the latest MIL-R-19A specs. Stock Sheet 164 lists 158 military composition types certified to MIL-R-94E. Both lists are single-page and illustrated. Chicago Telephone Supply Corp., Elkhart, Ind.



## For permanence of high absorption ... Raytheon specifies McMillan microwave absorbers

Peak quality products are prime requisites at Raytheon Manufacturing Company. As one of the outstanding contractors in *aircraft weapons systems, guided missile systems, major defense radars and fire control systems*, their superior quality work requires the finest radar testing facilities. They must have *both* high initial performance *and* stable, guaranteed performance. To satisfy these conditions they specify McMillan Microwave Absorber Products.

In their 17 large test stations at Maynard, Bedford, Lowell, and Andover, Raytheon has installed McMillan products — either block absorber material or modular prefabricated "free space" rooms. For all types of antenna and radome testing McMillan Absorber Products are specified because their high attenuation characteristics are long lasting.

In the main illustration above, a permanent test area has been "walled" with McMillan "BL" Plastic Foam Block. Inset shows a McMillan

Prefabricated "free space" Room. McMillan Microwave Absorbers are available in hair material, plastic foam block and thin flexible material, for ground, shipboard and airborne use, for frequency ranges from  $40$  mc to  $35,000$  mc.

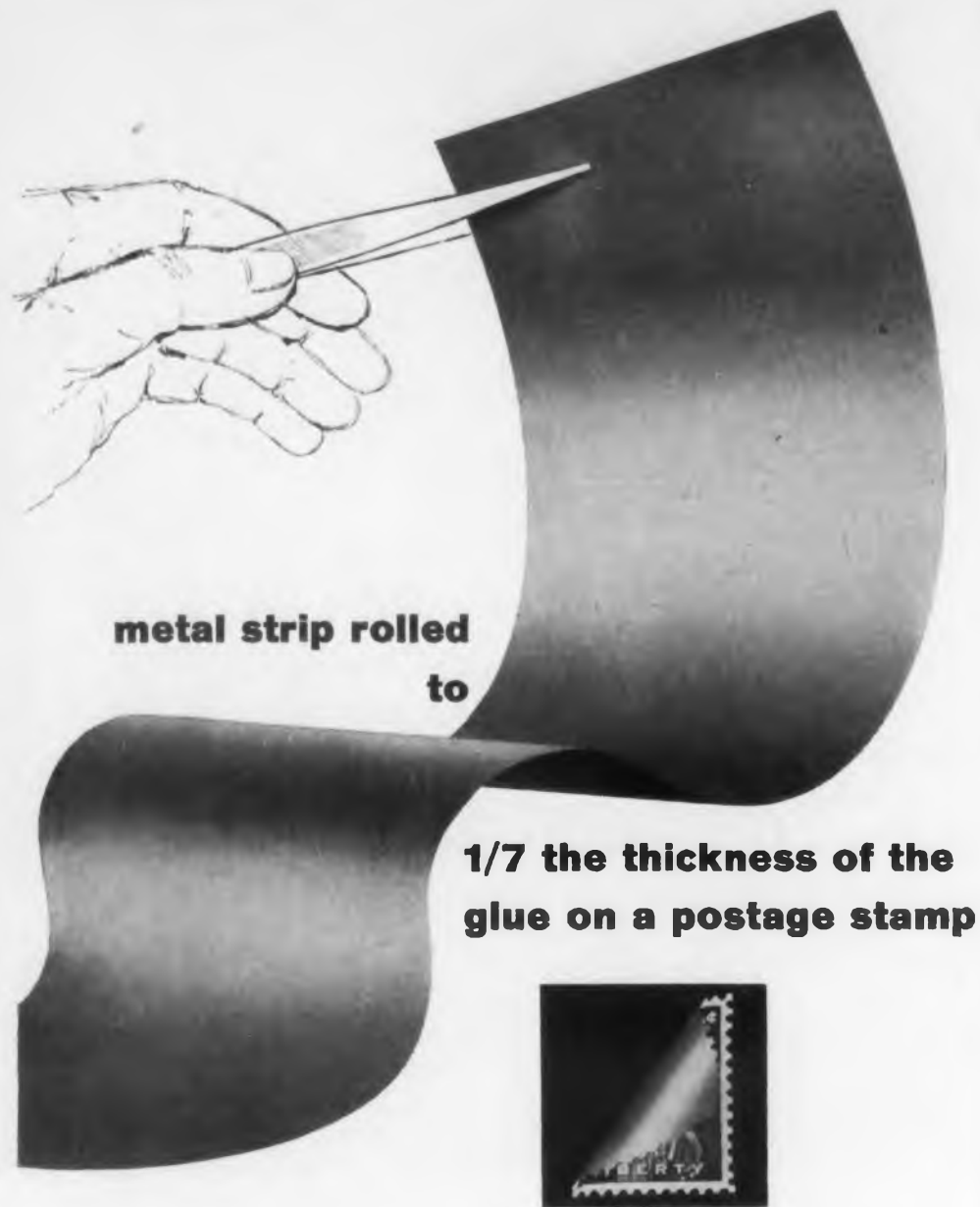
With their long experience in the field, backed by complete design, testing and manufacturing facilities, McMillan engineers are ready to assist you in any antenna and/or radome testing problem.

Send for latest catalog.

McMillan

McMILLAN LABORATORY, INCORPORATED  
BROWNVILLE AVENUE • IPSWICH, MASSACHUSETTS

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metal strip rolled  
to

1/7 the thickness of the  
glue on a postage stamp



Here is metal strip—available in virtually any alloy—produced in thicknesses ranging from .010" to .0001". (The glue on a stamp measures .0007".) Many of the miniaturization problems facing designers are being solved today by this ultra-thin strip and foil from the Precision Metals Division of the Hamilton Watch Company.

When product emphasis is on compactness and lightness, Precision Metals Division strip and foil will meet your exact mechanical, magnetic and physical specifications. For production orders or the development of new designs, this ultra-thin strip is available in any quantity. Special alloys to your own specification can also be made and furnished in the form you require.

A new 8-page facilities booklet illustrates and describes the operation of the Precision Metals Division, and shows how your precision metals problems can be solved practically and economically. Write on your letterhead today to Dept. ED-6



## Hamilton Watch Company

Precision Metals Division / Lancaster, Pennsylvania

Creator of the world's first electric watch  
CIRCLE 160 ON READER-SERVICE CARD

## NEW LITERATURE

### Pulse Height Analyzer

161

A four-page bulletin describing the model PA-400 multi-channel pulse height analyzer has been released. The bulletin notes the features and applications of the fifty-channel analyzer. It also gives specifications and physical and electrical descriptions of the component parts of the various modules that go into the complete unit. Eldorado Electronics, 1401 Middle Harbor Rd., Oakland, Calif.

### Motorized Devices

162

Miniature motorized devices are described in this 10-page illustrated catalog. The devices meet various MIL specifications, and also have application in industrial control equipment. Globe Industries, Inc., 1784 Stanley Ave., Dayton 4, Ohio.

### Low Voltage Transformers

163

A company has a 3-page bulletin on transformers for transistor applications which gives engineering data on basic audio and rectifier types. Operating characteristics, dimensions, ratings, line drawings, and photographs of cased and uncased units are shown. Ferrotran Electronics Co., 693 Broadway, New York 12, N.Y.

### Mylar Capacitor

164

This literature is a 4-page engineering bulletin for Mylar capacitors; types 101, 103, 106, and 107. The bulletin contains engineering data and electrical characteristics for a type of non-hygroscopic polyester film capacitor. Pyramid Electric Co., 1445 Hudson Blvd., N. Bergen, N.J.

### Servo Gain Variations

165

A graphical representation of the effects of gain changes at various points in an output rate stabilized servomechanism is provided in Paper CP-58-13. This paper was presented at the Winter Meeting of the AIEE by Mr. E. G. Trunk. Servo Corporation of America, 2020 Jericho Turnpike, New Hyde Park, N.Y.

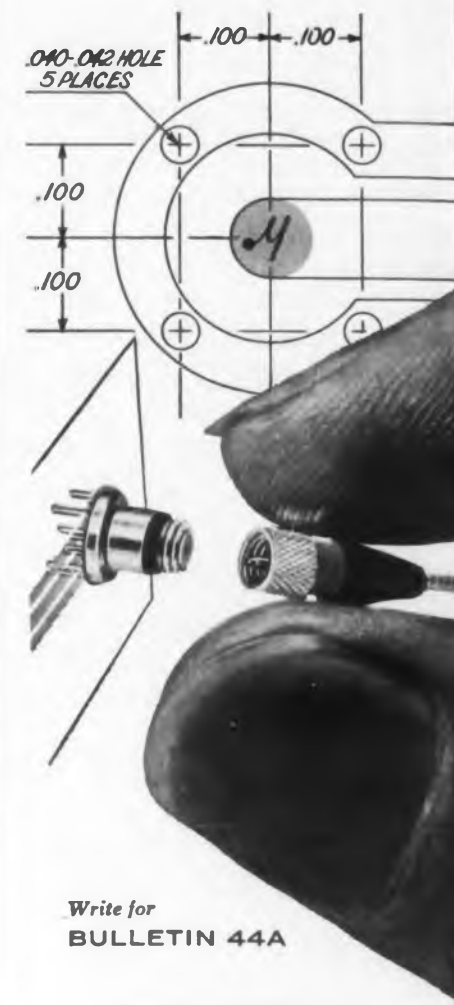
### Infrared Materials

166

This 4-page brochure provides revised comparative information on 15 different infrared transmitting materials suitable for use as optical elements. Transmission curves are included for the 11 most important materials. Servo Corporation of America, 2020 Jericho Turnpike, New Hyde Park, N.Y.

## SOLUTION TO A PRINTED CIRCUIT DESIGN PROBLEM

Microdot printed circuit to coax connectors are available to mate any of the standard Microdot micro-miniature coaxial fittings. Designed with "long" or "short" mounting pins to fit standard .100" grid pattern on panels 1/16" to 3/16" thick. Available in 50, 70 and 93 ohm for quick, easy connect and disconnect—screw or slide-on style, in straight or right angle types. Proven in commercial and military applications. Immediate delivery.



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BULLETIN 44A

"THINK SMALL—  
THINK MICRODOT"

Our sales engineers are located in all major cities to readily assist you in special design and standard applications. "Think Small—Think Microdot."

**MICRODOT, INC.**  
220 PASADENA AVENUE  
SO. PASADENA, CALIFORNIA  
CIRCLE 167 ON READER-SERVICE CARD

### Miniature Switch

168

A line of precision snap-acting subminiature switches in basic form and with a wide variety of actuators is covered in this bulletin. The 4-page illustrated bulletin gives photographs, detailed drawings, descriptions, operating characteristics, and electrical ratings. Special design services and laboratory acceptance tests that provide certified test data are also offered in the bulletin. W. L. Maxson Corp., Unimax Switch Div., Wallingford, Conn.

### Quality Control

169

A 4-page bulletin describing quality control services is now available. The bulletin covers such engineering functions as the design of quality control systems, inspection of facilities and purchased supplies at the vendor's plant, inspection and testing at the job site of equipment, materials and systems, and the handling of special problems. Burns and Roe, Inc., 160 W. Broadway, New York 13, N.Y.

### Printed Circuit Specs

"Military Standards for Printed Circuits" contains specifications required by the military in their printed circuit boards. The appendix of this book contains much information pertinent to printed circuit design and construction. Available to those engaged in either contract or sub-contract military production. Price is \$0.75. Write to Chief Engineer, Cleveland Metal Specialties Co., 1783 E. 21st St., Cleveland 14, Ohio.

### Microwave Tubes

170

A 36-page microwave tube catalog for 1958 is now available. The catalog details more than 100 klystrons, BWO's, TWT's, and related components, categorized by end use. Heading the list of recent products is the VacLon high vacuum pump, which is a completely non-mechanical type developing very high efficiency. Varian Associates, 611 Hansen Way, Palo Alto, Calif.

### Ferromagnetic Materials

"Nonmetallic Ferromagnetic Materials and Devices" reports a number of advances in various areas of ferrite development. "Research and Development on Magnetic Films" is directed toward expansion of knowledge of ferromagnetic materials and improvement of magnetic cores and memory units. These reports are available for \$3.75 and \$1.50 respectively. Order PB 131559 and PB 131557 from OTS, U.S. Department of Commerce, Washington 25, D.C.

# Here's how General Electric solves typical DC power-supply problems

for computers and special applications

## PROBLEM

*"We need to devote our engineering time to designing our electronic circuitry . . . not the power components."*



## SOLUTION

This is a frequent problem facing computer manufacturers. General Electric's Rectifier Department has complete engineering and manufacturing capability not only to design and apply all types of power supplies, but also to incorporate power supplies into completely integrated systems.

These systems could include load distribution, supply sequencing, protection for power supply and load, and complete power distribution. Let General Electric tackle your DC power problems such as those associated with load IR drop, "cross talk," and other nuisance-type problems plaguing your engineers.

## PROBLEM

*"It's always a problem making sure transistorized equipment is safe from its power supply."*

## SOLUTION

To alleviate this problem, General Electric has developed several methods of making transistorized equipment safer in this respect. With G-E protective circuits, shorting a plus high-voltage bus to a plus or minus low-voltage bus would not cause the low-voltage bus to exceed a small percentage of nominal rated value.

General Electric power supplies protect completely transistorized pieces of equipment from large losses due to over-voltage failures.

## PROBLEM

*"My power supply requirements fluctuate so much . . . big jobs, little jobs, all in between."*

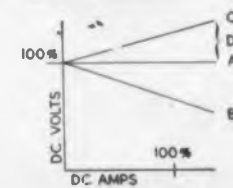
## SOLUTION

G.E. has built individual power supplies and complete systems ranging from less than one watt up to 35,000 kilowatts. These power supplies span the complete range of DC power—regulated and unregulated—applying all types of components. G-E experience includes completely transistorized supplies, and supplies with the new controlled rectifier, magnetic amplifiers, voltage stabilizing transformers, and motor-alternator "brute force" systems.

## PROBLEM

*"We have a real low-voltage power distribution problem with our computer."*

## SOLUTION



Low-voltage distribution problems can be handled easily through load compensation. Curve "A" is net desired no-load to full-load regulation at load point. "B" is regulation at load without remote sensing or load compensation. "C" represents IR compensation in power supply itself. "D" is amount of IR or load compensation.

If you have a computer or special power-supply problem, free your engineers of this problem and turn it over to General Electric for solution. It's more economical! G-E engineers can call on over 40 years of experience in the metallic rectifier field and put this experience to work in solving your particular problem—large or small. Contact your nearest General Electric Apparatus Sales Office or write Section A465-6, Rectifier Department, General Electric Company, Lynchburg, Virginia.

*Progress Is Our Most Important Product*

GENERAL  ELECTRIC

CIRCLE 171 ON READER-SERVICE CARD

WRITE TODAY FOR

## New Technical Data on MICROWAVE FERRITE MATERIALS & DEVICES



**RAYTHEON**

GET FULL DETAILS on Raytheon's completely new line of microwave ferrite materials and devices including the exclusive high-power L-band load isolator, miniaturized X, K<sub>F</sub>, and K<sub>V</sub> band isolators and others for C and S bands.

Write to W. C. Plouffe at the address below.

**RAYTHEON MANUFACTURING COMPANY**

Special Microwave Device Group  
Seyon St., Waltham 54, Mass.

CIRCLE 202 ON READER-SERVICE CARD

## COMAR'S NEW

**TQ**

**RELAY**

MINIATURE

RUGGED

SENSITIVE



Operates on D.C. coil signals at sensitivities from 20 to 100 milliwatts. SPDT, DPDT or 4PDT available.  
**CONTACT RATING** with resistive load at 28 VDC, or 115 VAC: silver contacts, 3 amperes; Palladium or gold alloy, 0.5 amperes.  
**CONTACT LIFE:** 100,000 operations, minimum.  
**OPERATING TEMPERATURE:** -55°C to +100°C.  
**SHOCK:** up to 50G. **VIBRATION:** up to 10G, from 10 to 500 cps.  
Also available hermetically sealed.



**COMAR ELECTRIC COMPANY**  
3349 ADDISON ST.,  
CHICAGO 18, ILLINOIS

RELAYS  
SOLENOIDS  
COILS  
SWITCHES  
HERMETIC SEALING

Send for Bulletin TQ  
CIRCLE 203 ON READER-SERVICE CARD

## IDEAS FOR DESIGN

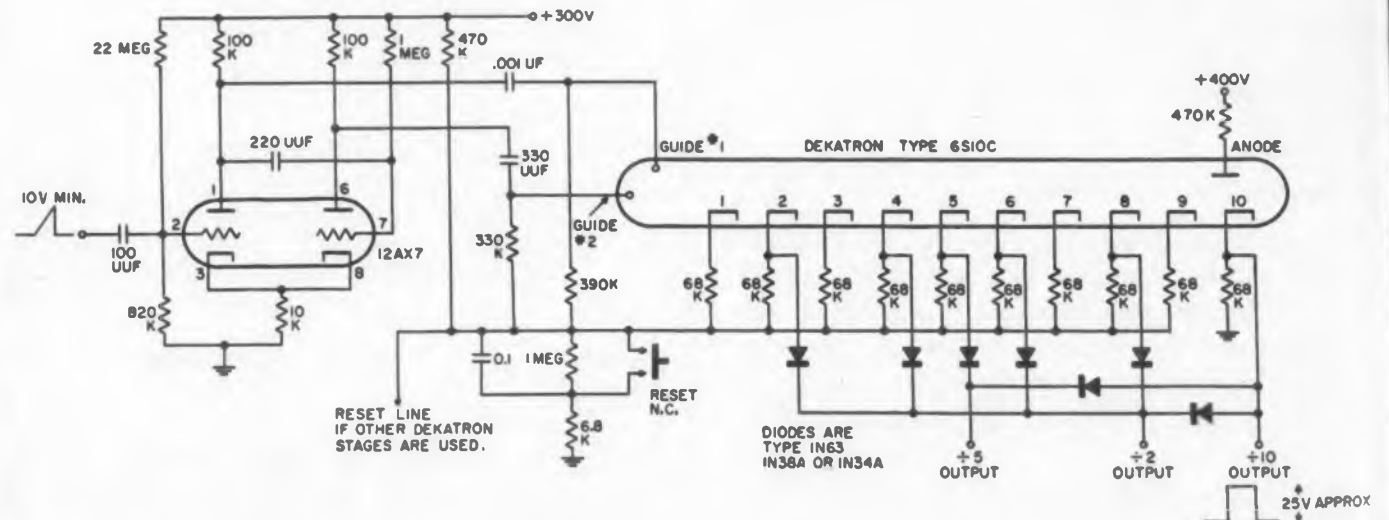
# A Simple Count-down Device

Get \$10.00 plus a by-line for the time it takes you to jot down your clever design idea. Payment is made when the idea is accepted for publication.

A COLD cathode glow-transfer tube (Dekatron) makes a simple reliable circuit for count-down by various division rates. The circuit shown simultaneously counts down a 10 pps pulse train by division rates of 1, 2, 5, and 10 and would produce outputs of 1, 2, 5, and 10 pps. By monitoring appropriate cathodes, outputs are produced as desired. For division by 10, one cathode (no. 10) is monitored; for division by 5, cathodes 5 and 10 are monitored through a diode isolating network. Division by 2 is obtained by monitoring all even cathodes through a similar isolating network. Dekatron stages can be cascaded for higher division rates. A two stage scaler can count down by any number evenly divisible into 100, i.e.; 1, 2, 4, 5, 10, 20, 25, 50, and 100. Two Dekatron stages will replace 12 tubes of a conventional feedback binary counter system.

A 12 cathode Dekatron can be used if division by 3, 6, and 12 is desired.

Jack Star, Associate Engineer, Johns Hopkins University, Silver Spring, Md.



This circuit can divide by different numbers simultaneously.



## Tape Recorder Motor Does Almost Everything

A low-cost German tape recorder has the motor provide four separate functions. Without gears, clutches, pulleys, belts, or any other mechanisms which tend to cause mechanical failure, the motor is mounted to provide:

- forward wind;
- reverse wind;
- stopping with instantaneous braking;
- slack take-up.

A mechanical lever on the face of the machine tilts the motor to drive either tape reel. When this lever is thrown to neutral, a spring pulls the motor over momentarily to brake the feed reel to prevent tape spillage.

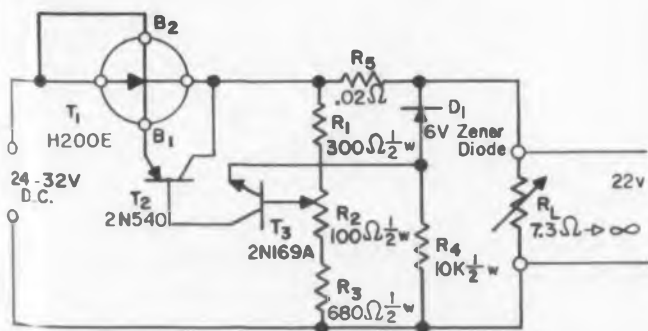
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This voltage regulator supplies 22 v  $\pm$ 1 per cent from a 28 v  $\pm$ 14 per cent line. It can supply loads from zero to 3 amps, and has built in short circuit protection.

The key to improved performance is the tetrode power transistor. Its second base controls the total system leakage. Thus the output terminals can be opened without lising control. If the output current exceeds a predetermined value, the system shuts itself off, and only leakage current will flow.

Minneapolis-Honeywell Regulator Co., Minneapolis 8, Minn.



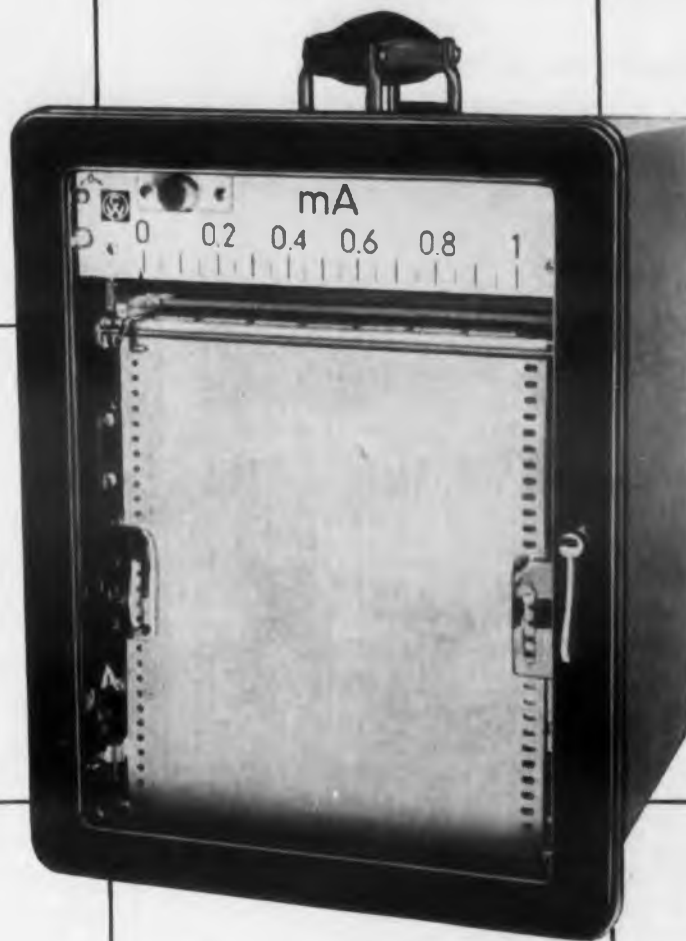
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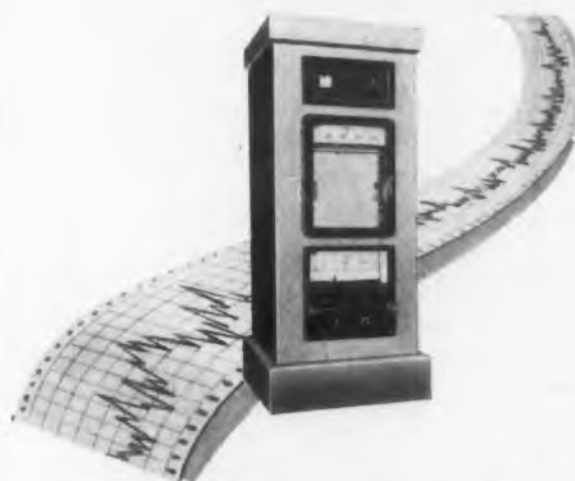
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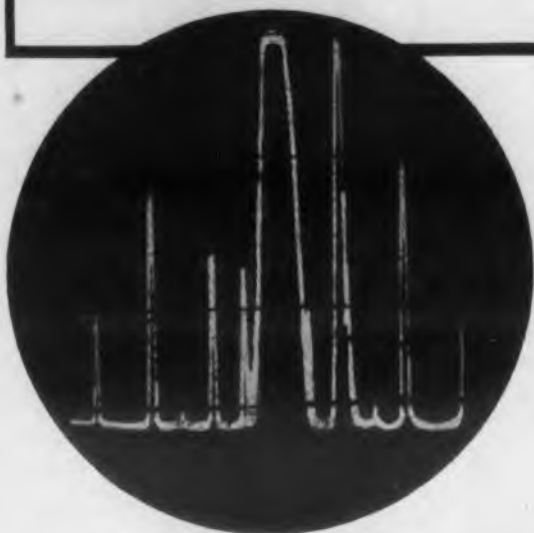
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## REPORT BRIEFS

### Laminar Flow Electron Beams

It would be desirable in designing an electron stream to be able to determine analytically the electrode shapes necessary to produce a given beam. A procedure for accomplishing this is developed on the basis of the assumption of laminar flow. An equation is derived from Maxwell's Equations, the equation of continuity, and the force equation which relates the shape function and the potential on the axis of the stream. Exact solutions are obtained for the special cases of (1) parallel flow; (2) constant axial potential (the beam spread case); (3) beam diameter decreasing exponentially with distance; (4) beam diameter decreasing algebraically with distance. In addition, approximate solutions for two types of periodic beams are discussed, the first having a boundary with a sinusoidal variation and the second an axial potential which varies sinusoidally. An experimental tube was designed to produce one of the periodic beams studied. Perveance of the gun was approximately 20 per cent below the design value, but transmission was nearly 100 per cent with very small collection by the various electrodes and little secondary emission. *Electrostatically Focused Laminar Flow Electron Beams*, William M. Mueller, California University, Division of Electrical Engineering, Electronics Research Lab., Microwave Tube Group, Berkeley, Calif. Aug., 1957, 77 pp, \$2.00. Order PB 131404 from OTS, U.S. Department of Commerce, Washington 25, D.C.

### Theory of Switching Report No. 9

For reports 1-8, 10-15 see PB 112812-112821, 112952, 122115-122116, 122820, and 128023. Contents: Section I. Survey of the theory of coding systems, by Robert Ashenurst and Anthony Oettinger; Section II. Multiple coincidence magnetic storage systems, by Robert Ashenurst and Robert Minnick; Section III. Multiple-output switching circuits, by Peter Calingaert; Section IV. Etched magnetic matrix storage systems, by Robert Minnick; Section V. Modular output wires, by Robert Minnick; Section VI. Higher dimensional magnetic core systems by Robert Ashenurst. *Theory of Switching Bell Labs. Report No. 9 Covering Period 1 May 1954-1 Oct. 1954*, Robert Burns, Dolores Diorio, and others, Harvard University, Computation Lab., Cambridge, Mass. Oct. 1954, 210 pp, photos, drawings, diagrams, graphs, tables, microfilm \$9.30, photocopy \$31.80. Order PB 128022 from Library of Congress, Washington 25, D.C.

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### Back Transients in Semiconductor Diodes

This report is designed to clarify the effect of back transients in the operation of semiconductor diodes. Back transients are discussed in relation to circuit parameters and system bandwidth. The transient effect may be predicted if quantitative tests are made on the diodes to be used. Based on these predictions, the effect may be minimized when the test data is intelligently applied to circuit design. *Back Transients in Semiconductor Diodes*, C.G. Dorn, U.S. Naval Ordnance Lab., Corona, Calif. Apr., 1956, 17 pp., microfilm \$2.40, photocopy \$3.30. Order PB 126193 from Library of Congress, Washington 25, D.C.

### Open Rectangular Waveguide

In this report a theoretical study is carried out to determine the phase velocity of a wave being propagated in an open rectangular waveguide of infinite height whose bottom portion has been filled with dielectric material either of the discretely variable type or the continuously variable type. *Study of an Open Rectangular Waveguide Partly Filled with a Stratified Dielectric*, R. I. Barnett, Jr., and C. T. Tai, Ohio State Research Foundation, Columbus, Ohio. Sept. 1956, 12 pp, diagrams, graphs, microfilm \$2.40, photocopy \$3.30. Order PB 124718 from Library of Congress, Washington 25, D.C.

### Electron Mirror Microscopy

The purpose of the research reported here was to find out if it is possible to utilize electron mirror microscopy for pictorial representation of magnetic patterns in general and of magnetic domains in particular. After establishing the basic facts of image contrast formation with types of artificial specimens, experimentation proceeded to specimens actually containing magnetic domains. The magnetic materials used for the purpose were barium ferrite and nickel ferrite. Samples of electron mirror micrographs of domain patterns of these materials are shown in this report and are compared with domain patterns of the same specimen areas obtained by the conventional powder technique. The identical nature of the configurations on both types of micrograph provided final proof of the feasibility of electron mirror microscopy in depicting magnetic patterns. An elementary theory of image contrast formation is included in this report. *Research to Investigate The Feasibility of Electron Mirror Microscopy in The Study of Magnetic Domains*, by Ludwig J. Mayer, General Mills, Inc., Mechanical Division, Minneapolis, Minn. Sept. 1957, 32 pp, photos, drawings, \$1.00. Order PB 131624 from OTS, U.S. Dept. of Commerce, Washington 25, D.C.

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MI-102 ●	-40° to 80°C	9.5 ± .5	.012"	.185" ± .004	130 ± 5 ohms
MI-104 ★	-75° to 250°C	11.0 ± .5	.019"	.185" ± .004	110 ± 5 ohms
MI-125 ●	-40° to 80°C	11.5 ± .5	.019"	.185" ± .004	105 ± 5 ohms
MI-126 ★	-75° to 250°C	6.0 ± .3	.007"	.330" ± .010	190 ± 10 ohms
MI-127 ●	-40° to 80°C	6.5 ± .3	.007"	.325" ± .010	185 ± 10 ohms



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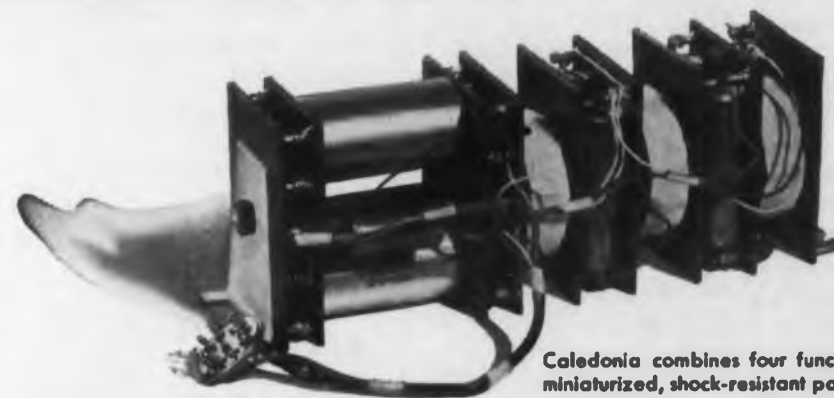
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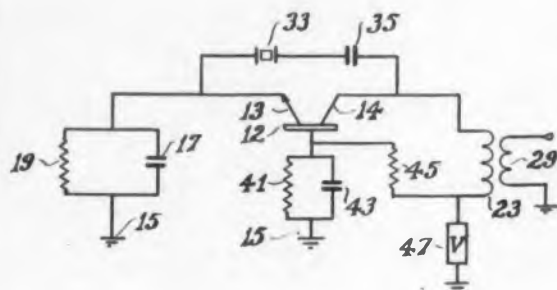
### Temperature-Compensated Transistor Oscillator Circuit

Patent No. 2,825,813. Jacob G. Sperling. (Assigned to Emerson Radio & Phonograph Corp.)

The transistor oscillator is of the feedback type where feedback is automatically varied during temperature changes up to 75 C to compensate for inherent instability of the transistor circuit.

An npn transistor is illustrated having fixed bias between emitter 13 and base 12 due to dc voltage-dividing series resistors 45 and 41. Collector 14 is connected to base 12 through high-Q primary 23 of the output transformer. Oscillations are permitted by connecting crystal 33 between the collector and the emitter through dc blocking condenser 35. In addition, temperature compensating condenser 17 between the emitter and the base determines, by voltage division, the magnitude of signal feedback.

For the grounded base configuration: As the temperature increases, the collector resistance decreases and the emitter resistance increases. Output amplitude would normally decrease with increase in temperature. However, the capacitive reactance of condenser 17 in-



creases as the temperature increases resulting in more feedback to the emitter. This compensates for the changes in emitter and collector resistances so that the output is substantially independent of the temperature change.

### High Voltage Power Supplies

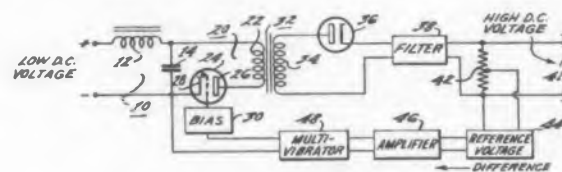
Patent No. 2,806,988. T. J. Sulpizio and John E. McWade. (Assigned to the United States of America)

An efficient power supply which can be accurately regulated and which occu-

# PATENTS

pies a minimum of space has been devised. This circuit feeds a low dc potential to a charging circuit consisting of inductor 12 and condenser 14. The condenser is discharged through transformer primary 22 and gas discharge tube 24. The pulse generated is the equivalent of a vhf pulse so that step-up in the inductor or primary winding 22 is very large. Therefore, a transformer with a high turn ratio is not necessary. Initially there is also a regenerative action which increases the discharge potential until a point of stability is reached. This action stems from the current-voltage phase relation between the condenser and inductor. When the condenser potential is zero the inductor current is at a maximum. The discharge tube continues conducting until the current is zero at which point the condenser potential becomes negative. The new charge builds up on this negative potential for several initial charging pulses. The secondary circuit of the transformer includes rectifier 36 and filter 38 which provide a high dc voltage at the output terminals 41.

By controlling the time of discharge of condenser 14 through gas tube 24, the potential at the output may be regulated. To accomplish this a resistor 42 is provided across the output terminals and serves as a voltage divider. The potential appearing across the resistor is compared with a reference voltage 44 and any difference in potential is amplified by amplifier 46. This amplified voltage controls the grid bias level of free-running multivibrator 48. Any change in the grid bias of the tubes of the multivibrator re-

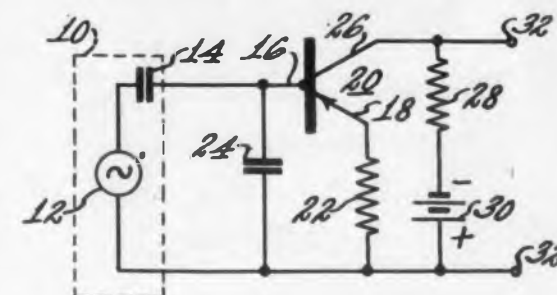


sults in a proportional change in the frequency generated. This change in frequency of the multivibrator changes the time of the discharge of the condenser through the tube and changes the amplitude of the potential appearing across the transformer primary winding 22. By proper adjustment and compensation, the difference potential goes to zero.

### Transistor Amplifier Circuit

Patent No. 2,822,430. Hung C. Lin (Assigned to Radio Corp. of America.)

A transistor amplifier circuit for an electro-mechanical transducer such as a crystal phonograph pickup is described. The circuit offers high gain and high signal to noise ratio throughout the audio frequency range. The circuit is unique since crystal phonograph pickups are usually operated into a high impedance load for flat frequency response, while the input impedance of base input transistor amplifiers is usually low. It might be possible to raise the input impedance of the transistor amplifier by inserting an additional impedance in series with either the base or emitter electrodes.



However, this increases the amplifier noise and a high supply voltage is required to compensate for the large voltage drop in the emitter resistor.

Compensation for low impedance is accomplished by connecting resistor 22 of relatively low resistance (about 1000 ohms) in series with the emitter electrode 18 of a common emitter transistor amplifier circuit.

In addition condenser 24 (about 0.05  $\mu\text{f}$ ) is placed in parallel with the input circuit of the amplifier when the crystal pickup has an internal capacitance of the order of 1,000  $\mu\text{f}$ . The complete circuit includes provision for operating bias for the base and emitter electrodes as well as capacitance bypass of resistor 22 to enable less degeneration at high audio frequencies. It is shown that there is proper impedance termination of the transducer 10 since the time constant is the same with input capacitor 24 connected or disconnected. In general, the increase in the equivalent capacitance reduces the size of the resistance required in the emitter circuit. Thus, for the same operating current the voltage drop across the emitter is less than if a larger resistance were inserted in the emitter circuit.

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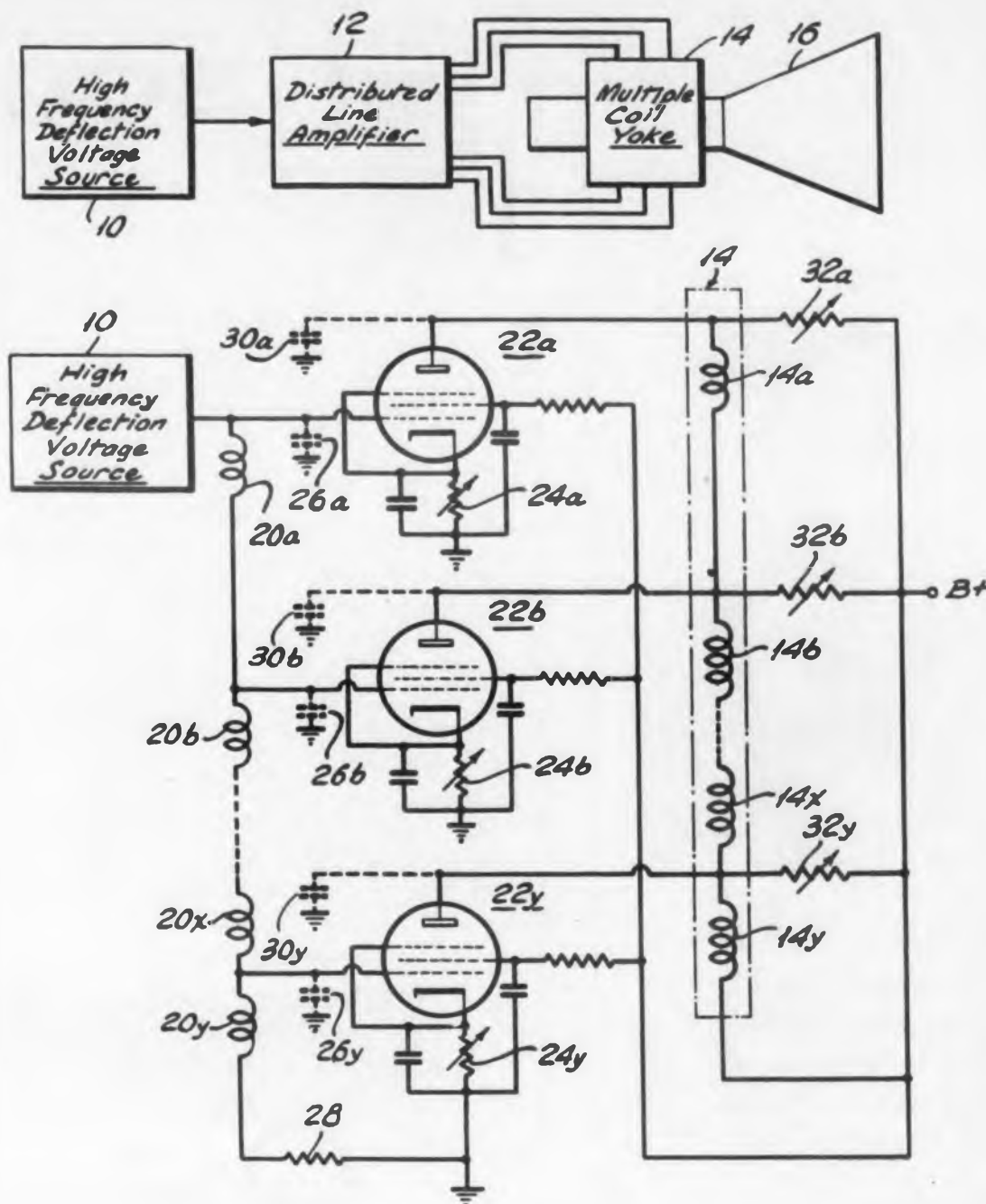
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### Electromagnetic Deflection System

Patent No. 2,820,175. Eugene G. Fubini.  
(Assigned by mesne assignments to the United States of America as represented by the Secretary of the Navy)

Since distributed line amplifiers have excellent h-f response, a distributed line amplifier is designed to drive the electromagnetic deflection yoke for oscilloscope display of narrow pulses. The deflection yoke consists of individual series-connected coils which are coupled as the output transmission line for the distributed line amplifier.

The first two stages and the last stage of distributed amplifier 12 are shown in detail. In practice, four to eight stages are sufficient to obtain the characteristics

of an actual distributed line. Series-connected coils, 20 a, 20 b . . . 20 x and 20 y and condensers 26 a, 26 b . . . 26 y comprise a tapped delay line which couples the deflection signal to amplifier tubes 22 a, 22b and 22 y. The output of each amplifier is connected to a point on the output transmission line corresponding to a point on the input delay line such that the delay due to each of the series-connected coils of the deflection yoke is equal to that of the corresponding section of the input delay line. Therefore, the contribution of currents from all of the pentode amplifiers are in phase. Reflections may be reduced by terminating the output transmission line by a resistance equal to the characteristic impedance of the line.

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## BOOKS

### The Radio Amateur's Handbook

American Radio Relay League, Inc., Administrative Headquarters, West Hartford 7, Conn., 745 pp, \$3.50.

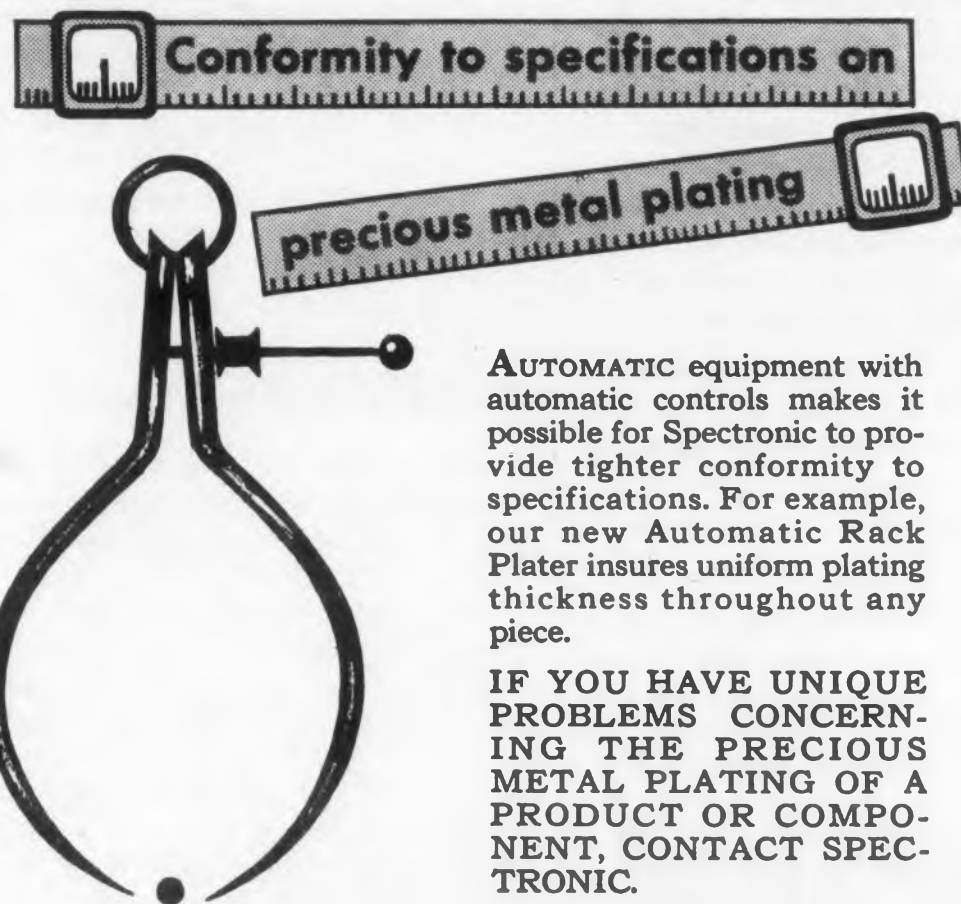
This thirty-fifth edition takes note of the changes in technical practice that have occurred in recent years. An appreciable amount of new equipment in all categories appears throughout the book. The chapter on receiver construction describes both simple and complex designs for complete receivers and various add-on units. The transmitter section features units for the novice as well as for the more experienced amateur. Additions to vhf section of the Handbook include high-powered amplifiers and beam antennas. Extensive material has been added on radioteletype machines

and circuits, in order to provide for the increasing use by radio amateurs of this mode of transmission. The basic theory sections include a chapter on semi-conductors. There are over 1350 illustrations, including some 500 tube-base diagrams.

### Control Engineers' Handbook

John G. Truxal, McGraw-Hill Book Co., Inc., 330 West 42nd St., New York, N.Y. 1048 pp, \$18.50.

With more than 50 contributing experts represented, this handbook gives engineers, designers, and development engineers a basic source of information on components and design techniques for use in the design of feedback con-



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trol systems. Emphasis is put largely on components, including electro-mechanical, mechanical, hydraulic, pneumatic, electronic, and magnetic.

The book discusses components by giving physical explanations of how they work, mathematical descriptions of them as used in typical control systems, limitations on the operating characteristics in practice as a result of theoretical limitations and practical considerations, and techniques for measuring the characteristics of components.

#### Television in Science and Industry

V. K. Zworykin, E. G. Ramberg, L. E. Flory, John Wiley & Sons, Inc., 440 Fourth Ave., New York, N.Y. 300 pp, \$10.00.

Analyzing both equipment and applications, the authors discuss closed-circuit color television and the improvements achieved by transistorization. Also described are stereo television, specialized television methods in research, television microscopy, etc. The principal fields of applications of television in industry, research, medicine, education, commerce, military affairs, and home are outlined.

#### Applied Statistics for Engineers

William Volk, McGraw-Hill Book Co., Inc., 330 West 42nd St., New York, N. Y. 250 pp, \$9.50.

Emphasizing engineering applications rather than theory, and providing a number of illustrative examples, the book deals with the treatment of engineering data for correlation, precision, and analysis of experimental factors. A review of probability theory and frequency distribution is included.

One feature is the statistical handling of correlation data. Not only does it describe the method of drawing the "best" line through the data but also the method of determining how well the line fits the data, how much variation in the data is eliminated by the line and by the correlation, and how much variation still remains. There are also detailed discussions of curvilinear correlation, analysis of the variance, and interpretation of the analysis of variance. Besides offering a view of the whole field of statistics in engineering, the book is arranged so that each chapter is complete in itself, providing a quick idea of how a particular type of problem has been handled.

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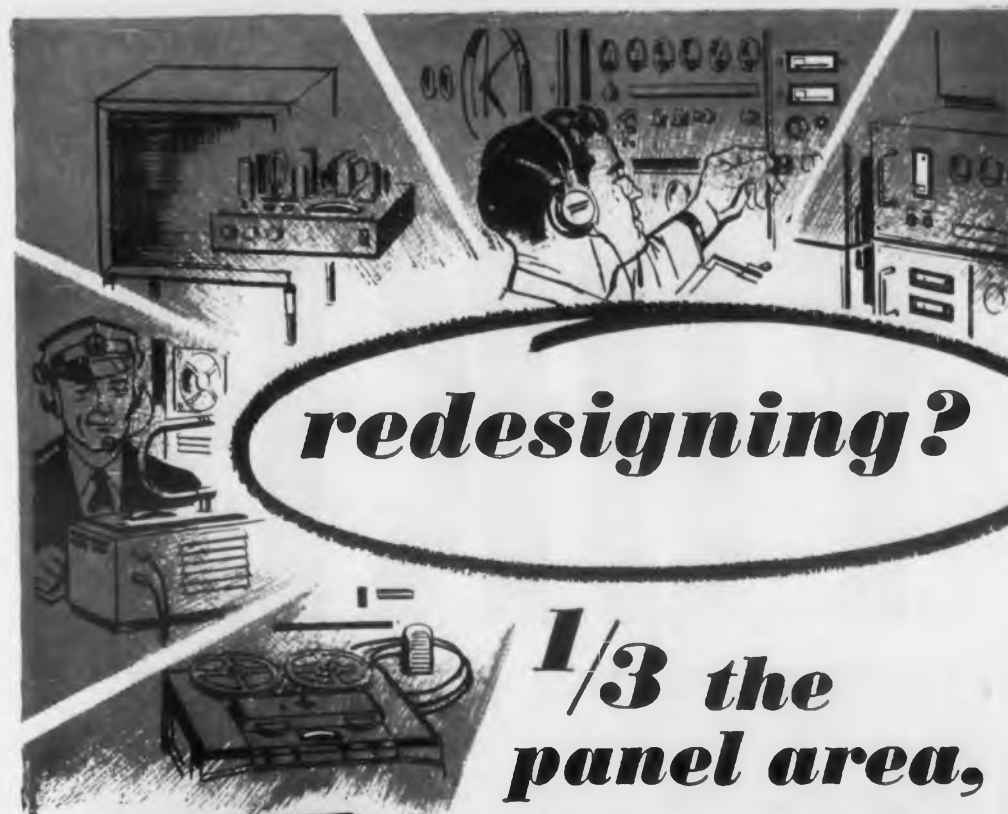
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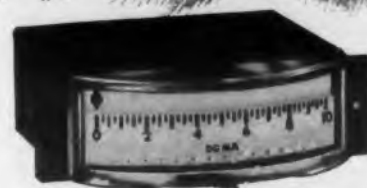
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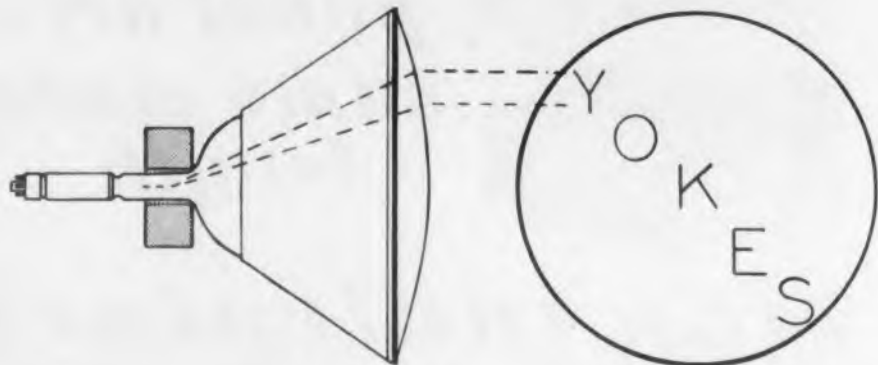


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## RUSSIAN TRANSLATIONS

# What The Russians Are Writing

J. George Adashko

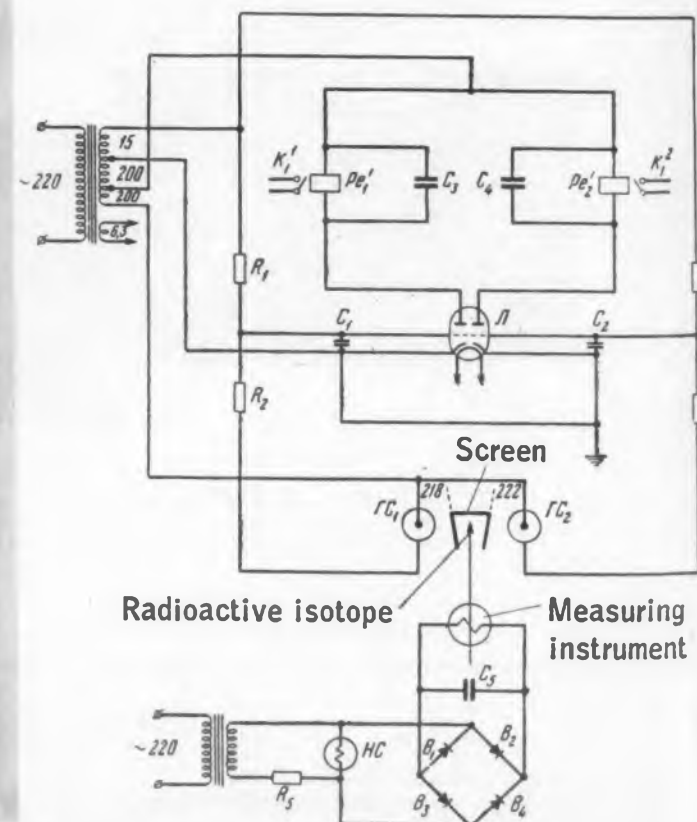
### AUTOMATIC CONTROL

Application of Radioactive Radiations in Automatic Control Devices by Yu. V. Grushchin, L. V. Mel'tser, M. I. Tolokonnikov, and N. N. Shumilovskiy. AT 9/57, pp 814-840, 25 figs.

This extensive survey article describes fundamental methods and trends in the use of nuclear radiation in automatic

control. The article discusses the fundamental characteristics of alpha, beta and gamma rays, and describes various radiation detectors, and radioactive isotopes. It then proceeds to describe the automatic control of productive processes with radiation, such as the automatic control of thickness and weight of material, media density, liquid-level regulation, gas and liquid flow regul-

Fig. 1. Relay circuit used for voltage regulation. A source of radiation is placed on an indicating instrument's pointer. Whenever the pointer moves outside the range of a screen, whose width is determined by the voltage accuracy required, nuclear particles strike one of the counters and connect the proper relays into the voltage regulation circuit.



on, automatic indication of the presence of impurity in gas, automatic control and regulation of gas pressure, and various relay circuits employing contactless radioactive relays. See Figs. 1, 2, 3.

**Relay System for Automatic Regulation of Position Using a Compound Motor by V. V. Gorskiy. AT 9/57, pp 781-791, 13 figs.**

The author derives equations for the speed and angle of the system output shaft, during synchronization. Motor transients are analyzed with allowance for saturation in its magnetic circuit. A nonlinear velocity feedback is determined to obtain a minimum backlash zone and absence of overshoot. Devices for functional transformation of the voltage by velocity feedback and a circuit are given. The use of dc motors with mixed excitation in relay systems for automatic regulation of position leads to master systems.

## CIRCUITS

**Contribution to Design of AC Circuit of a Magnetic Amplifier by N. A. Kaluzhnikov. AT 9/57, pp 792-801, 13 figs.**

A method for designing ac magnetic amplifiers with iron-nickel cores is suggested, based on the theory of the "ideal" magnetic amplifier. The performance of an ac magnetic amplifier with an inductive-resistive load is analyzed and the performance of a push-pull magnetic amplifier with inductive load is discussed.

**Single Tube Circuit for Division and Multiplication of a Crystal Frequency by G. M. Utkin. RE 9/57, pp 47-54, 7 figs.**

The author previously reported extensive investigation of two-loop self-excited oscillators with multiple frequencies. (Radiotekhnika, October 1956, ED 7/1/57; Radiotekhnika i Elektronika, January 1957, ED 9/1/57; Radiotekhnika, April 1957, ED 11/15/57. He now

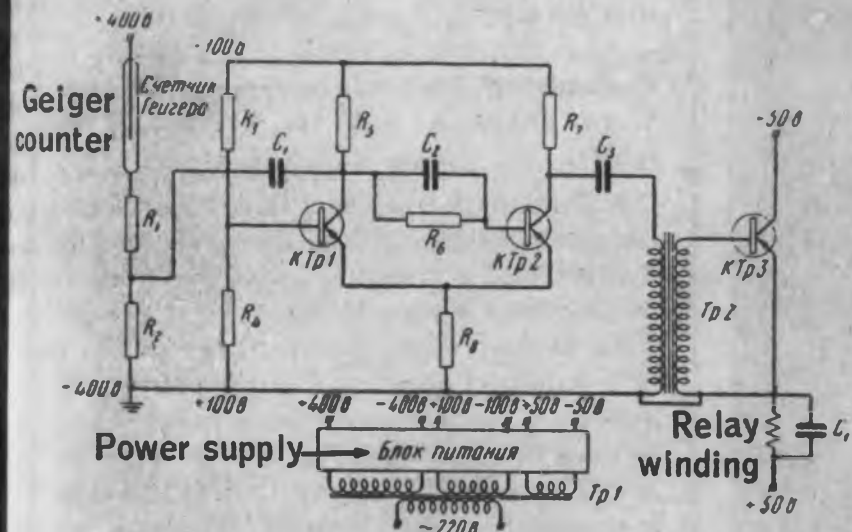


Fig. 2. Transistorized gamma ray relay developed by the All-Union Coal Institute.

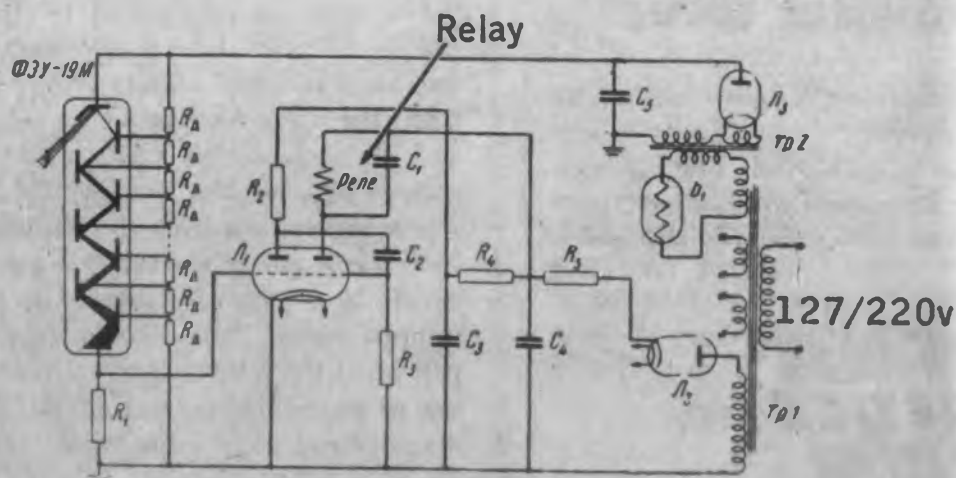


Fig. 3. A relay with a scintillation counter.

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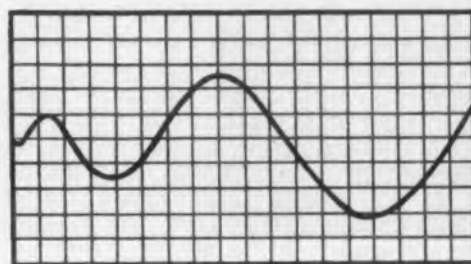
PRECISION, WIRE-WOUND

## NONLINEAR POTENTIOMETERS

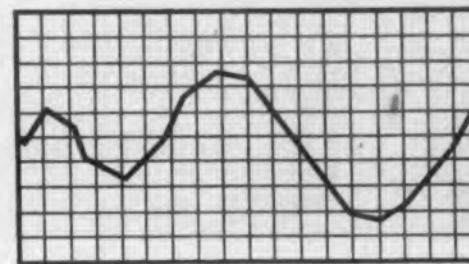
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## RUSSIAN TRANSLATIONS

uses his test results to develop circuits for practical use of such systems for division and multiplication of the frequency of a quartz oscillator. The equations derived for the self-excited oscillators are similar to those for the quartz oscillators. These circuits can be used to multiply and divide by a factor reaching 15. Report of an experimental verification of some of the circuits is also made.

**Temperature Coefficients of Frequency of Optimum Thermally Compensated Circuits by M. Ya. Movshovich. RE 9/57, pp 63-68, 3 figs.**

Expressions are derived for the temperature coefficients of the frequency of circuits that incorporate thermal compensation such that the temperature errors are reduced to a minimum. Results of calculations of a specific circuit are given; it is shown that simple compensation circuits can in many cases be just as effective as complex ones.

**Evaluation of Electronic Integrating Schemes by B. Ya. Kogan. AT 9/57, pp 841-846, 2 figs, 2 tables.**

A comparison is made of three basic electronic integrators relative to the minimum integration frequency of a sinusoidal signal and relative to the maximum integration time of a step signal.

An increase in the maximum integration time of a stabilized operational amplifier requires an increase in the dynamic voltage range. This can be done by reducing the error of the operational amplifier or by expanding the linear range of variation of the output voltage. A clever device for doing this is shown in Fig. 4, which represents a step integrator. Here, the operational amplifier integrates only during a given time. After the output voltage reaches a value of  $\pm 100$  volts, as established by the comparison device *EC*, the slide of the step switch moves one step and the voltage  $\pm \Delta u_1$  is memorized. Capacitor *C* is discharged by relay *P-1* or *P-2*, and the integration starts again. The output voltage  $U_{out}$  is taken from the auxiliary adder 2, where the voltage from the stepped selector and from the output of the integrator are added. This results in a piecewise linear curve instead of a stepped curve. Thus, after *n* steps a voltage  $nu_1$  will be at the output of the divider, corresponding to an *n*-fold increase in the paper limit of linearity and gain of the whole circuit.

**Concerning Reduction of Nonlinear Distortion by**

Feedback by L. Ya. Kantor. RE 9/57, pp 55-62, 6 figs, 1 table.

Nonlinear distortion at higher frequencies in feedback amplifiers should be determined only from the difference-tone coefficient; equations are given for this coefficient. Methods for increasing the effectiveness of the feedback at higher frequencies are proposed. The concept of a system with "frequency-dependent nonlinearity" is introduced and various distortion figures for such systems are given.

## COMPONENTS

Inductive Transducer of Higher Sensitivity for Recording Linear and Angular Displacements by A. S. Sadovskiy. AT 9/57, pp 802-813, 15 figs.

A toothed through-type inductive transducer, having a sensitivity greater than a transducer with a solid armature is described. The transducer enables measurement of displacement and recording of equal and unequal lengths within the range of the entire length of the armature. These can be made as large as desired. The armature may also be made in the form of a cylinder and the teeth in the form of rings or a screw thread. In the latter case the transducer can be used also to measure angular displacements.

Such a measuring device can be used in precision machine building and has replaced optical systems of measuring coordinates and displacement; it also lends itself to automatic positioning of the breadth of a machine tool at a preselected coordinate, something that cannot be done with an optical system.

Investigation of Transients in Germanium Point Contact Transistors by A. I. Skopenko. REE 9/57, pp 1210-1220, 8 figs, 4 tables.

It is shown that the time required to change

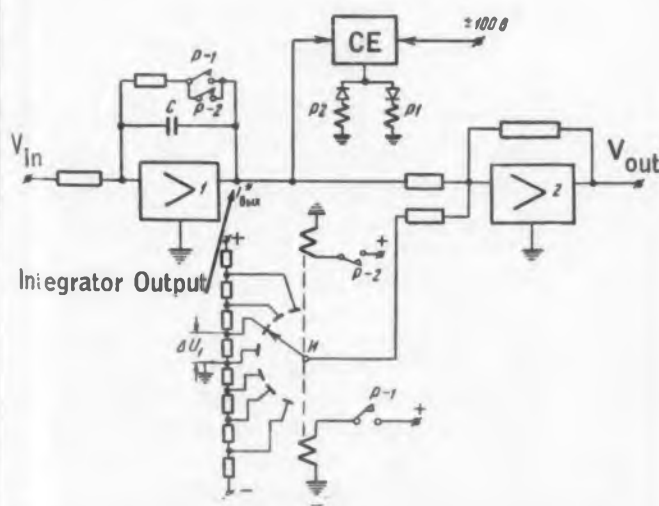
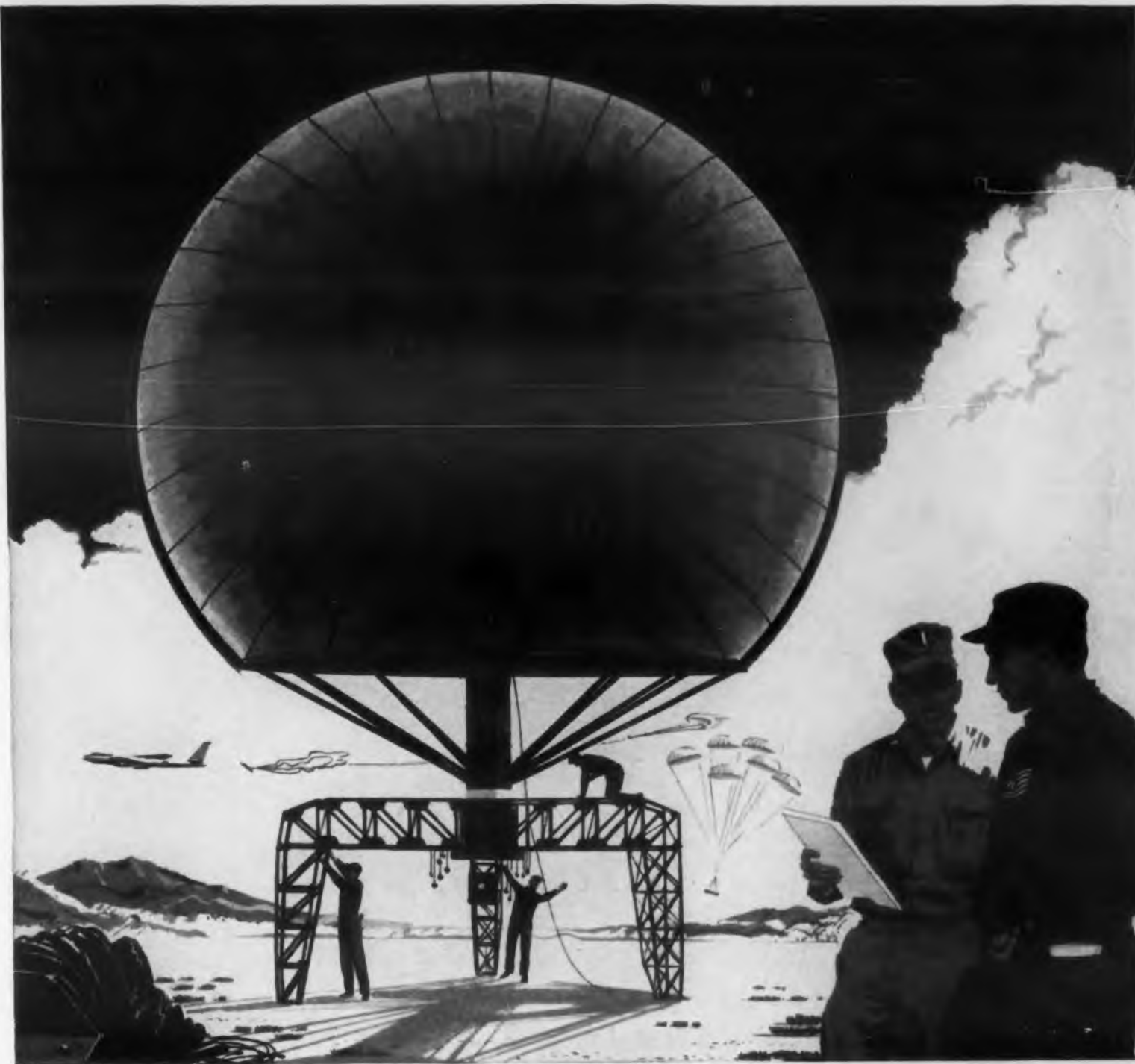


Fig. 4. A step integrator which expands the linear range of output voltage variation.



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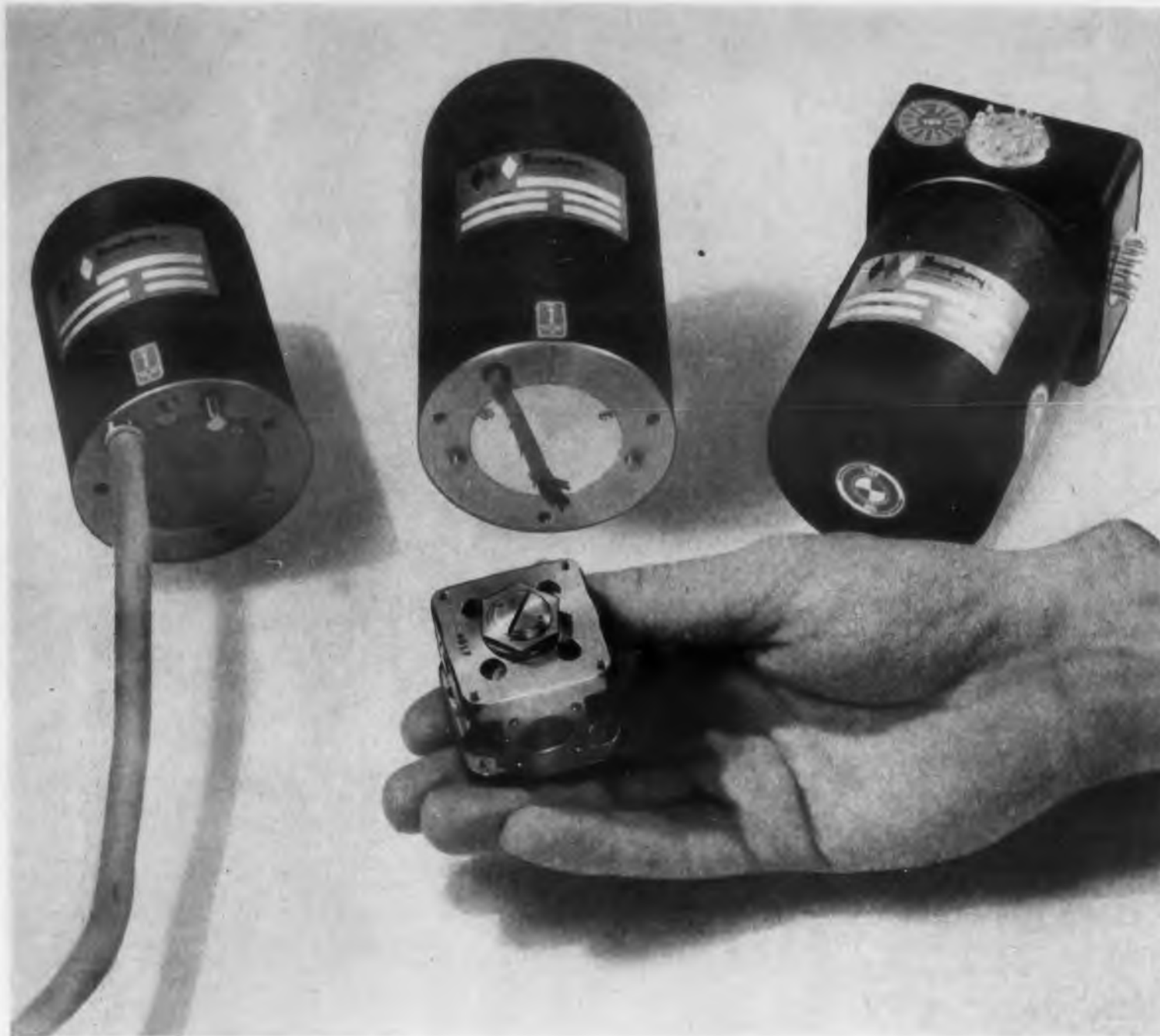
Wondering why the "Paraballoon" antenna can do such a big job, yet weigh so little? The unit is constructed almost entirely of lightweight, rugged magnesium alloy. The reflector platform is magnesium sheet and extruded channels. The turning tube is a magnesium sand casting and the tripod is welded magnesium tubing. The radar reflector is a fully deflatable fiber glass balloon.

The "Paraballoon" antenna is one of the many examples of how the high strength-to-weight ratio of magnesium pays off in terms of saved weight in electronic equipment. For more information on magnesium in electronics contact the nearest Dow Sales Office or write to THE DOW CHEMICAL COMPANY, Midland, Michigan, Department MA-1416M-1.

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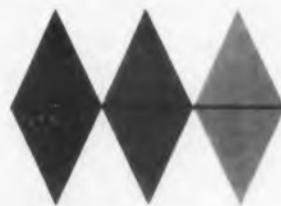
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## RUSSIAN TRANSLATIONS

point-contact transistors from the "off" to "on" state depends on factors that influence transit time of the minority carriers from emitter to the collector. The time to change from "on" to "off" depends fundamentally on the effective lifetime of the minority carriers in the germanium crystals of the transistor. Refers to a large number of American articles, the latest of which is by L. B. Valdes (*Proceedings IRE*, 1956, Pages 178-184).

**Magnetic Relay With Ferrite Cores** by G. D. Kozlov. *AT* 9/57, pp 847-851, 5 figs.

A magnetic amplifier with ferrite cores is used as a relay, in which the load current changes by a factor of 100-200. A method is given for designing such a magnetic relay.

**Dependence of Capacitance and Resistance of Alloyed Type Germanium Diodes on the Frequency and on the Positive Bias Current** by N. A. Penin and K. V. Yakunina. *REE* 9/57, pp 1200-1209, 13 figs.

Good agreement is shown between the diffusion theory of p-n junctions and experimental results for germanium diode frequency characteristics, with allowance for the charge capacity of the blocking layer. For specific resistivities of germanium, ranging from 0.01 to 10 ohm-cm, and for frequencies up to 1 mc the dependence of diode impedance on frequency and on positive bias current is always in line with the values called for by diffusion theory. One can determine the series impedance of a thickness of germanium crystal and the effective lifetime in a diode from the dependence of the real and

### KEY

The sources of the Russian articles and their dates of issue follow the authors' names. Here is the key to the names of the journals in which the articles originally appeared.

AT	Automation and Telemechanics ( <i>Avtomatika i Telemekhanika</i> )
CJ	Communications Journal ( <i>Vestnik Svyazi</i> )
EC	Electrical Communications ( <i>Elektrosvyaz</i> )
IET	Instruments and Experimental Techniques ( <i>Pribori i Tekhnika Eksperimenta</i> )
R	Radio
RE	Radio Engineering ( <i>Radiotekhnika</i> )
REE	Radio Engineering and Electronics ( <i>Radiotekhnika i Elektronika</i> )

imaginary components of the total impedance of the p-n junction or from the capacity and resistance of the blocking layer on the positive bias current for a constant frequency, if diffusion capacitance is much greater than the blocking-layer capacitance. It is possible also to determine the charge capacitance of the diode from the frequency dependence of the resistance and total capacitance of the p-n junction at a constant bias current. Reference is made to work by Lederhandler and Giacoletto, *Proceedings IRE*, 1955, Page 477.

**Frequency Characteristics of Junction Transistors** by Ya. A. Fedotov. REE 9/57, pp 1189-1199, 9 figs.

The author shows that the best criterion for estimating the frequency characteristic of a junction transistor (i.e., the current gain vs. frequency) is the maximum oscillation frequency, namely the frequency at which the intrinsic power gain of the transistor becomes greater than unity. Reference is made to work by Drouilhet (*IRE Transactions*, 1955, CT-2, 2, Page 178), Mason (*IRE Transactions*, 1954, CT-1, 2, Page 20), Pritchard (*IRE Transactions*, 1955, CT-2, 2, Page 183) and Early *Bell System Technical Journal*, 1954, Page 517).

### INFORMATION THEORY

**Methods of Investigating Transients in Phase-Correcting Systems Employed in the Reception of Code Combinations of Telegraph Pulses** by L. N. Shchelovanov. EC 9/57, pp 42-49, 11 figs.

Methods for investigating transients are given for open and closed pulse networks with variable pulse repetition frequencies which are multiples of the elementary telegraph pulse. The regulation process in the phase correction system of the tuning fork of multiplex telegraph apparatus in the reception of code combinations of telegraph pulses is investigated.

### TRANSLATIONS AVAILABLE

ELECTRONIC DESIGN is gratified to learn of the growing availability of full translations of important Russian electronics journals.

Consultants Bureau, Inc. of 227 W. 17th St., New York 11, N.Y. translates *Automation and Telemechanics* regularly.

Pergamon Press of 155 E. 55th St., New York 22, N.Y. is preparing translations of *Radio Engineering*, *Radio Engineering and Electronics*, and *Electrical Communications*.

Readers interested in specific Russian journals can obtain more information by writing directly to one of these publishers.



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and .015" in height, all with tolerances of  $\pm .002$ ". General Ceramics has designed and built special equipment for core testing to insure that each unit meets established electrical properties. 50 mil O.D. cores are supplied in production quantities in two quality levels. Parts are shipped according to MIL Specification 105A to 0.015 AQL or 6.50 AQL. For complete information on this core write General Ceramics Corporation, Keasbey, New Jersey, for Bulletin 326; address Dept. ED.

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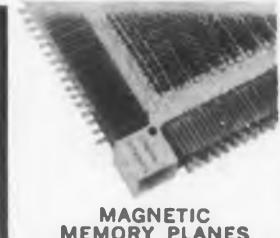
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**GERMAN ABSTRACTS**

E. Brenner

## Direct Reading Frequency Meter

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Operation of the instrument is based on the proportionality existing between current and frequency when a capacitance is periodically charged and discharged at a constant applied amplitude.

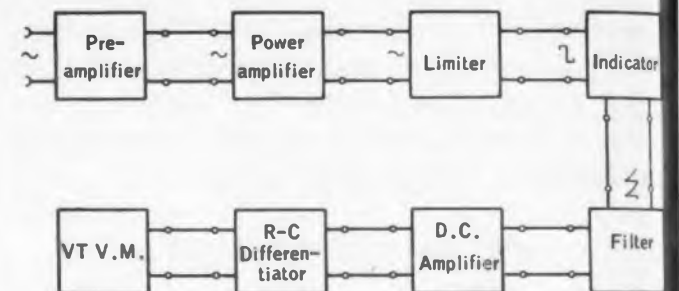


Fig. 1. Block diagram of the frequency meter.

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**B**OTH ac and dc sources can be used for magnetron supplies. In low power applications, such as in diathermy machines, ac operation of the magnetron tube may be economically advantageous because of the comparative simplicity of the supply. The magnetron, with an ac supply as indicated in Fig. 1, will only conduct during the positive half cycle of the ac wave.

Using the magnetron characteristics shown in Fig. 2, the voltage or current waveform can be calculated. Portions of sinusoidal pulses result exactly as they do in gas diodes. It can be shown that for a conduction angle between 60 and 120 deg, the peak anode current goes to eight times the value of a dc supply if it were used. For the small angles (less than 90 deg) the life of the tube, due to electron bombardment of the cathode, can be seriously reduced. Large angles require very high supply voltages. It appears advantageous to use the smallest conduction

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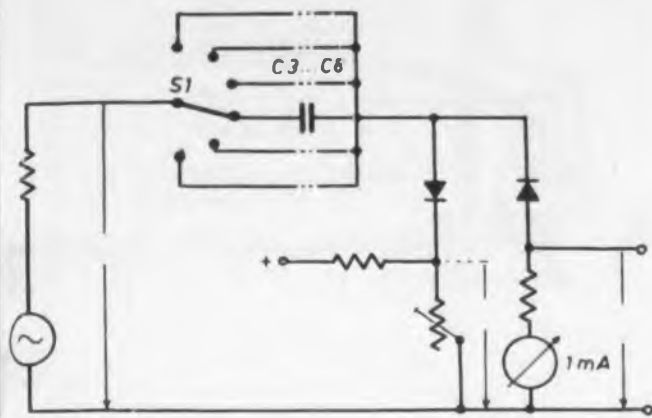


Fig. 2. Schematic diagram of the indicating circuit.

For the voltage applied to the indicating circuit to be independent of the signal amplitude a preamplifier, power amplifier, and limiter are cascaded as in Fig. 1. Therefore, square waves, the amplitudes of which are independent of signal amplitude, are applied to the indicating circuit shown in Fig. 2. It can be shown that the frequency is proportional to the meter reading, within 2 per cent, below 250 kc and within 5 per cent up to 300 kc if the maximum frequency is less than  $0.1/RC$ . Accuracy in the hf range can be improved by calibration curves.

The differentiator section shown in Fig. 1 is used to obtain a voltage which is proportional to the time rate of change of frequency. Such signals can be used for regulation or control purposes.

Abstracted from an article by R. Kosfeld and B. Ricke, *Elektronische Rundschau*, Vol. 12, No. 2, pp 53-56, Feb. 1958.

## of Magnetrons

angle for which the magnetron is rated.

Abstracted from an article by W. Schmidt, *Elektronische Rundschau*, Vol. 12, No. 1, pp 12-14, Jan. 1958.

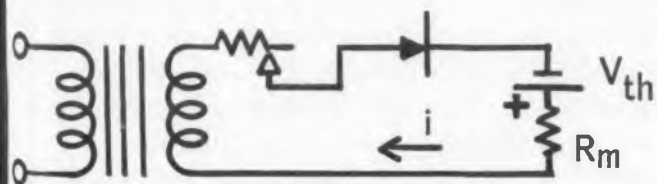


Fig. 1. Equivalent circuit of magnetron with ac supply.

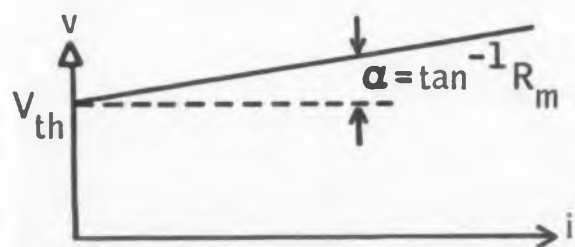


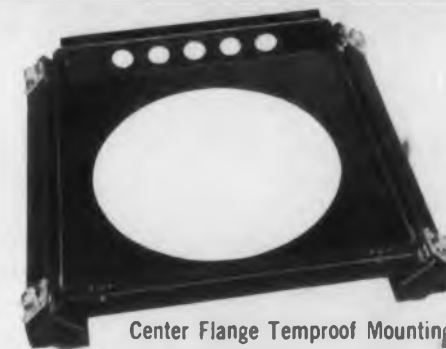
Fig. 2. Magnetron characteristics.



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## STATEMENT OF THE PROBLEM—

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(Place illustrations on separate sheet if necessary)



## STANDARDS AND SPECS

Sherman H. Hubelbank

### Terminal Diagrams

JO-EI-1, RECOMMENDED PRACTICE FOR PREPARATION OF BASING OR TERMINAL DIAGRAM, FEBRUARY, 1958

Formulated by the joint Electron Tube Engineering Council and issued jointly by the Electronic Industries Association and the National Electrical Manufacturers Association, this standard establishes the basic rules for guidance in the formulation of basing and terminal diagrams for electron tubes and associated sealed devices. It is not intended that the rules be applied to schematic or wiring diagrams, although the depiction of the internal connections of electron tubes and associated sealed devices in schematics and wiring diagrams may follow the basic rules established by this standard. The rules have been specifically planned to cover receiving, gas, high-vacuum transmitting, cathode-ray, klystron, and photo tubes. These rules do not cover magnetron, large power, and X-ray tubes, since basing diagrams for these tubes are not ordinarily prepared. Copies of this standard may be obtained from either Electronic Industries Association, 11 West 42nd Street, New York 36, N.Y. (Standard RS-206) or National Electrical Manufacturers Association, 155 East 44th Street, New York 17, N.Y. (Publication No. 513) for 60 cents each.

### Printed Wiring

RS-208, DEFINITION AND REGISTER, PRINTED WIRING, FEBRUARY, 1958

Definition and register of all forms of printed wiring are included. Definition is the degree of faithfulness of reproduction of conductor referred to the original master drawing. Register is the degree of alignment of the conductor with its intended positions on the printed wiring board. Copies of this standard may be obtained from the Electronic Industries Association, 11 West 42nd Street, New York 36, N.Y. for 25 cents each.

### Capacitors

MIL-C-14409A, CAPACITORS, VARIABLE (PISTON TYPE, TUBULAR TRIMMER), 10 JANUARY, 1958

The requirements for tubular-trimmer, piston-type, variable capacitors intended primarily for

use in high-frequency trimming applications are established by this standard. In general, these capacitors are for use where relatively few adjustments are required during the effective life of the equipment. A typical type designation for capacitors meeting this standard is PC35H030. This standard supersedes MIL-C-14409(SigC), 15 October 1956.

#### Military Specs

The military have announced the release or revision of the following specs:

MIL-W-13169A, WIRE, ELECTRICAL (FOR INSTRUMENT TEST LEADS), AMENDMENT 1, 2 JANUARY, 1958

MIL-C-71A, CONNECTORS, "N," FOR RADIO-FREQUENCY CABLES, SUPPLEMENT 1B, 28 OCTOBER, 1957

MIL-E-5422D(ASG), ENVIRONMENTAL TESTING, AIRCRAFT ELECTRONIC EQUIPMENT, 1 NOVEMBER, 1957

MIL-E-7080A, GENERAL SPECIFICATION FOR AIRCRAFT INSTALLATION AND SELECTION OF ELECTRIC EQUIPMENT, 19 NOVEMBER, 1957

MIL-E-16400B (SHIPS), ELECTRONIC EQUIPMENT, NAVAL SHIP AND SHORE, GENERAL SPECIFICATIONS

MIL-I-16910A, INTERFERENCE MEASUREMENT, RADIO, METHODS AND LIMITS; 14 KILOCYCLES TO 100 MEGACYCLES, 1 NOVEMBER, 1957

MIL-C-19080 (SHIPS), CAPACITORS, FIXED, FEED-THRU, METAL ENCASED, HERMETICALLY SEALED, A-C AND D-C, 27 DECEMBER, 1957

MIL-C-19978 (SHIPS), CAPACITORS, FIXED, PLASTIC DIELECTRIC, HERMETICALLY SEALED, 20 NOVEMBER, 1957

#### IRE Standards

The following standards are available from the Institute of Radio Engineers, 1 East 79 Street, New York 21, N.Y.

57IRE21.S2, STANDARDS ON REFERENCE DESIGNATIONS FOR ELECTRICAL AND ELECTRONIC EQUIPMENT, price 70 cents

57IRE21.S3, STANDARDS ON GRAPHICAL SYMBOLS FOR SEMICONDUCTOR DEVICES, price 60 cents

#### Cables

MIL-C-17B, CABLES, RADIO FREQUENCY; COAXIAL, DUAL COAXIAL, TWIN CONDUCTOR AND TWIN LEAD, AMENDMENT 1, 17 FEBRUARY 1958

The list of referenced specs and publications has been revised to bring them up-to-date. The group approval plan has been amended to include miniature cables. Miscellaneous cables, which were inadvertently omitted in the basic spec, have been added.

#### NEMA Standards Guide

The latest edition of "Your Guide to NEMA Standards Publications" is now available without charge from the National Electrical Manufacturers Association, 155 East 44th Street, New York 17, N.Y. The new guide contains information about nine new and thirteen revised standards.

#### ASTM F-1, Electron Tube Materials

This is the first edition of the Compilation of ASTM Standards for Electron Tube Materials. It is published in recognition of the growing importance of this field. There are 41 standards relating to cathode materials, insulators, strip materials, wire, metallic and non-metallic seals, and miscellaneous materials. Copies of this 242-page publication may be obtained from ASTM Headquarters, 1916 Race Street, Philadelphia 3, Pa., for \$3.50 per copy.

#### Control Panels

MIL-C-18012A(ASG), CONTROL CONFIGURATION AND MARKING (FOR PLASTIC LIGHTING PLATES, CONTROL PANELS, AND PLACARDS), AMENDMENT 1, 24 DECEMBER 1957

Wherever practicable, the criteria of the Society of Automotive Engineers' recommended practice ARP-498 entitled "Panels, Plastic Lighting, Design Criteria and Recommendations for Dimensions and Tolerances," should now be employed.

#### ASTM B-1, Metallic Conductors, 1958

This is a compilation of all ASTM standards in the field of electrical conductors. It supersedes the December 1955 edition. Contained in this book are 55 standards of which three are completely new and thirteen are revised or have had their status recently changed. Copies of this 334-page publication may be obtained directly from the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa. for \$3.75 per copy.

#### AIEE Standards

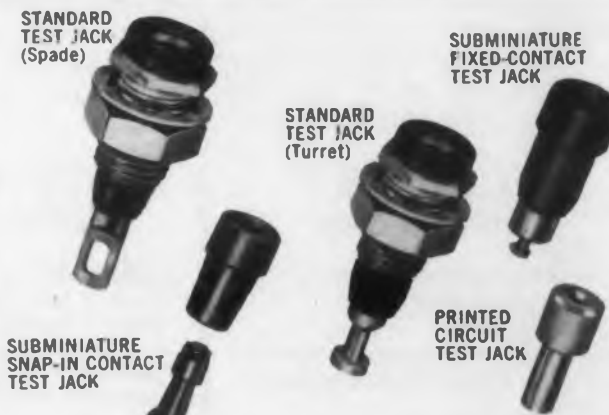
The American Institute of Electrical Engineers has published a listing of standards publications. This six-page pamphlet covers AIEE standards, test codes, recommended practices, specifications, guides, and certain reports. In addition, certain ASA standards are included. Copies of this April 1958 revision are available without charge from the American Institute of Electrical Engineers, 33 West 39th Street, New York 18, N.Y.



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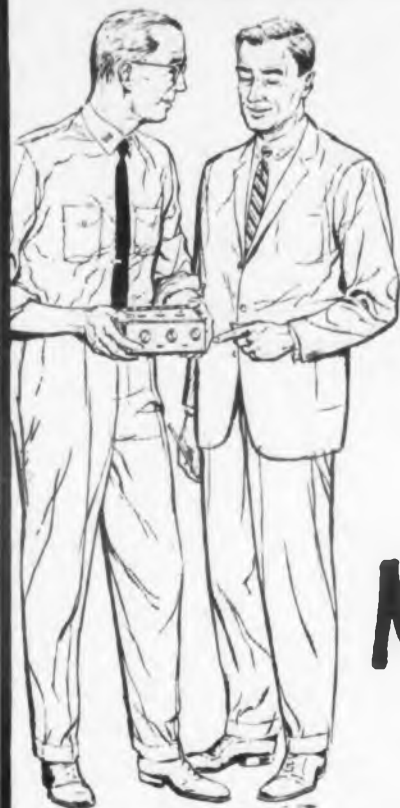
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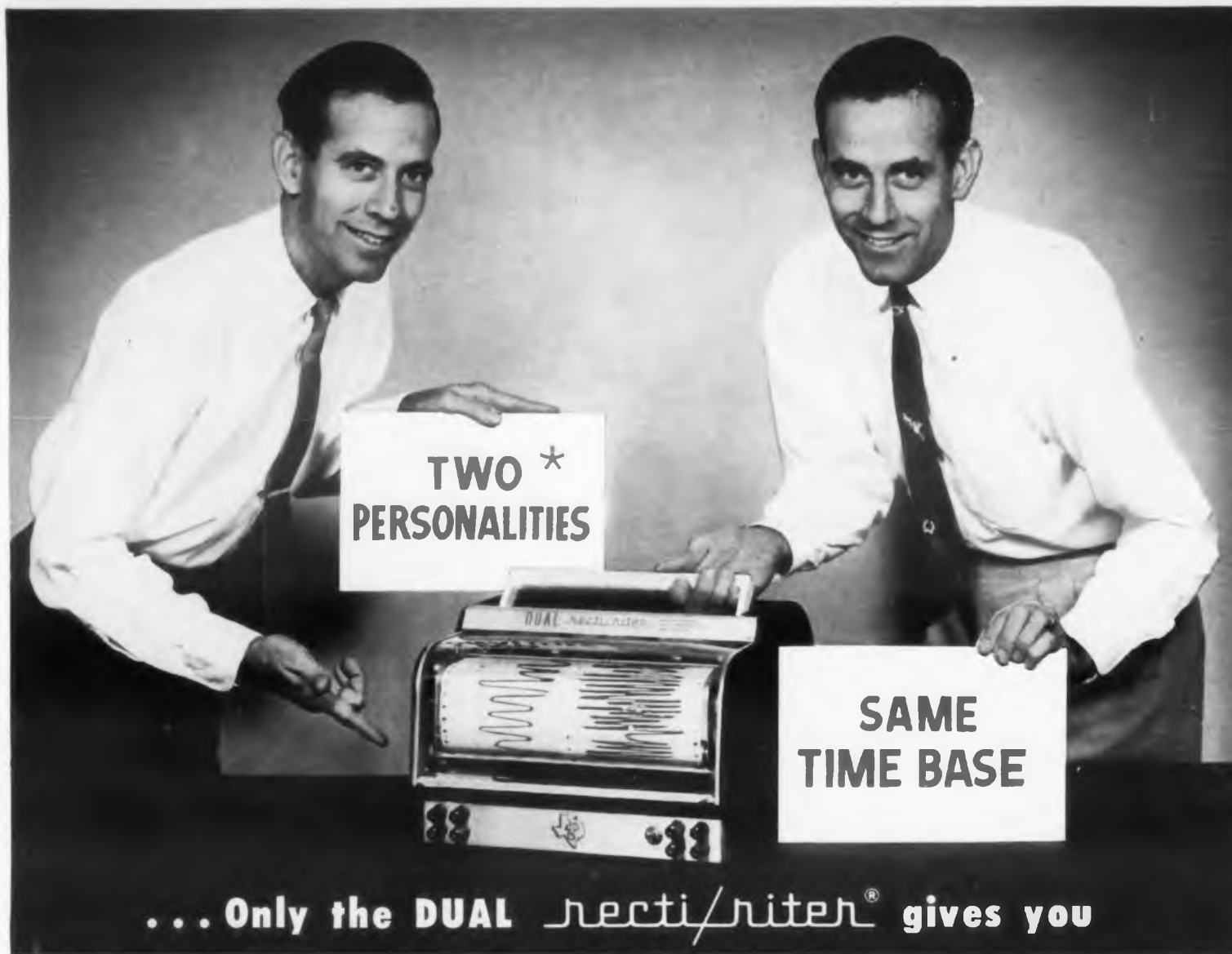
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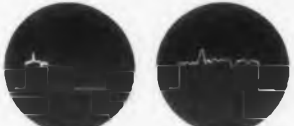
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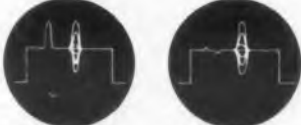
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