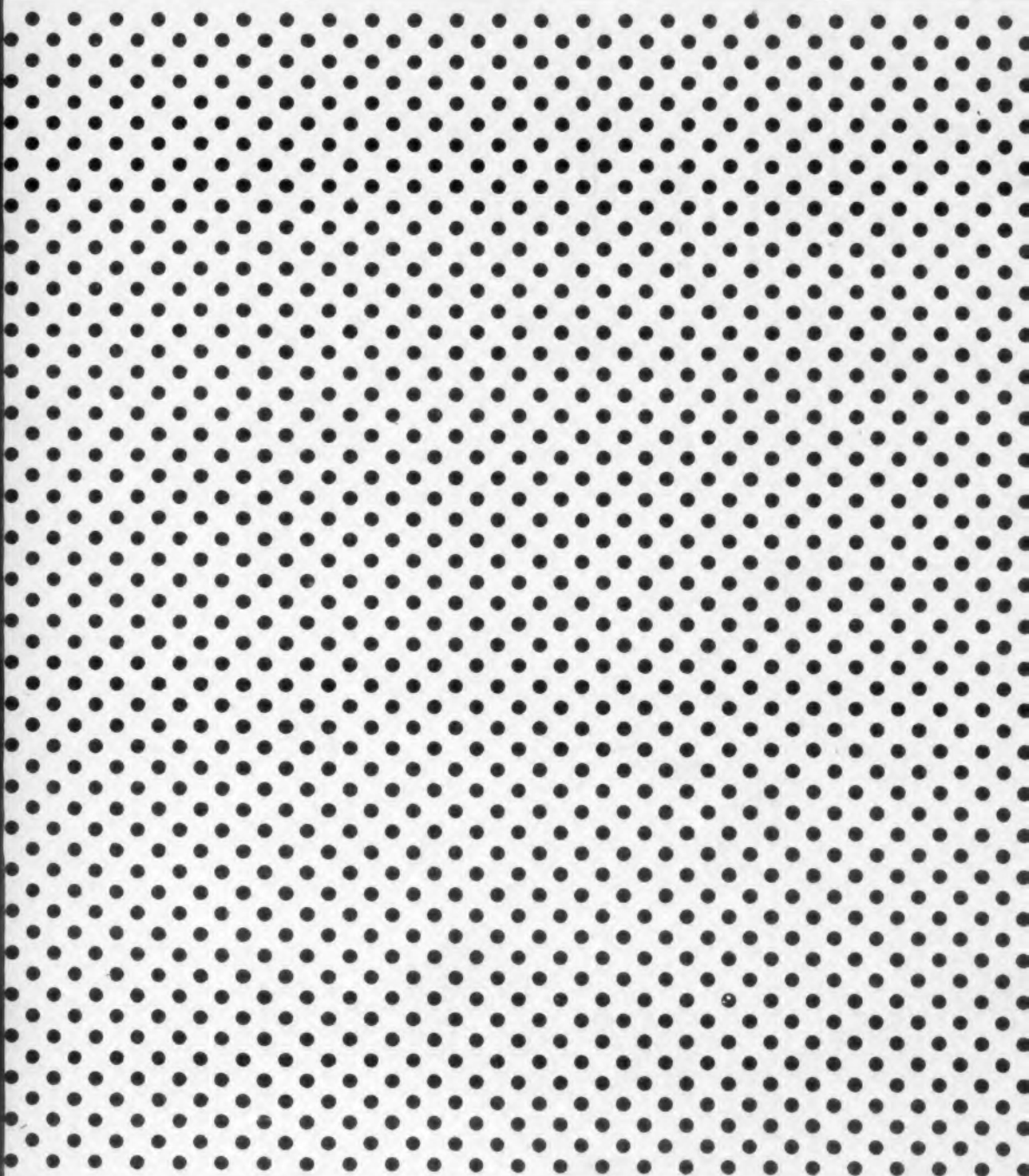


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N I C I G N

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Adjustable
Precision Resistor

.. 26



FREED

MIL-T-27A TRANSFORMERS

POWER TRANSFORMERS-STANDARD

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

Cat. No.	Hi Volt Sec.	ct	DC Volts	DC Amps	Filament #1		Filament #2		MIL Case Size
					Volt	Amp.	Volt	Amp.	
MGP1	400/200	✓	185	.070	6.3/5	2	6.3	3	NA
MGP2	650	✓	280	.070	6.3/5	2	6.3	4	JB
MGP3	650	✓	245	.160	6.3	5	5.0	3	KB
MGP4	800	✓	318	.175	5.0	3	6.3	8	LB
MGP5	800	✓	345	.250	5.0	3	6.3	8	MB
MGP6	700	✓	255	.250					KB
MGP7	1100	✓	419	.250					LB
MGP8	1800	✓	640	.250					NB

FILAMENT TRANSFORMERS-STANDARD

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

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

PULSE TRANSFORMERS

Cat. No.	Block'g. Sec.	Imp. Coupling	Leak. Perm. Det.	Pulse Voltage Kilovolts	Pulse Duration Microseconds	Duty Cycle	No. of Wdgs.	Test Volt. VRMS	Other Imp. Ohms
BPT1	✓	✓	✓	0.25/0.25/0.25	0.2-1.0	.004	3	0.7	250
BPT2	✓	✓	✓	0.25/0.25	0.2-1.0	.004	2	0.7	250
BPT3	✓	✓	✓	0.5/0.5/0.5	0.2-1.5	.002	3	1.0	250
BPT4	✓	✓	✓	0.5/0.5	0.2-1.5	.002	2	1.0	250
BPT5	✓	✓	✓	0.5/0.5/0.5	0.5-2.0	.002	3	1.0	500
BPT6	✓	✓	✓	0.5/0.5	0.5-2.0	.002	2	1.0	500
BPT7	✓	✓	✓	0.7/0.7/0.7	0.5-1.5	.002	3	1.5	200
BPT8	✓	✓	✓	0.7/0.7	0.5-1.5	.002	2	1.5	200
BPT9	✓	✓	✓	1.0/1.0/1.0	0.7-3.5	.002	3	2.0	200
BPT10	✓	✓	✓	1.0/1.0	0.7-3.5	.002	2	2.0	200
BPT11	✓	✓	✓	1.0/1.0/1.0	1.0-5.0	.002	3	2.0	500
BPT12	✓	✓	✓	0.15/0.15/0.3/0.3	0.2-1.0	.004	4	0.7	200

AUDIO TRANSFORMERS

Circuit No.	Application	Impedance		DC Current	Max. Level	DBM	
		Prim. Ohms	Sec. Ohms				
MGA1	Single or P.P. Plates to Single or P.P. Grids	10K	50K Split	✓	10	15	
MGA2	Line to Voice Coil	600 Split	4, 8, 16	✓	0	33	
MGA3	Line to Single or P.P. Grids	600 Split	135K	✓	0	15	
MGA4	Line to Line	600 Split	600 Split	✓	0	15	
MGA5	Single Plate to Line	5.6K 4.8T	600 Split	✓	40	33	
MGA6	Single Plate to Voice Coil	7.8K 4.8T	4, 8, 16	✓	40	33	
MGA7	Single or P.P. Plates to Line	15K	50K Split	✓	10	15	
MGA8	P.P. Plates to Line	24K	500 Split	✓	10	30	
MGA9	P.P. Plates to Line	60K	600 Split	✓	10	1	27

TELEMETERING COMPONENTS

BAND PASS FILTERS				DISCRIMINATORS			
Cat. No.	Cat. No.	3DB Bandwidth per cent of F ₀	Center Frequency F ₀ (KC)	Cat. No.	Per cent Deviation of F ₀	Per cent Linearity	Cat. No.
POP-10	POP-34	✓	4	DST-10	✓	✓	DST-10
POP-11	POP-35	✓	7.6	DST-11	✓	✓	DST-11
POP-12	POP-36	✓	30	DST-12	✓	✓	DST-12
POP-13	POP-37	✓	96	DST-13	✓	✓	DST-13
POP-14	POP-38	✓	1.3	DST-14	✓	✓	DST-14
POP-15	POP-39	✓	1.7	DST-15	✓	✓	DST-15
POP-16	POP-40	✓	2.3	DST-16	✓	✓	DST-16
POP-17	POP-41	✓	3.0	DST-17	✓	✓	DST-17
POP-18	POP-42	✓	3.9	DST-18	✓	✓	DST-18
POP-19	POP-43	✓	4.4	DST-19	✓	✓	DST-19
POP-20	POP-44	✓	7.3	DST-20	✓	✓	DST-20
POP-21	POP-45	✓	10.5	DST-21	✓	✓	DST-21
POP-22	POP-46	✓	12.3	DST-22	✓	✓	DST-22
POP-23	POP-47	✓	14.5	DST-23	✓	✓	DST-23
POP-24	POP-48	✓	22.0	DST-24	✓	✓	DST-24
POP-25	POP-49	✓	27.0	DST-25	✓	✓	DST-25
POP-26	POP-50	✓	30.0	DST-26	✓	✓	DST-26
POP-27	POP-51	✓	30.0	DST-30	✓	✓	DST-30
POP-28	POP-52	✓	40.0	DST-28	✓	✓	DST-28
POP-29	POP-53	✓	40.0	DST-31	✓	✓	DST-31
POP-30	POP-54	✓	52.5	DST-27	✓	✓	DST-27
POP-31	POP-55	✓	52.5	DST-32	✓	✓	DST-32
POP-32	POP-56	✓	70.0	DST-29	✓	✓	DST-29
POP-33	POP-57	✓	70.0	DST-33	✓	✓	DST-33

DISCRIMINATOR LOW PASS FILTERS

Cat. No.	Center Frequency F ₀ (cps)	Cat. No.	Center Frequency F ₀ (cps)	Cat. No.	Center Frequency F ₀ (cps)	Attenuation
LPO-10	4	LPO-19	81	LPO-28	790	
LPO-11	8	LPO-20	110	LPO-29	900	
LPO-12	11	LPO-21	160	LPO-30	1,050	
LPO-13	14	LPO-22	185	LPO-31	1,200	
LPO-14	20	LPO-23	220	LPO-32	1,400	
LPO-15	25	LPO-24	230	LPO-33	2,100	
LPO-16	33	LPO-25	450	LPO-34	2,200	
LPO-17	45	LPO-26	400	LPO-35	10,000	
LPO-18	60	LPO-27	640			

OUTPUT

Cat. No.	Output	Cat. No.	Output	Cat. No.	Output
LPO-10	4	LPO-19	81	LPO-28	790
LPO-11	8	LPO-20	110	LPO-29	900
LPO-12	11	LPO-21	160	LPO-30	1,050
LPO-13	14	LPO-22	185	LPO-31	1,200
LPO-14	20	LPO-23	220	LPO-32	1,400
LPO-15	25	LPO-24	230	LPO-33	2,100
LPO-16	33	LPO-25	450	LPO-34	2,200
LPO-17	45	LPO-26	400	LPO-35	10,000
LPO-18	60	LPO-27	640		

INPUT

Cat. No.	Input	Cat. No.	Input	Cat. No.	Input
LPI-10	400	LPI-17	3,000	LPI-23	14,500
LPI-11	560	LPI-18	3,900	LPI-24	22,000
LPI-12	730	LPI-19	5,400	LPI-25	30,000
LPI-13	960	LPI-20	7,350	LPI-26	40,000
LPI-14	1,300	LPI-21	10,500	LPI-27	52,500
LPI-15	1,700	LPI-22	12,300	LPI-28	70,000
LPI-16	2,300				

MINIATURE COMPONENTS

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

MINIATURE AUDIO TRANSFORMERS

Catalog No.	Input Coupling	Power Level	Balanced DC Current	Unbalanced DC Current	Impedance Ohms	
					pri.	sec.
PMA-1	✓	+8	0	0	50/200/500	60,000 center tapped
PMA-2	✓	+8	0	0	4/8	
PMA-3	✓	+8	0	0	50/200/500	
PMA-4	✓	+11	0	0	15,000	
PMA-5	✓	+8	2	2	15,000	
PMA-6	✓	+8	0	0	15,000	
PMA-7	✓	+8	2	2	15,000	
PMA-8	✓	+8	2	.25	30,000 ct	
PMA-9	✓	+8	0	0	60,000	
PMA-10	✓	+8	0	0	50/200	

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

TRANSISTOR TRANSFORMERS

Catalog No.	200 to 15,000	300 to 15,000	Unbalanced DC Current	Max. Power Out	Impedance Ohms	
					pri.	sec.
TMA-1	±1		0	.25	500	500
TMA-2	±2	3	.25	50K	50K	500
TMA-3	±2	3	.25	50K	6	6
TMA-4	±3	1	.25	100K	1.2K ct.	1.2K ct.
TMA-5	±2	3	.25	25K	1.2K ct.	1.2K ct.
TMA-6	±2	3	.25	50K	1.2K ct.	1.2K ct.
TMA-7	±1	4	.25	600/150	1.2K ct.	1.2K ct.
TMA-8	±2	3	.25	25K	600	600
TMA-9	±1	1	.25	4K ct.	600/150	600/150
TMA-10	±2	10	.25	2K	3.2	3.2
TMA-11	±1	1	.25	4K ct.	3.2	3.2
TMA-12	±2	4	.25	20K	50	50
TMA-13	±2	8	.25	1K	50	50
TMA-14	±2	0	.10	100K	1K	1K
TMA-15	±2	1	.04	20K	50	50
TMA-16	±2	1	.04	20K	600	600
TMA-17	±2	3	.06	1K	50	50
TMA-18	±2	0	.10	100K	1K	1K
TMA-19	±2	20	1.	1K	3.2	3.2

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

MINIATURE HIGH Q TOROIDS

Cat. No.	Ind. MHY	Cat. No.	Ind. MHY	Cat. No.	Ind. MHY	Cat. No.	Ind. MHY
F2050	1	F2100	0.1	F2140	0.1	F2180	0.1
F2051	3	F2101	0.2	F2141	0.2	F2181	0.2
F2052	5	F2102	0.3	F2142	0.3	F2182	0.3
F2053	10	F2103	0.4	F2143	0.4	F2183	0.4
F2054	15	F2104	0.5	F2144	0.5	F2184	0.5
F2055	30	F2105	1.0	F2145	1.0	F2185	0.6
F2056	50	F2106	2.0	F2146	2.0	F2186	0.7
F2057	75	F2107	3.0	F2147	3.0	F2187	0.8
F2058	100	F2108	4.0	F2148	4.0	F2188	0.9
F2059	150	F2109	5.0	F2149	5.0	F2189	1.
F2060	200	F2110	7.5	F2150	7.5	F2190	2.
F2061	300	F2111	10	F2151	10	F2191	3.
F2062	400	F2112	15	F2152	15	F2192	4.
F2063	500	F2113	20	F2153	20	F2193	5.
F2064	750	F2114	30	F2154	30		

ELECTRONIC DESIGN

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CIRCLE 3 ON READER-SERVICE CARD FOR MORE INFORMATION

Editorial

Is Your Environment a Vacuum?

An alternate title for this editorial might be: "Insulating Yourself from Information." The point we want to make is: engineers try too much to hide their ignorance and as a consequence do not become better engineers.

Often an engineer seems to work in a vacuum. He needs information. But does he openly profess, "I don't know what will work here. I'll have to ask around?" No. If he can get the information very discreetly he then becomes a knower and boasts of his solution, his cleverness. But too frequently he will not expose himself as not knowing even if it means he could learn more by doing so. To prove this point, let me mention an ELECTRONIC DESIGN project that failed. We frequently get letters asking for engineering information. Since we don't have an adequate staff set up to handle such inquiries, we reasoned that if such requests were published, our readers who knew the answers would be glad to communicate directly with persons seeking information. In fact, this was so. Engineers who asked for information usually got it. Nevertheless, the plan failed. It failed simply because engineers did not want to sign their names to a letter to the engineering public saying they didn't know the answer to a problem.

It might be argued that it was not the engineers' reluctance to ask, but a company policy not to indiscriminately indicate what areas it was working in. The wisdom or folly of this reasoning is the subject of another editorial, but there is something definite to be said for professing your ignorance, proclaiming what you are working on, and asking for information. Usually everyone benefits.

The Eraser Co., for example, broadcast via their newsletter, recently, what they were working on: a coaxial cable stripper, a rotary blade-type stripper which would strip certain types of plastic insulated stranded wire (without nicking a single strand), brushes for mechanically cleaning printed circuits, etc. The Eraser Co. then asks their readers for information on stripping problems. The company claims only after they get full information from potential users can they come up with a successful development.

You may have an idea for a better mousetrap, and when you perfect it the world will beat a path to your doorstep. The chances are, though, that if you haven't talked with other mousetrap builders, yours won't get perfected. In the meantime, the person who says, "I'm working on a problem. What's your experience been?" gathers knowledge which can lead to products. The advice to ask what may be a foolish question to minimize misapprehension should be heeded.—JAL

Engineering Review

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

FM Transmitter is Swallowed

A "radio pill" that sends out fm signals to medical researchers as it passes through the human body was demonstrated recently at the Rockefeller Institute. Designed for research in the intestinal tract, the new pill is a plastic capsule 1-1/8 in. long and 4/10 in. in diam. It is stated to be the world's smallest fm radio broadcast station.

The pill consists of a tiny transistor, an oscillator, a ferrite cup inductance core and other circuit ele-

ments, and a minute, replaceable storage battery which powers the oscillator and has a life of 15 hr. This battery is similar to the one used in the proximity fuse for anti-aircraft shells during World War II. Heart of the capsule is the oscillator which is so sensitive that its frequency varies with changes in the pressure to which the pill is exposed. Information about these pressure changes is transmitted continuously in the form of fm radio signals that carry for a distance of several feet. These signals can be picked up on an outside fm radio receiver when an antenna is held close to the body.

When the pill is swallowed by the patient, its course through the gastrointestinal tract can be traced by fluoroscopy or other means. Since it has magnetic properties, it can be manipulated by magnetic forces outside the body. The capsule can be recovered and re-used in later experiments.

The radio pill has been developed and tested jointly by the Rockefeller Institute, the New York Veterans Administration Hospital and the Radio Corp. of America. It is hoped that the pill will prove valuable in studying human digestion and absorption in normal and pathological states. The new information which may be obtained on the physiology of muscular contractions is expected to be important in understanding gastrointestinal disorders. Particularly important would be the knowledge gained about the muscular activity of the right side of the colon, heretofore almost inaccessible to study. This knowledge may prove useful in understanding the pathological physiology of such ailments as spastic colitis, ulcerative colitis and other organic and functional disease states.

Besides measuring pressure changes in the digestive organs of the body, the radio pill is now being modified so that it may generate and transmit impulses relating to temperature within the gastrointestinal tract.



FM signals broadcast from a previously swallowed pill are received by an antenna held close to the body. Changes of pressure on the pill alter the frequency of an oscillator within the pill. By studying these changes, it is hoped that much can be learned of both the normal and pathological functioning of the gastrointestinal system without disturbing it unnecessarily.



Data Reduction Center: Taped information from telemetered missile test flights, from rocket sled runs, and from other test activities connected with missile programs is brought to this highly organized data reduction center. The center was recently completed in Los Angeles by the Electronic Instrumentation Div. of Ramo-Wooldridge Corp. Besides data reduction, the equipment includes an analysis section which makes possible the study of complex waveforms. A high-speed tape reading mechanism, called the Magnescanner, permits automatic auto-correlation and cross-correlation analyses of taped functions. The tape is scanned in sections by holding the tape stationary on a drum while the playback heads rotate about it. Flexibility of the wide selection of equipment is achieved by routing all circuits through a central patchboard control panel. Temperature and humidity within the entire system are controlled by a separate ventilation unit which includes 22 tons of refrigeration equipment.



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Engineering Review

Crevasse Detector

Army Engineers have developed a device that locates snow-covered crevasses, Arctic "canyons" which men, equipment and supplies can fall into through the deceptive layer of snow covering them. Developed by the Engineer Research and Development Laboratories, Fort Belvoir, Va., and the Southwest Research Institute of San Antonio, Tex., the unit creates a low frequency electromagnetic field which is distorted by a crevasse.

Basically, the device consists of four "electrodes" placed at approximately 20-foot intervals. Its work-horse is an over-snow vehicle called a Weasel that carries the electronic equipment, and which moves three electrodes in the form of disk-shaped sleds about four square feet in size and also acts as an electrode itself.

The search-head is pushed ahead of the Weasel, and other sleds are towed behind. The rearmost sleds combine to create the electromagnetic field. Power is provided by a generator carried on the sled initially behind the vehicle. For practical application, multiple electrodes are provided to produce alternate configurations for optimum detection over varying snow conditions and crevasses. Provisions are also made to power the electrodes from the vehicle.

In operation, the driver keeps a watchful eye on a special recorder as the Weasel moves over the ice. As long as the meter stays steady, it means the terrain is uniform. When the search-head reaches a crevasse, the dielectric difference in the air in the crevasse and the surrounding area causes a noticeable change in the recording. The alarm is distinct when the Weasel is about ten feet from the danger point. Since the vehicle travels only about three-to-five miles an hour, this is sufficient warning.

Eventually, the engineers hope to have a detector that will stop the Weasel automatically as soon as the search-head finds a crevasse, and which will provide data on the depth, width, and bridge thickness of the crevasse.

Stereoscopic Television

A stereoscopic television camera unit which has been designed specifically for use in nuclear research is shortly to be supplied by Marconi's Wireless Telegraph Company Ltd. to the Atomic Energy Authority's research station at Hartwell, England.

The equipment will be used with special remote manipulating equipment for the handling at a distance of dangerous radio-active materials. Special equipments are at present under development, some of which will be capable of remote manipulation up to distances of half a mile, or more if desired.

It is obvious that some form of visual aid is necessary for operations of this kind. Ordinary closed-circuit television has already been tried, but has proved to have limitations, insofar as the absence of perspective in the screened image makes it difficult for the operator to judge the distance of the manipulator's "hands" from the objects to be handled. With the stereoscopic television now developed by Marconi's, perspective has been restored and the operator sees what appears to be a solid image.

The stereoscopic camera channel consists of two industrial Vidicon cameras, two control units and two display monitors. The cameras are mounted side by side, with their lines of sight inclined so that they intercept at the point of interest. The left-hand camera of the pair (corresponding to the left eye) is connected to one of the monitors, which thus gives a left-eye view of the scene; similarly, the right-hand camera and monitor give a right-eye view.

The two monitors are positioned in the display cabinet in such a way that the pictures are superimposed by means of a semi-silvered mirror. A vertically polarized polaroid filter covers the face of one screen, while the other is covered by a second polaroid filter which is horizontally polarized. If the composite image is viewed through suitably polarized spectacles a stereoscopic effect is obtained.



Germanium Crystals:

This pure germanium bar after processing is converted into the small pile of crystals shown on circular paper—80,000 of them. Each will form the heart of a germanium diode.

NOW...A MORE COMPACT 28 VOLT, 100 AMPERE

tubeless magnetic amplifier regulated
DC POWER SUPPLY

by **PERKIN!**

24 to 32 Volts Adjustable Range...
IMMEDIATE DELIVERY!

This power supply represents the latest design thinking of the nation's top specialists in the field. Hundreds of these units are now in operation, replacing generators and batteries in electronic laboratories, industrial plants, and military ground radar systems, etc., where utmost reliability and performance are essential. Over 15,000 Perkin power supply units are in operation in industry today.

No tubes, moving
parts or vibrating
contacts.

Regulation
 $\pm 1/2\%$

**IMMEDIATE
DELIVERY!**

DIMENSIONS:
26 1/2" L x 17" D
x 17" H.

Additional
Specifications:

Ripple: 1% RMS

AC Input: 208, 230 or 460V $\pm 10\%$, 3 phase, 60 cycles

Weight: 230 lbs.

MODEL NO. MR917-100XA—also available: specifications same as above except output of 9—17 volts DC.

When you require a power supply, SPECIFY PERKIN,
for a wider range of standard models and immediate delivery from stock.

Wire factory collect for prices. For a prompt reply on your
application, write factory on your letterhead or contact
local representatives listed below.

PERKIN

PERKIN ENGINEERING CORPORATION

345 KANSAS STREET, EL SEGUNDO, CALIFORNIA • OREGON 8-7215

Leader in Tubeless Magnetic Amplifier Regulation

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VA 1-5330 • Miami: MO 5-1563 • Minneapolis: MI 4-7884 • Seattle: MO 4895 • St. Louis: PA 5-7701
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CIRCLE 5 ON READER-SERVICE CARD FOR MORE INFORMATION

OTHER PERKIN STANDARD DC POWER SUPPLIES 28 Volt Models

Model	Volts	Amps	Reg.	AC Input (60 cps)	Ripple rms
28-5VFM	0-32 V	5	15-20% (24-32V range)	115 V 1 phase	2%
28-10WX	24-32 V	10	$\pm 1/2\%$	100-125 V 1 phase	1%
MR532-15A	2-36V	15	$\pm 1/2\%$	105-125V 1 phase	1%
28-15VFM	0-32 V	15	15-20% (24-32V range)	115 V 1 phase	5%
M60V	0-32V	25	$\pm 1\%$	115V 1 phase	1%
MR1040-30A	5-40V	30	$\pm 1\%$	100-130V 1 phase	1%
28-30WXM	24-32V	30	$\pm 1/2\%$	100-125V 1 phase	1%
28-50WX	24-32 V $\pm 10\%$	50	$\pm 1/2\%$	230 V* 3 phase	1%
MR2432-100XA	24-32V	100	$\pm 1/2\%$	208/230V* 3 phase	1%
MR2432-200	24-32 V	200	$\pm 1/2\%$	208/230V* 3 phase	1%
MR2432-300	24-32 V	300	$\pm 1/2\%$	208/230V* 3 phase	1%
MR2432-500	24-32 V	500	$\pm 1/2\%$	208/230V* 3 phase	1%

* $\pm 10\%$. Also available in 460 V $\pm 10\%$ AC input. Will be supplied with 230 V input unless otherwise specified.

6, 12, 115 Volt Models

Model	Volts	Amps	Reg.	AC Input (60 cps)	Ripple rms
6-5WX	6 $\pm 10\%$	5	$\pm 1\%$	95-130 V 1 phase	1%
6-15WX	6 $\pm 10\%$	15	$\pm 1\%$	95-130 V 1 phase	1%
6-40WX	6 $\pm 10\%$	40	$\pm 1\%$	95-130 V 1 phase	1%
12-15WX	12 $\pm 10\%$	15	$\pm 1\%$	95-130 V 1 phase	1%
115-5WX	115 $\pm 10\%$	5	$\pm 1/2\%$	95-130 V 1 phase	1%
MR15125-S	15-125	5	$\pm 1\%$ †	95-130 V 1 phase	1% ††
6125-25**	115-125	25	$\pm 1 1/2-4\%$	230/460 V 3 phase	5%

**Germanium Rectifier Unit ††Increases to 4% @ 15V.
†Increases to 2% @ 15V.



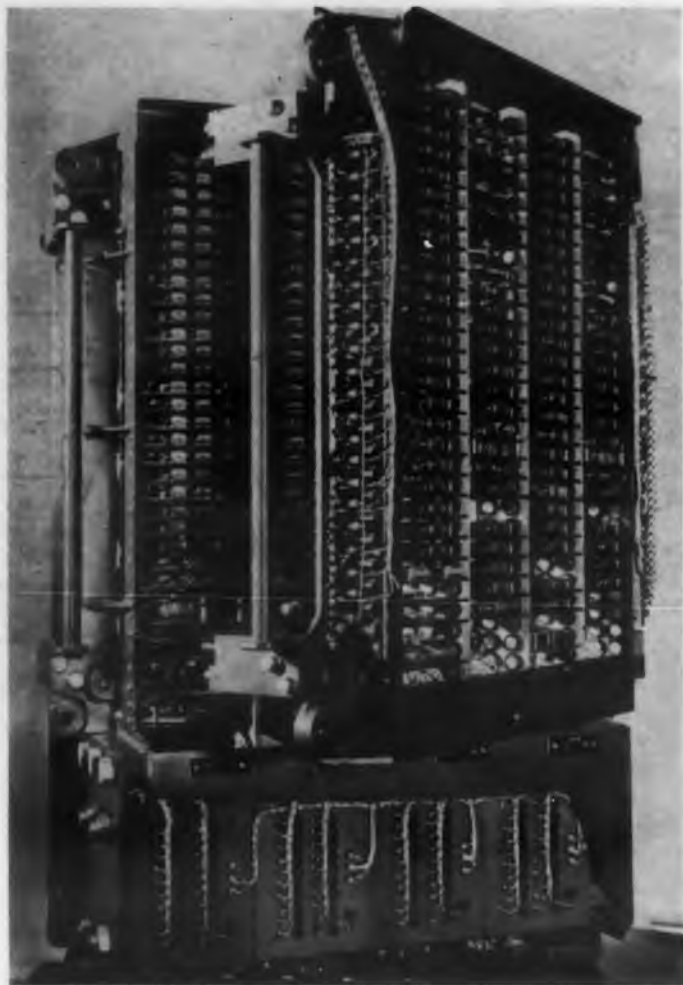
Engineering Review

Electronic Phone Exchange

A fully electronic automatic telephone switchboard has been developed for the French Navy by the Laboratoire Central de Telecommunications, a research associate of IT&T. The 20-line exchange has automatic interconnection among 20 subscribers; and the tones and ringing equipment are carried out by static electronic components. All mechanical movements and metallic contacts are eliminated.

The connections are made through silicon diodes in preference to germanium transistors, for long-term reliability shock resistance. The other basic component of the exchange is a magnetic tripper comprising a saturable self-inductance coil placed in series with a capacitance to form a ferro-resonant circuit. The speech currents pass through gates formed by the diodes and controlled by the trippers. Four truck units and two registers allow four simultaneous calls and two simultaneous dialings.

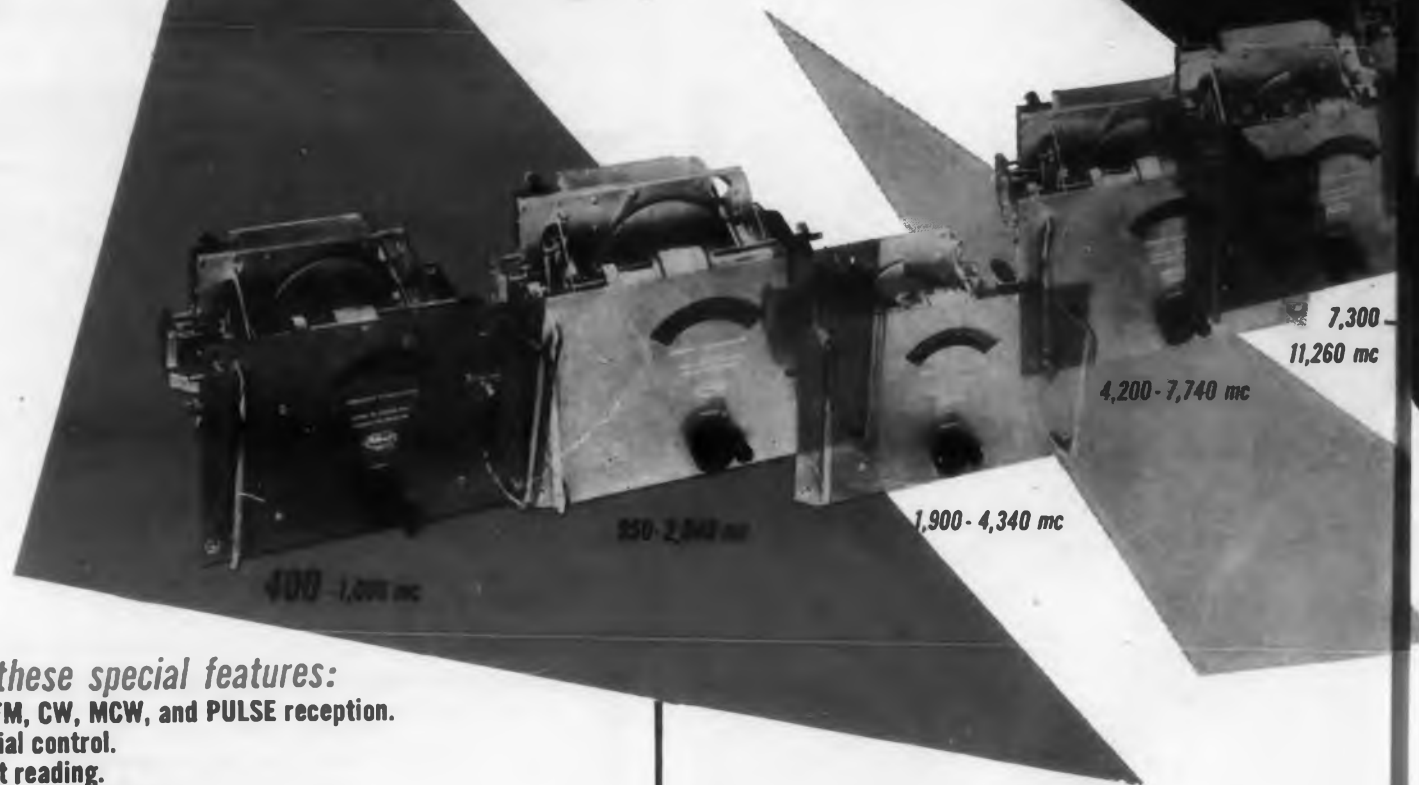
The magnetic trippers are supplied with an a-c voltage of about 10 v at 8 kc, which produces two operating states. One current is 15 times the other. After rectification, these currents polarize the diodes in blocking or passing position.



Twenty-line fully electronic telephone exchange. As no mechanical or electrical adjustments are required, the equipment is designed as a compact unit comprising three hinged panels.



Model R



Note these special features:

- AM, FM, CW, MCW, and PULSE reception.
- Uni-dial control.
- Direct reading.
- Broadband coverage.
- Output level reading directly in db.
- High sensitivity.
- Seven interchangeable plug-in r-f tuning units cover the entire frequency range.
- Low noise figure; excellent gain stability.
- Microwave preselection, tracked and double-tuned, used in the plug-in tuning units covering the range 400 to 11,260 mc.
- Audio, video, and trigger outputs.
- Special recorder output.
- High video output—low impedance.
- AGC and AFC circuits.

For these applications:

- General communications.
- Field intensity meter.
- Frequency meter.
- Measurement of radiation and leakage of microwave devices.
- Measurement of bandwidth of microwave cavities.
- Measurement of relative power of fundamental and harmonic signal frequencies.
- Measurement of noise figure.
- Antenna field patterns.

CIRCLE 6 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • May 1, 1955

EXTENDED RANGE MICROWAVE RECEIVER! 400 to 22,000 mc

Three new r-f tuning units double the frequency range of the well-known Polarad Microwave Receiver. Now more than ever the Model R becomes a basic multi-purpose instrument for microwave research and production in the field, in the laboratory, and in the factory.

This receiver is designed for quantitative analysis of microwave signals and is ideal for the reception and monitoring of all types of radio and radar communications within the broadband 400 to 22,000 mc. It permits comparative power and frequency measurements, by means of its panel-mounted meter, of virtually every type of signal encountered in microwave work.

It is compact and functional, featuring 7 integrally designed plug-in, interchangeable RF microwave tuning units to cover 400 to 22,000 mc; non-contacting chokes in pre-selector and microwave oscillator to assure long life and reliability; and large scale indicating meter for fine tuning control.

Call any Polarad representative or direct to the factory for detailed specifications.

SPECIFICATIONS:

Basic Receiver: Model R-B Tuning Unit Frequency Ranges:

*Model RR-T	400- 1,000 mc
*Model RL-T	950- 2,040 mc
*Model RS-T	1,900- 4,340 mc
*Model RM-T	4,200- 7,740 mc
*Model RX-T	7,300-11,260 mc
*Model RKS-T	9,500-15,600 mc
*Model RKU-T	14,700-22,000 mc

Signal Capabilities: AM, FM, CW, MCW, pulse

Sensitivity:

- (a) For Model RR-T: Minus 85 dbm
(b) For Models RL-T, RS-T, RM-T, and RX-T: Minus 80 dbm
(c) For Models RKS-T and RKU-T: Minus 65 dbm

Frequency Accuracy: $\pm 1\%$

IF Bandwidth: 3 mc
Video Bandwidth: 2 mc

Image Rejection:

- (a) For Models RR-T thru RX-T:
Greater than 60 db

- (b) For Models RKS-T and RKU-T:
Spurious response rejection
obtained through the use of a
bandpass filter

Gain Stability with AFC: ± 2 db

Automatic Frequency Control:
Pull-out range 10 mc off center

Recorder Output: 1 ma. full scale (1,500 ohms)

Trigger Output:
Positive 10-volt pulse across 100 ohms

Audio Output:
5 volts undistorted, across 500 ohms

FM Discriminator:
Deviation Sensitivity: .7 v./mc

Skirt Selectivity:
60 db — 6 db bandwidth
ratio less than 5:1

IF Rejection: 60 db

Input AC Power:
115, 230 V ac, 60 cps, 440 watts

Input Impedance:
Models RR-T through RX-T: 50 ohms
Models RKS-T & RKU-T: waveguide

VSWR: Less than 4:1 over the band

Range of Linearity: 60 db

Receiver Type: Superheterodyne

Maximum Acceptable Input
Signal Amplitude: 0.1 volt rms, without
external attenuation

Video Response: 30 cps to 2 mc

Size: 17" w x 23" d x 19" h

Weight: 180 lbs. for basic unit with
one tuning unit.

For private demonstration
without obligation
ask for the



to stop
at your plant

maintenance
available by field
service specialists

The amount of power supplied at 8 kc is 10 w, presently supplied by a vacuum tube oscillator which will be replaced by a two-transistor oscillator operating from a 24 v battery. This would make the unit completely self-contained.

At a later stage subscriber stations will be designed to meet the advantages of the electronic exchange. This would mean replacing the present dial with a push-button call sender, and replacing the ringer with an electro-acoustic transducer supplied from a transistor amplifier contained in the subscriber station.

Resources Dwindling

The search for new sources of energy may become more a necessity than a pastime within the next few decades, according to an address by Dr. J. A. Hutcheson of Westinghouse Electric Corp.

The burden on our present sources has been particularly increased by the ever-growing need for electrical power. Television sets, for instance, would use up one-tenth of the nation's generating capacity if they were all turned on together, which might happen during an appearance of the President. If all the homes which owned television sets also had air conditioning units, then their simultaneous operation would equal the generating capacity.

Dr. Hutcheson approximates the amount of energy used yearly by each individual in this country to be equivalent to eight tons of coal. If this situation were present everywhere in the world, then a pessimistic prediction would be that we would virtually run out of our present resources of energy by the end of the century.



Weapons Display: Among the exhibits at the two-week show at the Grand Concourse of the Pentagon are these pie-shaped displays of National Defense products. Each of the seven displays depicts the operation and mission of a different product produced by Martin Co., Baltimore, Md. for the Armed Forces. Gardner, the largest display house in the world, prepared the exhibit to include segments on the Department of Defense Project Vanguard, the U. S. Navy P6M Sea-Master and P5M Marlin, the U. S. Air Force B-57 and TM-61 Matador and the U. S. Army Lacrosse and Missile Master.

POLARAD

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REPRESENTATIVES: Albany, Albuquerque, Atlanta, Baltimore, Boston, Chicago, Cleveland, Dayton, Denver, Englewood, Fort Worth, Kansas City, Los Angeles, New York, Philadelphia, Portland, Rochester, St. Louis, San Francisco, Schenectady, Stamford, Syracuse, Washington, D. C., Winston-Salem, Canada: Arnprior, Ontario.
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CIRCLE 6 ON READER-SERVICE CARD FOR MORE INFORMATION



George L. Larse (right), Group Engineer, Instrumentation and Development, discusses development of high performance FM sub-carrier oscillators for application in advanced telemetry systems with Electronic Research Engineers Hans Becker (left) and Jay Cox.

ELECTRONIC SYSTEMS FOR GUIDED MISSILES

Continuing advances in guided missiles require electronic systems possessing ever faster, more accurate perceptions and reactions. Problems faced by missiles engineers and scientists grow constantly in magnitude and complexity.

At Lockheed Missile Systems Division, Electronic Systems and Components Engineers receive the broadest possible responsibility in fulfilling their assignments. New activities have created positions in a wide range of areas, including:

- Command guidance involving development and application of radio frequency communication, pulse circuitry and control devices.
- Data transmission and telemetry involving development and application of antennas, transducers, VHF transmitters and receivers.

- Automatic data processing equipment requiring analog-to-digital conversion, and electronic and magnetic storage devices.

Positions are open at Lockheed's Sunnyvale Engineering Center and Palo Alto Research Center. Those possessing a high order of ability in both systems and component development are invited to write.

Lockheed

MISSILE SYSTEMS DIVISION
 LOCKHEED AIRCRAFT CORPORATION
 PALO ALTO • SUNNYVALE • VAN NUYS
 CALIFORNIA

Engineering Review

Battle Against Paper Work

RCA's \$4 million Bizmac system is now at work at the Army Ordnance Tank-Automotive Command headquarters in Detroit. Savings of many millions of dollars are expected from Bizmac, the world's largest electronic data processing system, in up-to-the-minute inventory keeping. Sharp inventory reduction and more efficient records processing are anticipated.

The installation, covering 20,000 sq. ft of floor space and including 22 units of equipment handles data daily on 170,000 separate tank and automotive spare parts from 10 ordnance depots throughout the country.

At electronic speed it takes inventory, catalogs spare parts, prepares catalog manuscripts, forecasts supplies requirements, produces budget summaries and ensures that the right supplies are at the right place at the right time.

Gallons and Gallons

Since it started production in 1949, Tungsten and Chemical Division, Sylvania at Towanda, Pa., has produced and shipped 5 million gallons of high-purity potassium-silicate enough for the manufacture of over 50 million TV picture tubes. It is used on black and white screens to bond the phosphors to the tube face.

Electronic Breathing for Polio Victims

Polio patients confined to iron lungs will benefit from a new system which allows them control of their respiration. Even in the most severe cases of paralysis, the victim is left with control over a few muscles which contract when he tries to breathe. This contraction generates a minute voltage which can be detected by sensitive electrodes placed on the skin. By amplifying the voltage, a signal is generated which can regulate the supply of air to the patient's need.

Although the equipment is still an experimental stage, the National Foundation for Infantile Paralysis plans to make it available to polio centers as soon as it is possible.

◀ CIRCLE 571 ON READER-SERVICE CARD

CIRCLE 9 ON READER-SERVICE CARD

CIRCLE

Engineering Review

Mountains Aid Uhf Transmission

A phenomenon noticed by American scientists in the mountainous terrain of the area was recently re-investigated by a group of radio engineers. Known as "obstacle gain," the effect is that of an accountably improved radio reception when a mountain obstructs the path of transmission.

A series of tests conducted at different locations in California verified that sharp mountain peaks blocking the transmission path actually strengthen the signal by as much as 100 million times. These tests utilized a wide range of frequencies above 50 mcs. The theory was advanced that these waves act much like light waves, and are bent down toward the ground when they pass over sharp mountain peaks, just as light waves are diffracted when passing by the edge of an opaque object.

Practical of Computer Advantages

Present day electronic equipment for data processing is not suited to the needs of all but a few giant retail organizations and many of these are impractical of the vaunted advantages, according to Milton Woll, Research Director of the Retail Research Institute of National Retail Dry Goods Association.

On the basis of a study of data processing equipment of members of the NRDGA, Mr. Woll pointed out that most retailers were still using mechanical tabulating equipment let alone electronic. Although there is a great interest among retailers in all parts of the country in the development of automatic data processing equipment, most store managers feel that the cost of the equipment available is much too high to justify its installation.

Mr. Woll was critical also of the haphazard approach to electronic applications and indicated his preference for a gradual and experimental type of approach. He expressed conviction that the step-by-step licking of one problem after another is the only way to make progress in adjusting to the tremendous procedural rigidity of data processing.

CARD NO. 9 ON READER-SERVICE CARD

CIRCLE 10 ON READER-SERVICE CARD

New!....

FROM TRANSISTOR CENTER U.S.A.

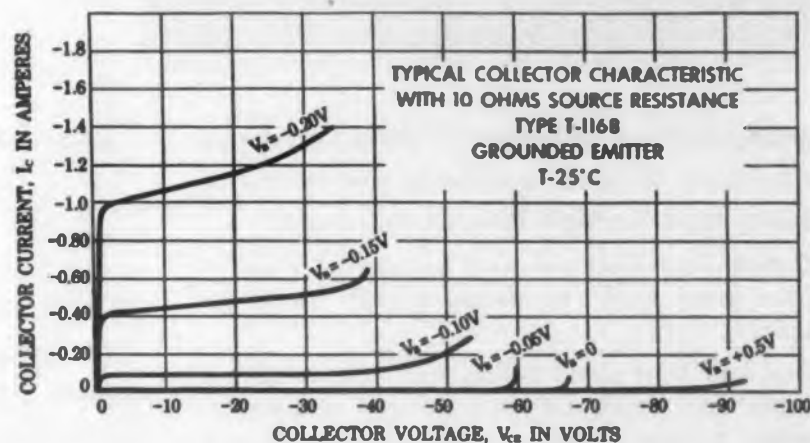
PHILCO 60V and 80V Power Transistors

Designed for servo, control, power converter and power supply applications.

Here are extremely reliable, moderately priced, high voltage power transistors—immediately available in production quantities. These transistors perform with a typical thermal drop of only $1\frac{1}{2}^{\circ}\text{C}$ per watt . . . with storage temperature of 100°C . They have high beta at high currents . . . improved alpha cut-off . . . low surface leakage currents . . . low saturation resistance . . . low distortion. Both transistors operate at power load of 12.5 watts. The unique *knee-action* between the aluminum mounting clamp and the copper mount assures maximum dissipator contact at all times.



Philco cold-welding process permits hermetic sealing in controlled atmosphere . . . assuring exceptional transistor life and performance!



Philco transistors, after vacuum baking, emerge into a controlled atmosphere . . . where they are welded to insure perfect sealing for life. This process eliminates contamination of the transistor elements by moisture or atmosphere. Uniformity and quality control are strictly maintained throughout.

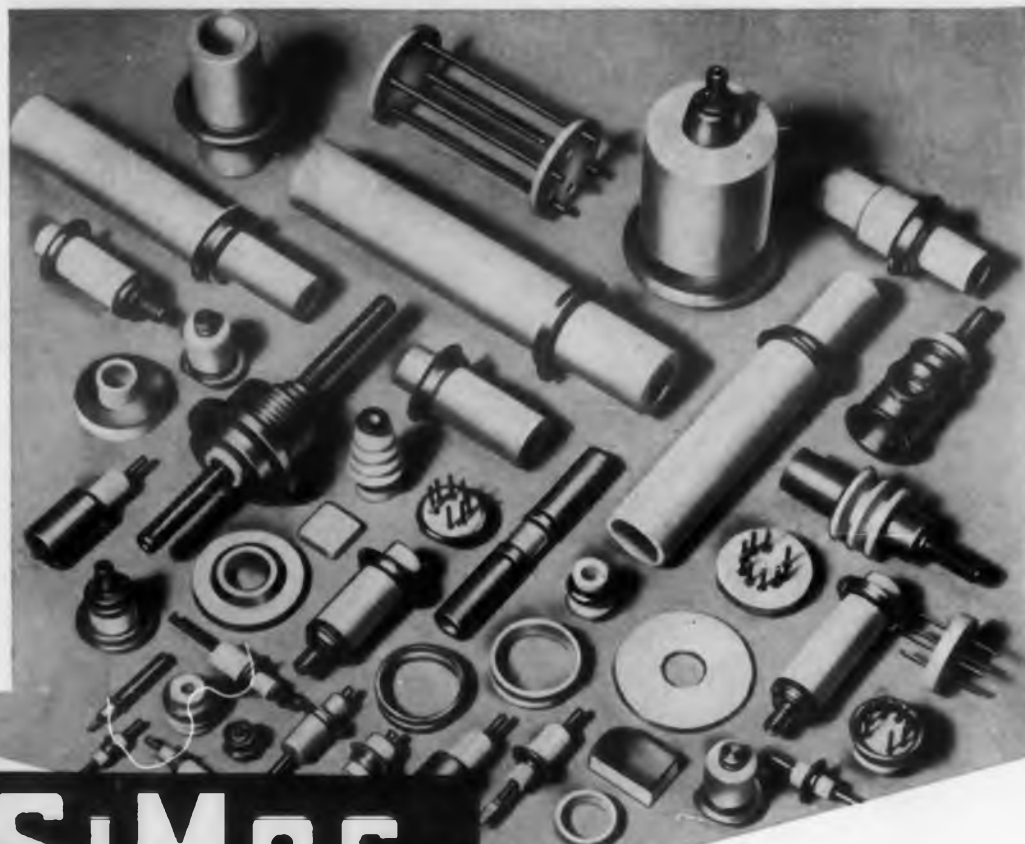
Write for complete data and prices. Make Philco your prime source of information for power transistor applications!

PHILCO CORPORATION

LANSDALE TUBE COMPANY DIVISION

LANSDALE, PENNSYLVANIA

dependable



ALSiMAG

Rugged, low-loss ALSiMag Alumina ceramics permanently bonded to appropriate metals to produce superior high temperature seals.

Outstanding electrical and mechanical characteristics over wider temperature and frequency ranges.

Excellent heat shock resistance. High softening temperatures. Vacuum tight. Improved glaze with superior surface resistivity. Greater impact and tensile strengths. Resistant to chipping and spalling. Precision tolerances.

Complete facilities for volume production. Uniform . . . piece to piece. Standard or custom designs. To assure optimum performance of the latter, our engineers cooperate in establishing proper specifications and configurations. Low temperature metal-ceramic combinations available.

For complete information on ALSiMag Metal-Ceramic Seals for either low or high temperature applications, send blueprint with planned installation and operating temperatures, electrical requirements or other relevant data.

A Subsidiary of
Minnesota Mining and
Manufacturing Company

Engineering Review

Mathematical Handbook

The National Bureau of Standards has begun preparation of a comprehensive "Handbook of Mathematical Tables." In addition to the elementary functions, the Handbook will cover almost the entire field of transcendental functions. Expected to be ready before the end of 1958, it will appear as a volume of about 1000 pages—750 pages of tables, 50 pages of graphs and 200 pages of text.

Numerical tables of mathematical functions are in continual demand by scientists and engineers, as shown by the success of such works as Jahnke and Emde's "Tables of Functions with Formulae and Graphs." A great variety of functions and higher accuracy of tabulation are now required as a result of scientific advances and especially, of the increasing use of automatic computers. In the latter connection, the tables serve mainly for preliminary surveys of problems before programming for machine operation.

The project is supported by the National Science Foundation, and is being carried out by the Bureau's computation laboratory and numerical analysis group. Correspondence should be addressed to Dr. M. Abramowitz, National Bureau of Standards, Washington 25, D.C.

Reliability Conference

The emphasis on reliability was continued with increasing fervor at the 27th USAF-Aircraft Industry Safety Conference held a few weeks ago at Santa Barbara, Calif. The failure of a multi-million dollar missile because of a faulty 50-cent part, especially one that missile might be carrying an atomic warhead, was the perspective on reliability taken at the conference.

Within the last seven years, reliability has come to the forefront of the hottest subjects within the Air Force and the aircraft industry. A three-day conference served to evaluate the aircraft and electronic industries as to what they might expect

◀ CIRCLE 11 ON READER-SERVICE CARD

CIRCLE

liability stipulations in future contracts, such as:

- Cradle-to-grave responsibility for liability of a product.

- Exhaustive testing-to-failure of developmental models.

- Exhaustive testing of initial production models and healthy samplings thereafter.

- An accurate determination of time to failure, and perhaps a guarantee of this lifetime for parts, components and systems.

Woman's Voice for Lost Pilots

tuning in a VHF receiver to 124.6 MHz, a pilot approaching Teterboro Airport, N.J., can pick up his compass bearings in the feminine tones of a recorded woman's voice. Called the "speaking beacon," the equipment was recently demonstrated by Air Associates, Inc., of Teterboro.

Specifically designed for planes not equipped to pick up and read coded compasses, the system allows a pilot to hear two or three compass headings at 15-sec intervals. When two of these headings are equally audible he will know he is halfway between two beams. The louder one sounds, the closer he is to that beam. Thus, when on a single beam, he will hear one heading loud and clear, and two others will come in faintly.

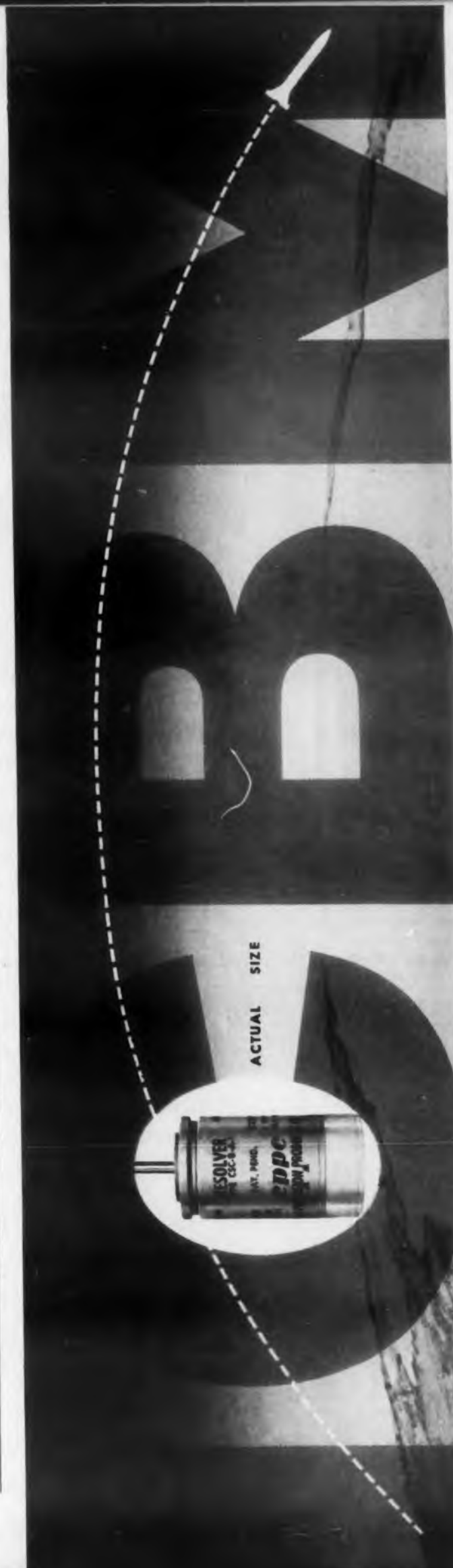
Military Expenditures Increase

Estimated Department of Defense military electronics expenditures in four categories of military functions increased substantially during the second quarter of fiscal year 1957 over the first quarter. According to a TMA compilation issued recently, total expenditures in the first half of fiscal year 1957 exceed \$1.53 billion.

Aircraft electronics expenditure increased from \$213 million during the first quarter to \$566 million in the second quarter. Other significant increases over the same period were in communications and guided missiles. Communications showed an increased expenditure of \$263 million over \$130 million in the first quarter, and guided missiles showed an increase of \$216 million over \$205 million.

CARD

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When Minutes (of error) Mean Miles "off target"
 specify Clifton Precision Size 8 Synchronos

for

H I G H E S T A C C U R A C Y

SYNCHRO FUNCTION	CPPS TYPE	ROTOR AS PRIMARY					STATOR AS PRIMARY					D.C. RESISTANCE			IMPEDANCE			Min. Full Scale Error (Max.)					
		Input Voltage (VRMS)	Input Current (amps)	Input Power (WRMS)	Output Voltage (VRMS)	Specificity (MV/deg.)	Phase Shift (deg. Max)	Input Voltage (VRMS)	Input Current (amps)	Input Power (WRMS)	Output Voltage (VRMS)	Specificity (MV/deg.)	Phase Shift (deg. Max)	Resistance (Ohms)	Inductance (Ohms)	Capacitance (Ohms)	Resistance (Ohms)		Inductance (Ohms)	Capacitance (Ohms)			
Torque Transmitter	CGC-8-A-7	26	.100	.5	11.8	206	8°	—	—	—	—	—	—	—	—	—	37	12	54 + j260	12 + j45	80 + j20	30	7
Control Transformer	CTC-8-A-1	—	—	—	—	—	—	11.8	.090	.23	23.5	410	8.5°	143	25	220 + j740	28 + j110	246 + j60	—	—	—	30	7
Control Transformer	CTC-8-A-4	—	—	—	—	—	—	11.8	.029	.08	22.5	390	8°	389	64	560 + j1860	90 + j340	640 + j190	—	—	—	30	7
Torque Receiver	CRC-8-A-1	26	.100	.5	11.8	206	8°	—	—	—	—	—	—	—	—	—	37	12	54 + j260	12 + j45	80 + j20	30	30
Electrical Resolver	CSC-8-A-1	26	.039	.43	10.6	185	20°	11.8	.084	.27	23.2	400	11°	230	27	280 + j600	38 + j136	70 + j136	—	—	—	30	7
Electrical Resolver	CSC-8-A-4	26	.039	.43	26	454	20°	26	.038	.30	27.5	480	13°	230	150	280 + j600	200 + j660	70 + j140	—	—	—	30	7
Control Differential	CDC-8-A-1	—	—	—	—	—	—	11.8	.085	.21	11.8	206	9°	36	25	38 + j122	27 + j120	48 + j14	—	—	—	30	7
Vector Resolver	CVC-8-A-1	26	.057	.34	11.8	206	10.2°	—	—	—	—	—	—	78	27	103 + j440	8 + j30	—	—	—	30	7	



LOOK TO CPPC FOR SYNCHRO PROGRESS
 CLIFTON PRECISION PRODUCTS CO. INC.

Clifton Heights, Pa.

Engineering Review

Global Noise Recorders

During the International Geophysical Year, 16 stations around the world will be recording atmospheric noises and radio interference. These stations are now being set up by scientists from the Boulder Laboratories of the National Bureau of Standards with the cooperation of other U. S. agencies and other countries.

Although some stations will be recording man-made noises, most of the stations will be as far removed from civilization as possible. One station to be erected at Marie Byrd Base in the Antarctic, will be measuring the effect on radio transmission of the auroral zone—that belt circling the pole in which the southern lights appear during magnetic storms. The recording stations will operate continuously between the frequencies of 15 kc and 20 mc. In this band, those frequencies above 10 mc will be of special interest, since radio waves of these frequencies coming from regions beyond our atmosphere will be received.

Data from these various stations will be analysed at the Boulder Laboratories. The results will not only provide answers to questions in such fields as radio propagation and meteorology, but will also provide a scientific basis on which to assign frequencies to transmitting stations so that they will incur minimum interference from their environment.



Dubbed the "dog house," this actually is one of a world-wide chain of observation stations that will be recording static or radio noise largely generated by thunderstorms. The vertical rod near the center of the building is the receiving antenna while the radiating wires are used to stabilize reception.

New Sylvania package offers

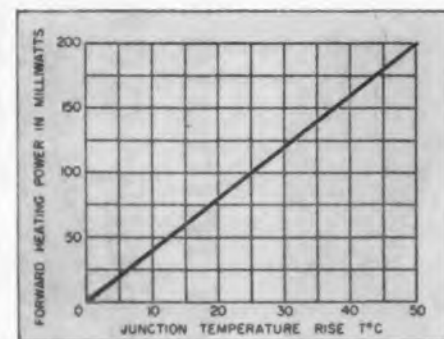
Maximum Dissipation in Miniature Diodes



Cooler operation resulting from higher dissipation of Sylvania glass-to-metal miniature diode permits closer printed board spacing for maximum savings in space.



Right angle bending of leads for printed board insertion does not affect the diode body since metal-to-glass design avoids chipping or cracking.



Typical dissipation curve of the Sylvania glass-to-metal diode.

Actual comparison of Sylvania miniature diodes with all-glass miniatures shows that the Sylvania metal-to-glass package design results in greater dissipation. As a result, cooler operation can extend diode life and improve product dependability and performance. Diodes can be banked closer on printed circuit boards for maximum space savings.

Metal-to-glass package offers other important advantages. The diode cartridge is assembled *before* installation of the whisker and die—avoiding excessive heating. In addition, right angle bending of the leads for printed board insertion does not result in chipping or cracking of the diode body.

Sylvania offers a complete line of miniature diodes in the glass-to-metal package. The package meets the standard RETMA outline of .105" maximum diameter and .265" maximum overall length. Write for complete details.

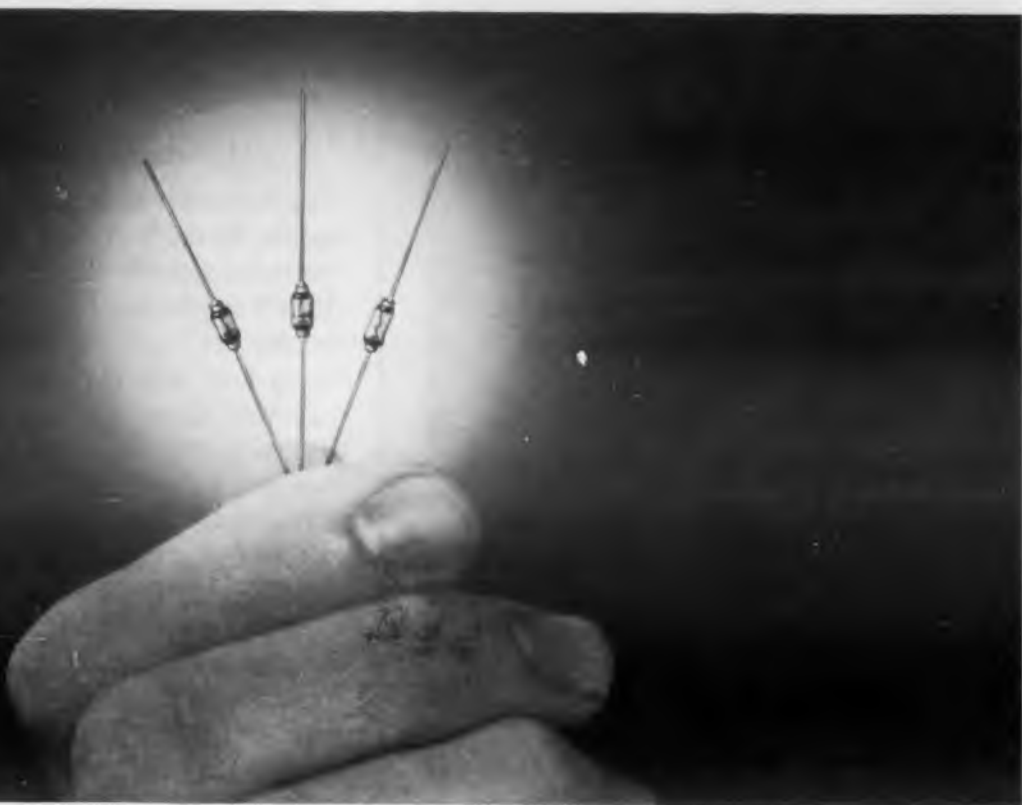


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ELECTRICAL CHARACTERISTICS OF SYLVANIA MINIATURE DIODES AT 25° C

Type	Minimum Forward Current at 1 volt	Maximum Reverse Current	Minimum Peak Inverse Voltage (0 dynamic impedance)	Maximum Forward Voltage	Minimum Reverse Resistance	Maximum Reverse Recovery @ 0.3 μ sec (Note 3)	Stability
IN67A	4 ma	50 μ a @ -50 volts 5 μ a @ -5 volts	100 volts				
IN90	5 ma	750 μ a @ -50 volts	75 volts				
IN98	20 ma	100 μ a @ -50 v 8 μ a @ -5 v	100 v				
IN126	5 ma	850 μ a @ -50 v 50 μ a @ -10 v	75 volts				
IN127	3 ma	300 μ a @ -50 v 25 μ a @ -10 v	125 volts				
IN128	3 ma	10 μ a @ -10 v	50 volts				
IN191	5 ma	Note 1	Note 1				
IN198	4 ma (5 ma @ 75° C)	50 μ a @ -50 v (Note 2) 10 μ a @ -10 v	100 volts				
IN631				3.5 v (Note 4)	500 kohms (Note 5)	500 μ a	Note 7
IN632				1 V If = 7 ma	500 kohms (Note 5)	800 μ a	Note 7
IN633				1 V If = 125 ma	500 kohms (Note 6)	1650 μ a	Note 7
IN634	50 ma	45 μ a @ -45 v 100 μ a @ -100 v	115 volts				
IN635	50 ma	175 μ a @ -150 v	165 volts				

Note 1: For type IN191 at 55° C the reverse resistance will be 400 ohms or better between -10 and -50 volts when swept from 0 to -70 volts at a 60 cycle rate.

Note 2: The reverse recovery time will not exceed 0.5 μ sec at 700 μ a or 3.5 μ sec at 100 μ a of current when rapidly switched (to 60 cycle rate) from +30 ma forward

current to -35 volts.

Note 3: For type IN198 at 75° C the maximum reverse current at -50 volts is 250 μ a and at -10 volts is 75 μ a.

Note 4: a) Forward current exposure = 5 ma. b) Reverse test voltage = 40 \pm 2 volts. c) DC circuit resistance = 2000 ohms.

Note 5: Peak measurement with half sine wave of 50 ma peak current, 0.1 μ sec pulse width, and 100 kc pulse repetition frequency.

Note 6: Minimum resistance in thousands of ohms when E/I characteristic is swept at 60 cycles from 0 to -70 volts and resistance slope observed between -10 and -60 volts.

Note 7: Additional control measurements are made for reverse current hysteresis, reverse current drift, and flutter.

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CIRCLE 13 ON READER-SERVICE CARD FOR MORE INFORMATION

Man Talks with Computer

To further the education of electronic brains, a device has been developed which enables a human being to tell a computer what to do more often and more easily. Conceived at M.I.T. of Cambridge, Mass., its purpose will be to facilitate the transmission of general ideas, as in a conversation, between a human and a computer, so that the maximum use of their respective capabilities can be made.

A computer readout and intervention system makes possible the introduction of human logic midway in a problem's computation. Under this system a computer will no longer continue doggedly trying to solve a problem in one way after a partial solution has shown that a modified approach is needed.

The readout system allows information to be displayed in either tabular or graphic form. If desirable, long columns of statistics can be converted automatically and swiftly into graphs. The operator can watch the progress of the computations and, if necessary, can intervene directly into the computer's calculations.

Summer Fellowships for Science Teachers

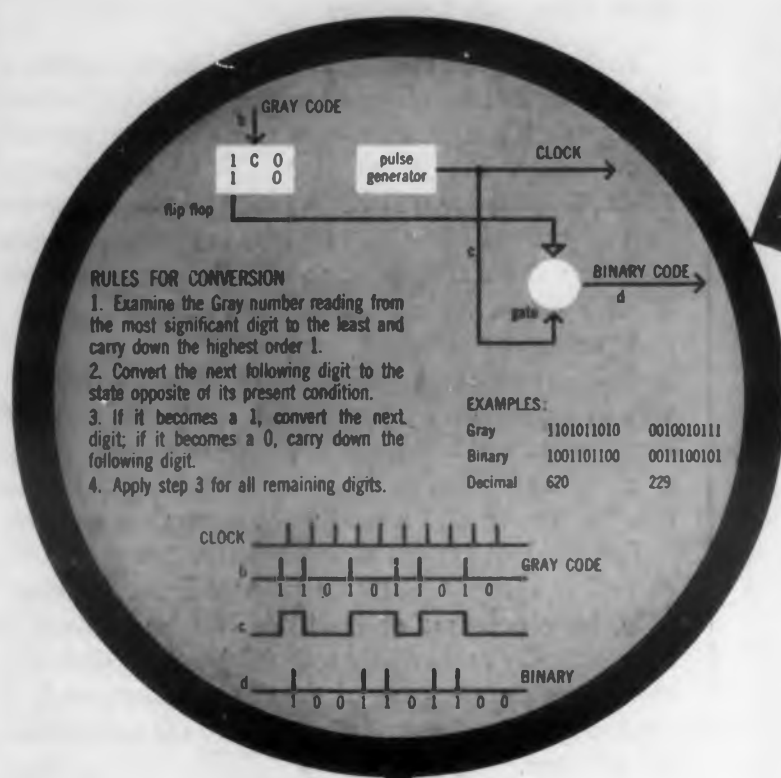
Three hundred fellowships for secondary school physics, chemistry and mathematics teachers are being offered this year under sponsorship of the General Electric Educational and Charitable Fund.

Teachers from 38 states are eligible to apply for the six-week expense-free summer fellowships offered in six universities and colleges from coast to coast. Purpose of the fellowships is to enable teachers with demonstrated interest and ability to increase their understanding and appreciation of modern mathematics and science and their role in human affairs.

Including those selected this year, more than 1900 secondary school science and mathematics teachers will have participated since inception of the General Electric programs 12 years ago. Graduates of these programs have come from approximately 1500 of the nation's 28,000 secondary schools.

The series of programs was initiated by General Electric as part of its extensive support of education. The Educational and Charitable Fund pays traveling expenses from their school to the college and return, board and lodging while attending the sessions, and tuition and fees in connection with the fellowships, thus giving the teachers expense-free advanced study.

Faculties of the six colleges conduct the courses which are designed to bring teachers up-to-date in their fields of instruction. Personnel and facilities of General Electric are made available to the colleges. Company engineers, scientists and executives give talks in their special fields, and trips to laboratories and plants in the area of the schools are arranged to give teachers opportunity to see the importance industry places on application of the subjects they teach.



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pulse control systems

converting Gray code to
binary equivalents

Here is a simple method for converting Gray code to true binary equivalents. It was put into operation in minutes just by interconnecting Burroughs Pulse Control Units in accordance with the engineer's block diagram, without detailed specifications or complicated circuit designs. With pulse control equipment at his disposal, the engineer was able to turn immediately to other important problems awaiting his attention.

The majority of engineers solving logical problems are badly in need of such tools. Most are bogged down by equipment of limited use that must be redesigned and rebuilt for every new project . . . that clutters the path to a working solution instead of clearing and shortening it.

The smallest discrete units with which such a man can work are logical concepts . . . the basic logical operations. The ideal tools for him are these same operations, packaged for convenient and immediate use by simple interconnections—like the blocks in his block diagram. Such tools are Burroughs Pulse Control Units, which bring block diagrams to life in a matter of hours rather than weeks. Wherever logical problems are being solved with pulses they have earned the title "Tools For Engineers" by eliminating intermediate steps to a proof, obsoleting the frustrations and complexities of breadboarding.

Why not lift the burden of proof from your shoulders by passing pulse problems on to us? We'll gladly show you how Burroughs Pulse Control Units can bring your logical problems closer to a neat working solution . . . at no cost. Or, write for Bulletin 236.

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CIRCLE 15 ON READER-SERVICE CARD FOR MORE INFORMATION

Washington Report

Herbert H. Rosen

Allocations between 25 and 890 Mc:

In light of technological developments since the end of World War II, the Federal Communications Commission feels that it must re-examine its basic allocation policies for frequencies between 25 and 890 Mc. It hopes to obtain data and information which will help it make its future determination.

Persons desiring to respond to this inquiry on behalf of particular services should furnish specific data and information to the FCC before July 1.

The 25-890 Mc portion of the spectrum embraces a variety of radio services including broadcast (radio and TV), domestic and international marine, aeronautical, public safety, industrial, amateur, land mobile, transportation, ISM (industrial, scientific, medical), citizens, disaster, restricted radiation services, control of devices, telemetering, signaling, radar, radiolocation, radionavigation, etc.

The current proceeding is companion to the finding hearing regarding the allocation of frequencies in the bands above 890 Mc (Docket No. 11866). The latter pertains mainly to aviation, Government, fixed point-to-point relay and common carrier operations, and some broadcast non-broadcast relay.

The commission hopes to:

- Determine whether a more efficient utilization can be made of these frequencies (25 to 890 Mc) and potential users.
- Evaluate the long-range requirements of existing and potential users.
- Obtain data as to the feasibility of applying known and potential techniques and methods relating to efficient utilization of spectrum space.
- Evaluate what systems of frequency allocation the future would best serve the public interest.
- Obtain knowledge of the possible conflicts between the requirements of non-government services and the space allocated to Government users.
- Consider long-range plans for the future use of the radio spectrum, and in particular, to determine the impact, economic or otherwise, upon users of spectrum and the general public of implementing desirable future changes.
- Assist the Commission in formulating its proposals with regard to the preparation of United States proposals at the International Radio Conference in 1959.

The Commission points out that this proceeding is not intended to freeze or otherwise impede other proceedings which have been, or may be, instituted by the Commission with respect to specific services and allocations in these bands. Such cases will be dealt with on an ad hoc basis.

At the same time, the FCC also warns the electronic industries that they had better consult them before designing equipment for use at certain frequencies. Such developments should be aligned with the Commission's Table of Frequency Allocations. Better still, more companies should adopt the policy of including an office or individual in their organization primarily responsible for such matters.

Rocketing to the Moon:

Scientists from the Martin subsidiary RIAS, Inc. recently proposed an idea for a recoverable rocket carrying an instrument payload out 2000 miles above the atmosphere. A preliminary study has indicated feasibility of sending such a craft into the sky and recording cosmic radiation. Exposed emulsions, on every, would indicate magnitude of the radiation as well as probably give evidence of other hitherto undiscovered particles. The Martin three-stage IGY vehicle—or a close second cousin—would carry the 150-pound payload aloft. The RIAS people have calculated that the payload would spend about 40 minutes above the earth. It would attain a top speed of about 13,000 miles per hour upon entering the earth's atmosphere.

Incidentally, the disclosure was made at a special meeting solely to stimulate thinking in this direction. A special committee of Government, industry, and educational scientists has been formed to look further into this idea. They, at least, believe it has sufficient merit to warrant additional study.

On a still related subject, the Air Force recently announced that they have given Rocketdyne Division of North American a contract to study an ion-propelled rocket. This disclosure falls on top of a paper written by a Rocketdyne engineer on what he calls an ion-propelled rocket. This ion-propelled rocket would be capable of "snooping" around the solar system. In fact, the name "Project Snooper."

The ion-propelled rocket would be almost all wings,—like bat-like affairs that radiate heat generated in a nuclear reactor, through suitable heat exchangers and turbines would supply electrical energy to an electrostatic field generator and to the electronic test equipment. The electrostatic field would propel ionized cesium atoms, which would constitute the small propellant force needed to drive the missile in rarified atmospheres. Conventional rockets would raise the missile out of the earth's atmosphere. To all but members of the American Rocket Society—before which the paper was presented—this sounds like pure science fiction. But so it was not too many years before World War II.

new

a single or multiple disconnect using seamless, crimp-type terminations

Easy Circuit Check
Probes reach insulation grip of socket terminating each wire. Printed numbers on all faces of plug and receptacle make circuit identification simple.



Quick Multiple or Individual Connections
Any wire is easily inserted or removed from plug individually. Each contact clearly identified on all six faces of plugs and receptacle.



Crimped Terminations
Each connector is crimped on the insulation as well as on the wire. Provides maximum mechanical and electrical efficiency. Eliminates need for cable grip.



Rapid, Foolproof Assembly

Tough nylon polarizing pins engage corresponding holes before threads or contacts can engage.



Short Circuit Prevention

Recessed pins eliminate possibility of shorts from accidental contact of plug and receptacle.



High Pullout Resistance

Pull-out from plug (in excess of 50 pounds) is maintained by compression spring locks. Lock is quickly freed for wire removal by small screwdriver or knife blade.



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- saves space
- simplifies installation and maintenance on all pressurized bulkheads

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high speed transistors for computer switching circuits

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

And the 2N240 gives you:

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

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

Write for complete data sheets on Sprague 2N240 Germanium Surface Barrier Transistors and on Sprague General Purpose High-Frequency Surface Barrier Types 2N344/SB101, 2N345/SB102, 2N346/SB103. All are available on letterhead request to the Technical Literature Section, Sprague Electric Co., 347 Marshall Street, North Adams, Massachusetts.



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Meetings

May 7-9: Eleventh Annual Frequency Control Symposium

Berkeley-Carteret Hotel, Asbury Park, N.J. Sponsored by the U. S. Army Signal Engineering Laboratories. A total of 35 technical papers will be presented during the three-day conference by outstanding scientists and engineers. Prof. Polycarp Rusch of Columbia University, a recent co-recipient of the Nobel prize in Physics, will present a paper on "Precision Atomic Beam Techniques." The main sessions will be concerned with fundamental properties of quartz, piezoelectric resonators, quartz synthesis, crystal units for adverse environmental conditions, high precision crystal units and oscillators, gas cell devices, atomic beam devices, quartz crystal measurements, crystal oscillator circuits, precision filters, frequency and time measurements, and molecular amplification by stimulated emissive radiation (MASER). By means of talks and informal discussions the conference endeavors to promote better understanding and wider dissemination of technical information related to frequency control through the exchange of new ideas and reports on progress made during the past year.

May 9-10: Symposium on Microwave Ferrites and Related Devices and Applications

Western Union Auditorium, New York City. Program will have reports on advances in microwave ferrite devices and their applications, non-reciprocal propagation in gas media, and microwave solid state devices. There will be two sessions of contributed papers and a round table discussion on design limitations of microwave ferrite devices, high power effects, low frequency limits, high frequency limits, anomalous propagation in ferrite loaded waveguides, below saturation behavior of ferrites, "fast" ferrite devices (depending upon relaxation time), bandwidth problems and material losses. Award for the best paper appearing in the Transactions of PGMTT will be given. For information write Samuel Weisbaum, Bell Telephone Laboratories, Murray Hill, N.J.

May 13-15: National Aero and Navigational Electronics Conference

Dayton, Ohio. Sponsored by Professional Group Aeronautical and Navigational Electronics, Dayton Section. For more information, write John E. Wilkerson, 410 W. First St., Dayton 2, Ohio.

May 13-16: Fifth Annual Semiconductor Symposium of the Electrochemical Society

Statler Hotel, New York City. For more information, write the Electrochemical Society, 216 W. 10th St., New York, N.Y.

May 16-18: Eighth Annual Conference and Convention, American Institute of Industrial Engineers

New York City, Hotel Statler. For information write to AIIE, P.O. Box 8, Substation 135, The Bronx 53, New York.

June 6-7: First National Symposium on Production Techniques

Hotel Willard, Washington, D. C. Sponsored by the IRE Professional Group on Production Techniques. Discussions will be held on "How to Prepare For and Implement Automation" and "Military Problems in Electronic Automation." Papers will be presented on "Designs for Production." For information, write to IRE, 1 E. 79th St., New York 21, N.Y.

June 8-12: Technical Career Conference

Sherman Hotel, Chicago. Sponsored by the Technical Career Council. For more information write Marcus W. Hinson, Technical Career Council, 19 S. LaSalle St., Chicago 3, Ill.

June 10-11: Second RETMA Symposium on Applied Reliability

Syracuse, N.Y., Hotel Syracuse. Symposium emphasizes the practical aspects of achieving reliability. Sessions will be held on mechanical design, selection and use of components, proof of mature design and case histories of reliable and unreliable designs. A panel discussion is planned on industry vs. military responsibility on contract and specification control for reliability. Advance registrations will be handled by the RETMA Engineering Office, Rm. 550, 11 W. 42nd St., New York 36, N.Y.

June 10-14: Fifth Annual Technical Writers' Institute

Rensselaer Polytechnic Institute, Troy, N.Y. Designed for those who supervise technical writing in business, industry and the professions. Sessions on manuals and instruction books, reports, technical promotion, training programs, industrial films and graphic and illustrative aids. For additional information, write Jay R. Gould, Director, Technical Writers' Institute, Rensselaer Polytechnic Institute, Troy, N.Y.

Group deadlines

Aug. 1: Deadline for papers proposed for the Oct. 1-Nov. 1 conference of the Professional Group on Electronic Devices, IRE, in Washington, D.C. Abstracts should be submitted to the program chairman, W. M. Webster, RCA Semiconductor Div., Morristown, N.J. Subject matter should concern developmental techniques and devices, such as electron tubes and transistors, rather than basic research or circuit applications.

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HIGH INPUT IMPEDANCE

The KINTEL Model 111 amplifier provides maximum stability and the lowest drift of any commercially available broadband d-c amplifier. It is the end result of years of research in the field of chopper stabilized broadband d-c amplifiers. Thousands of KINTEL amplifiers are in daily use. The Model 111 incorporates KINTEL's proven chopper amplifier circuitry and provides ten extremely precise, feedback controlled gain ranges. Several feedback loops assure high accuracy, stability and uniform frequency response. The completely new and unique circuit provides rapid recovery from severe overloading and unsurpassed dynamic performance - unaffected by load or gain changes. The Model 111 is available in a single-unit cabinet or in a six-unit rack-mountable module. The amplifiers are extremely compact; the six unit module occupies only a 19-inch rack width.

APPLICATIONS: The Model 111 is ideal for permanent low level d-c instrumentation, telemetering, or as a strain gage amplifier, transducer amplifier, scope preamplifier, recorder driver amplifier, or general purpose laboratory amplifier.

SPECIFICATIONS

Gain	0, 20, 30, 50, 70, 100, 200, 300, 500, 700, 1000	Power Requirements:	
Gain Accuracy	± 1% DC to 2 KC	Amplifier	117 V - 60 cycles - 70 VA
Input Impedance	100,000 Ω	Cabinet	117 V - 60 cycles - 15 VA
Output Capability at DC	0 to ± 35 V where $R_L > 1000 \Omega$ 0 to ± 40 MA where R_L is 10 to 400 Ω	6 Unit Rack Adaptor	117 V - 60 cycles - 45 VA
Output Impedance	Less than 1 Ω in series with 25 μh	Dimensions: Amplifier Unit	2 7/8" wide, 7 1/2" high, 14 1/2" deep
Equivalent Input Drift	± 2 μv with regulated line	Rack Adaptor for 6 Units	19" wide, 8 1/2" high, 18 1/4" deep
Equivalent Input Noise	0 to 3 cps, less than 5 μv peak to peak 0 to 750 cps, less than 5 μv RMS 0 to 50 kc, less than 12 μv RMS	Net Weight - Amplifier	11 pounds
Chopper Intermodulation	Less than 0.1%	PRICE: Amplifier Unit	\$550.00
Linearity	Better than 0.1% to 2 KC	19-inch Rack Adaptor for 6 amplifier (with fans and connectors)	200.00
Frequency Response	± 3% (0.3 db) DC to 10 KC, less than 3 db down at 40 KC	Cabinet for single amplifier (with fan and connector)	is available.

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Reliability in Electrical

The problem of reliable electrical connections is involved in all phases of the electronic industries. With military and commercial applications demanding increasingly higher reliability in the face of vibration, g-stress, temperature and environment extremes, this problem becomes paramount to the design engineer who is carrying a project through to its culmination in a finished unit. For this reason **ELECTRONIC DESIGN** presents here a brief survey of the questions and answers interchanged at the 2nd RETMA conference on reliable connections. Covered are the problems involved in connecting wires to terminals or pressure connectors and printed circuits, from cleaning and coating the metals concerned through the use of ordinary organic and activated fluxes to the comparative merits of dip soldering, ultrasonic soldering and solderless connections.

Printed Circuit Problems

Have any mechanical standards been established for the preparation and assembly of soldered joints to wiring boards? Are there any standards covering crimp or noncrimp of wires? Is there one best way of making the joints which will insure adequate strength and reliability of the electrical connections?

Opinions are being exchanged in the RETMA automation and printed wiring committees, but no agreement has yet been reached. The manufacturers of component inserting equipment each have their own specifications. For 0.032-in. component leads, a compromise is yet to be reached between a 0.056-in. hole which gives the best insertion and a 0.042-in. hole which gives the best capillary rise and therefore soldering strength. A lead extension of 1/2-in. beyond the hole has been suggested. Nothing has been standardized on crimp, but it would seem to be necessary for the most reliable joint. The Signal Corps, on the basis of its findings, definitely opposes the use of eyelets as a detriment to reliability.

Wilson H. Hannahs, Automatic Production Research.

In cleaning printed wiring boards, what method is recommended for treating the copper surfaces—chemically by means of acids or mechanically by brushing or abrading the surfaces?

A chemical method can be used provided thorough washing facilities are available and the boards are assembled and dip soldered immediately afterwards. In most cases these conditions cannot be met and cleaning by mechanical means is preferable.

L. Pessel, Radio Corp. of America.

Copper oxide and tarnish may be removed in a dilute acid solution, if subsequent thorough rinsing is practicable. An example is a 30-sec immersion at room temperature in 5 per cent (wt) HCl or 2 per cent (wt) H₂SO₄. A common mechanical treatment consists of abrading with a pumice suspension. Such a suspension may be made of 10 pts (wt) water and 1 pt (wt) grade FFF pumice. If organic films are present, acid dipping cannot be used alone. The acid dip must be preceded either by pumicing or by treatment in a hot mild alkaline solution.

E. B. Saubestre, Sylvania Electric Products, Inc.

Assuming it is not practical to use wiring boards immediately after cleaning, what method is recommended for protecting the copper surfaces? How about applying a coating, such as lacquer or wax? Would it suffice to package in vinyl sacks with moth crystals?

Protected storage over silica gel has been a recommended method. Coatings are not only more expensive but may, unless carefully controlled, affect solderability.

L. Pessel, Radio Corp. of America.

We have had excellent results using a light cross coat of water dip lacquer. Some activated rosin fluxes have also given excellent long time (6 months) protection of solderability. We use no special packaging.

Donald R. Aldrich, The Magnavox Co.

Is there a likelihood that rosin flux residues cause electrical leakage problems in the use of soldered printed circuits? Should these residues always be removed? If so, by what means?

A rosin flux that passes an insulation resistance test of 50,000 megohms or more, in all likelihood will not

cause electrical leakage that will present problems. Residues of this flux need not be removed on television and radio applications.

William L. Lehner, Sylvania Electric Products, Inc.

Is there one solder alloy which is best for copper circuits, another which is best for silver plated circuits and still another which is best for solder plated circuits? If so, what are they? Is the same thing true of fluxes?

The solder used in printed circuit soldering is independent of the type of printed circuit. Generally speaking for all printed circuit soldering, those alloys closest to the eutectic composition are most satisfactory because of their freer flowing quality and the readiness with which they alloy with the terminal points.

The flux, or its residue, must of course be noncorrosive and electrically nonconductive, which means a rosin or resin type flux. Due to the unusual requirements involved in the printed circuit soldering, it appears that only the activated rosin fluxes are useful. I have never seen any successful printed circuit soldering done with a pure rosin flux.

C. L. Barber, Kester Solder Co.

Does prefluxing of copper etched surfaces preserve the solderability of the copper? If so, what fluxes and methods of application are recommended?

Prefluxing of cleaned copper etched surfaces does preserve the solderability of the copper. A white rosin flux applied by spraying, dipping or roller will give

Connections

R. George Roesch

The Eraser Company

A complete account of topics discussed and papers given can be obtained in the Proceedings of the 2nd RETMA Conference on Reliable Electrical Connections, Engineers Publishers, P.O. Box 1151, New York 1, N.Y.



In automatic dip soldering of printed circuit laminates, what is the best soldering temperature?

The best soldering temperature is the lowest one you can use and still obtain good results. A recommended temperature is approximately 100 deg over the melting point of the particular alloy used.

William L. Lehner, Sylvania Electric Products, Inc.

What solder is recommended for the dip soldering of copper etched wiring boards?

60 tin-40 lead or 63 tin-37 lead are in alternate use. The eutectic of 63-37 has a slight advantage of approximately 9 F lower liquidus temperature.

Martin A. Boyle, Alpha Metals, Inc.

In mechanized dip soldering of printed wiring, how does one control the amount of flux? Since some wires or parts may project farther from the base than others, it does not seem possible to get the correct amount of flux on each.

One method of controlling the amount of flux deposited on a circuit board is by roller coating the panel with flux prior to insertion of parts.

William L. Lehner, Sylvania Electric Products, Inc.

In the dip soldering of copper etched wiring boards, what is the optimum relationship between the inside diameter of the holes in the wiring board and the outside diameter of the connectors in the holes, if the best bridging of the gap with solder is to be attained?

The inside diameter of the holes should not be more than 0.002 in. larger than the outside diameter of the part inserted in the hole.

Martin A. Boyle, Alpha Metals, Inc.

The closer the inside diameter of the hole to the outside diameter of the wire, the easier it is to solder single sided etched panels. Recommended maximums are inside diameter, 0.062 in. and outside diameter, 0.031 in.

William L. Lehner, Sylvania Electric Products, Inc.

In the dip soldering of copper etched wiring boards using 60-40 or 63-37 solder, what dwell time is recommended?

Dwell time will range from 4 to 8 sec since the size of the board and number of components would alter the time.

Martin A. Boyle, Alpha Metals, Inc.

Three seconds.

William L. Lehner, Sylvania Electric Products, Inc.

Is there a test method which might be used to determine the condition of printed copper circuitry for soldering, without using the destructive solder dip tests?

A number of nondestructive tests have been based on the spread and/or contact angle of a droplet of solder. The Task Group of RETMA's Printed Wiring Committee, entrusted with finding a suitable solderability measure, tried such a test and reported it to be unreliable. However, it is possible that someone can improve on the existing procedure. RETMA has not yet been able to find a satisfactory quantitative test. The rejected procedure employed a chisel-shaped chromium plated tip with embedded thermocouple and a fixed shape and size of solder pellet, the spread

sufficient coverage for protection for periods up to one month.

William L. Lehner, Sylvania Electric Products, Inc.

In mechanized soldering of printed wiring, is the temperature of the solder bath critical?

The temperature of a soldering bath used in mechanized soldering is critical with relation to the dwell time or contact time and the solder alloy used. By increasing the temperature, shorter dwell time can be obtained.

William L. Lehner, Sylvania Electric Products, Inc.

The solder temperature is important and should be closely controlled. The temperature of the bath has to be high enough to allow the solder to wet the conductors and leads without reaching the range where the adhesive bond between the conductor and the laminate is affected. Adequate wetting of the parts with the solder is usually obtained when the solder temperature is approximately 100 F above the liquidus temperature for the particular solder being used. The normal temperature range is 450 to 550 F when the lead eutectic solder is used. Immersion time can be 2 to 7 sec depending on the mass and thermal conductivity of the parts exposed to the solder and on the temperature of the solder bath. If the surfaces do not wet with solder in 2 to 7 sec, the indication is that they were not properly prepared. Longer immersion times usually do not result in significantly improved wetting.

R. White, Bell Telephone Labs., Inc.

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Aerovox Polystyrene Capacitors are designed for applications where stability and low dielectric absorption are essential—such as computing devices, tuned circuits demanding highest Q standards, capacitance bridges, and laboratory standards. They are available in many case styles and in capacities from 0.001 mfd to 25. mfd and in voltage ratings from 100 VDC to 1600 VDC.

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- Extruded vinyl tubing and tape
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of solder along a 1/8-in. line being used as an index to solderability.

Wilson H. Hannahs, Automatic Production Research.

When dip soldering copper-etched wiring boards, should the solder bath be agitated during the operation? Should the wiring board be dipped in quickly or slowly? Should it be withdrawn quickly or slowly?

The solder bath can be agitated, but it is not necessary. If it is done, it should be done once each day after the pot is initially heated. If pure tin is added to the pot to replace tin loss due to tin-copper crystallization and impoverishment of tin in the pot, the pot should definitely be stirred to effect realloying. A gradual immersion and withdrawal is recommended and the rate would depend upon the dwell time necessary.

Martin A. Boyle, Alpha Metals, Inc.

2 Mechanical Assembly, Soldering

When making an electrical connection between the end of a wire and a terminal or connector, is a mechanical joint necessary? What constitutes a good mechanical joint?

A mechanical joint preparatory to a soldered electrical connection is most desirable. It is obtained by bending the end of a wire around the terminal or connector, to prevent separation under stress, and is such that there is no motion between wire and terminal or connector during the soldering operation. Robert A. Johnson, Hexacon Electric Co.

In dip soldering operations when solder is expected to bridge gaps between wires and prongs (for example), is it dependable for strength? Do its "cold-flow" properties cause joint failures?

Time-honored good practice says that solder is not relied upon for its mechanical strength. The same principle should apply in joining wires to printed circuits and similar applications. Notwithstanding, millions of vacuum tubes have been produced with the lead wires held into the prongs merely by solder between wire and sleeve. The success of such joints depends upon a proper fit between wire and sleeve that results in a high capillary rise and therefore lengthy joint area.

Wilson H. Hannahs, Automatic Production Research.

Can some uniform specification for solderability be established? Can shelf life of metallic coatings be standardized? Is there any specification covering thickness of metallic coatings? What direction is the industry taking with regard to alloy plating as an answer to solderability?

A standard test for solderability has been established by RETMA Committee 37-C and is expected to be soon available for general distribution. So far, RETMA has not attempted to standardize shelf life. There have

been strong proposals to establish minimum thickness values for solderable metallic coatings, but no uniform agreement in this respect has been reached, as yet. The merits of alloy plating have yet to be clarified with respect to shelf life and minimum thickness. L. Pessel, Radio Corp. of America.

Is it practical to spot weld small copper tabs to printed wiring boards?

Resistance welding of wires, lugs, and terminals to copper foil on printed circuits is not practical. When contacting one side (series weld), the etched foil blows up during the weld cycle, due to the high current needed to produce sufficient heat to make a weld on copper.

B. J. Guty, Radio Corp. of America.

In the soldering of two or more wires to the same terminal, the bottom wires invariably cause service trouble within 6 to 12 months and inspection leads us to believe they have oxidized. What techniques or soldering materials can be suggested to help us overcome our difficulties?

If the two wires are soldered to the same terminal at the same time, perhaps flux erosion or a cold soldered bottom joint may be the cause of the trouble. Proper choice of a soldering iron and proper application of the iron should permit a reliable electrical connection.

Robert A. Johnson, Hexacon Electric Co.

Difficulty may take place when two separate soldering operations are made on the same terminal due to the fact that the first connection melts while the second is being soldered. This condition is relieved by using a relatively high melting solder for the first operation.

C. L. Barber, Kester Solder Co.

What methods and alloys do you suggest for joining terminal lugs to twisted copper cable?

In joining copper terminal fittings to copper cable, the BCuP-5 alloy is most frequently used. The joint is generally locally heated as rapidly as possible to the brazing temperature with either an oxy-acetylene torch or electric carbon resistance heat. The alloy is fed into the joint with a piece of wire or strip which it comes up to above 1300 F. Some people paint a mixture of magnesia powder and powdered graphite on the cable just outside the joint to prevent the alloy from sweating back up the cable.

A. W. Swift, Handy & Harman.

Is there a preferred method for placement of cold solder preforms?

In my opinion, the best joint is obtained when the solder preform can be placed outside the joint and the solder allowed to flow into the joint by capillary action. The assembly can be accurately positioned when round-cored solder preforms are used and the minimum amount of solder will produce a satisfactory joint.

L. R. White, Bell Telephone Labs.

We would like to know how to tin dip sockets and connectors efficiently.

The preferred solution is the use of metal coatings or plating that provide better solderability without pretinning components. In general, tin dipping can be done by using an approved type modified liquid rosin flux with approximately 35 per cent rosin solids. The solder should contain at least 50 per cent tin for good spreading properties, and the pot temperature should be 550 F with a tolerance of plus 10 deg. Parts dipped in molten solder will pick up less solder coating if the rate of removal of the parts is slow.

B. J. Guty, Radio Corp. of America.

What is solder oxidation and what causes it? If harmful, how does one eliminate the cause of it?

Solder oxidation is caused by the union of solder with oxygen at high temperatures to form lead and tin oxides which is generally called scum or dross. One does not eliminate solder oxidation. It is skimmed off at frequent intervals.

C. L. Barber, Kester Solder Co.

We are interested in all presently known methods of connecting small aluminum wires to aluminum wires as well as to copper wires.

Included among all presently known methods is the use of the proper soldering iron, together with special aluminum fluxes and/or special aluminum solders.

Robert A. Johnson, Hexacon Electric Co.

Our present knowledge of the reliable ways of connecting aluminum is not complete. Some success has been obtained with ultrasonic soldering, but the question of the suitability of the joint, particularly with reference to its freedom from corrosion, is still unknown.

Alph Hall, Phelps Dodge Copper Products Corp.

We have now available thoroughly tested pressure connections for No. 16 stranded aluminum wires and larger. We cannot as yet guarantee the integrity of the connection on solid wire or on sizes smaller than No. 16.

Franklin H. Wells, Aircraft-Marine Products.

What is the measurement of contact resistance at 0.1 amp suitable method of evaluating a printed circuit receptacle?

The measurement of contact resistance in evaluating printed circuit receptacles at 0.1 amp is considered suitable since this value closely approximates the value in actual use of the connectors.

Charles P. Lescaro, Hq Signal Corps Engineering Labs.

What is the best method of stripping AWG No. 30 enamel insulated wire?

Wheel-type wire stripping machines such as made by The Eraser Co. and others can be used. If the connection is to be made to a lead, perhaps it can be Sil-

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Fos brazed without removing the insulation. Or, if proper controls are used, the insulation can be chemically removed. An alternative suggestion would be to use a solderable wire instead of Formvar.
Ralph Hall, Phelps Dodge Copper Products Corp.

What technique can be used for visual evaluation of soldered connections?

The touch technique is a method of verifying the secureness of a soldered connection by means of slight pressure applied against the wire with a fibre spudger or similar tool.

Insecure connections that cannot be seen may be felt in most cases since there is a definite difference in the feel of a solid connection and one that is insecure. All solder connections should be checked by this method instead of applying pressure only to the suspicious cases. It is important that all soldered connections be carefully watched while the wire or terminal is being moved. In moving the wire, keep the amplitude of the movement at a minimum.

Harold R. Kellogg, Western Electric Co.

What methods can be used to determine when a solderless connection is mechanically secure and electrically reliable?

The most practical method is by checking minimum pull-out. The electrical reliability measured in resistance can be calibrated so that it can be measured by pull-out force of the conductor.

S. D. Bergman, Burndy Corp.

The most accurate method is to test the terminal under full current for multivolt drop (resistance) and temperature rise. The maximum pull-out force obtainable does not necessarily imply proper electrical performance. A proper electrical connection usually will be obtained when the maximum tensile strength has been passed by crimping to a cross section less than that needed for maximum strength.

Donald L. Bowen, Lockheed Aircraft Corp.

In some cases we find the temperature required to heat a wire and terminal for soldering is such that the insulation on the wire is affected and shrinks back. This leads me to wonder if there are any liquid solders or other substances which might be used without the application of heat.

We know of no suitable liquid solders or other substances which might be used without the application of heat in making a reliable electrical connection. If the insulation on the wire is affected and shrinks back it may be that the particular soldering iron used has to be held on the joint too long to get a good soldered joint. The right soldering iron to make the soldered joint very quickly may avoid heating the wire to the point where the insulation is destroyed. The idle tip temperature of such an iron should not be high, but the reserve heat available should be substantial to obtain a quick soldered joint. This technique of quick soldering through proper choice of the soldering iron

has been used in many applications to eliminate damaging nearby components.

Robert A. Johnson, Hexacon Electric Co.

The term liquid solder is used by certain persons to denote a mixture of glue and powdered metal; the material has nothing to do with solder. Even if there were a liquid solder, it would still have to be heated in order to form a soldered connection.

C. L. Barber, Kester Solder Co.

Burgess Conductive Wax has many physical properties similar to those of paraffin. It can be made to have a soft waxy feeling at room temperature or it can be made to resemble a hard wax. It has a sharp melting point at about 80 C and melts to a thin liquid. The specific conductivity of the material is about 0.003 ohm-cm.

The material can be used to make electrical connections by techniques very similar to soldering. It is readily applied by a soldering iron, but with the temperature of the iron greatly reduced. It adheres well to graphite, to such materials as conductive rubbers, and to metals which are difficult to solder such as magnesium and aluminum. The mechanical strength of the joint is about that obtained by using paraffin.
R. George Roesch, The Eraser Co.

3 Fluxes and Residues

Is there a standard limit of so-called noncorrosive solder flux corrosivity? If not, why not establish one?

Pure rosin has always been recognized as a working standard for a noncorrosive flux. Otherwise there is no standard limit for the measurement of flux corrosion.

C. L. Barber, Kester Solder Co.

How much risk lies in activated rosin fluxes as far as electrical leakage or corrosion is concerned?

There is no risk as far as electrical leakage or corrosion is concerned. The activated rosins made today by reputable solder manufacturers are noncorrosive and electrically nonconductive.

C. L. Barber, Kester Solder Co.

Activated rosin flux and/or activated flux residues are good insulating and protective coatings. We ran tests under conditions of high humidity and elevated temperature. No corrosive or electrical leakage was evident after several weeks of exposure.

Donald R. Aldrich, The Magnavox Co.

What is activated rosin as compared with water white rosin? Wherein does it differ from a rosin alcohol flux?

An activated rosin flux is composed of water white rosin to which has been added, in addition to the vehicle or solvent, a third ingredient which increases the fluxing activity of the rosin. An activated rosin can be obtained in a semisolid state for cored solder or a liquid for external fluxing. A rosin alcohol flux

prepared from rosin and a suitable alcohol. If an activator is added, the supplier should describe the flux as an activated rosin alcohol flux. The hydrazine salts are noncorrosive and nonconductive only when completely decomposed. If any undecomposed salt remains, it is, of course, conductive and corrosive. In my opinion, activated rosins must be heated to a high enough temperature to destroy or volatilize the active ingredient.

Frederick C. Disque, Jr., Alpha Metals, Inc.

If the removal of flux residues is deemed necessary, what procedures combine lowest cost with maximum efficiency?

Spray with trichlorethylene using a gun regulated to a minimum fan. This is a low production process. Donald R. Aldrich, The Magnavox Co.

Flux is best removed in solvents such as a mixture of equal parts of toluene, ethyl alcohol and acetone, and such other solvents as carbon tetrachloride, trichlorethylene and perchlorethylene. The action of these solvents can be accelerated by agitation with ultrasonics and sprays.

E. B. Saubestre, Sylvania Electric Products, Inc.

Solder contamination is the result of an alloying of the metals being soldered with the solder itself. Can this action be slowed down? How does one know that the solder is contaminated to such an extent it should no longer be used?

If you attempt to slow down solder contamination you will slow down solder alloying which, of course, is the purpose of soldering. Solder is contaminated beyond the point of usage when it no longer meets the requirements of the user. These requirements can be determined only by the user.

L. Barber, Kester Solder Co.

Is there a way of knowing when the solder is contaminated and should be changed, rather than relying on a hit-and-miss guess?

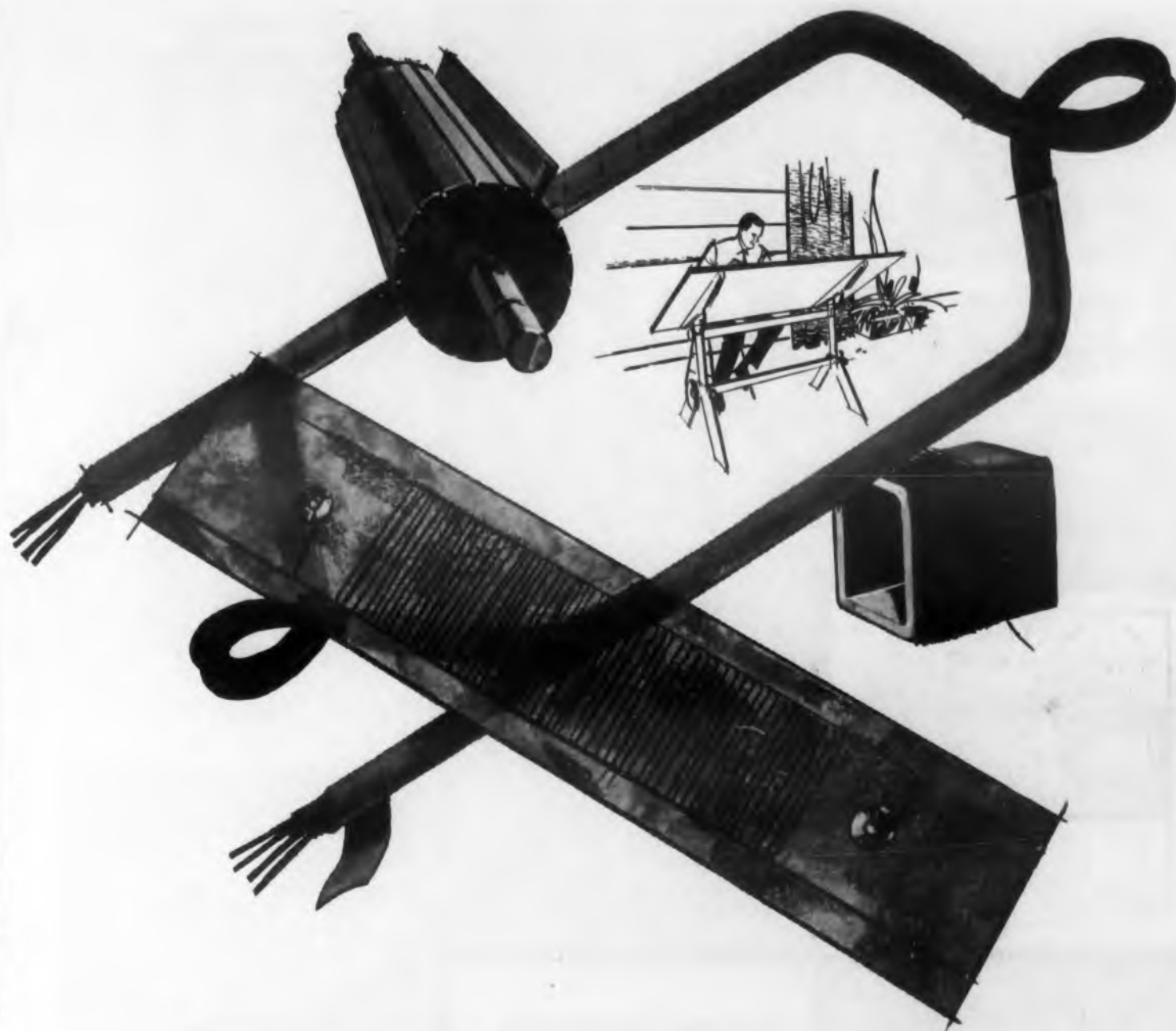
This question is like asking "How does one know when he has a toothache?". The only way that one can determine when solder is contaminated beyond the point of satisfactory usage is to note when it no longer performs satisfactorily in accordance with the standards or requirements of the user. In other words, as long as the solder performs satisfactorily, then any contamination is irrelevant.

L. Barber, Kester Solder Co.

What is the present state of the art in regard to fluxless soldering of terminals? We are primarily concerned with the flux that may be trapped in sealed containers and resultant malfunction.

Fluxless soldering of terminals is a straightforward operation with ultrasonic fluxless soldering. Accordingly, there need be no precleaning and no postcleaning and no concern whatever about flux in sealed containers.

E. Wismantel, Aeroprojects, Inc.



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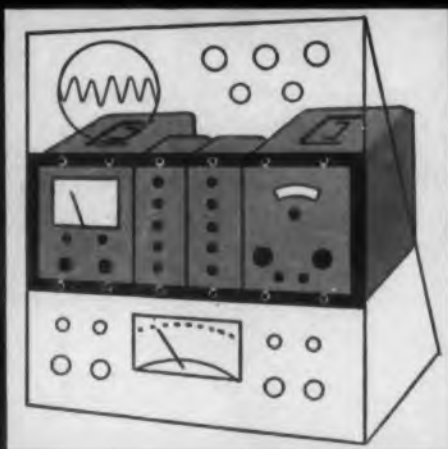
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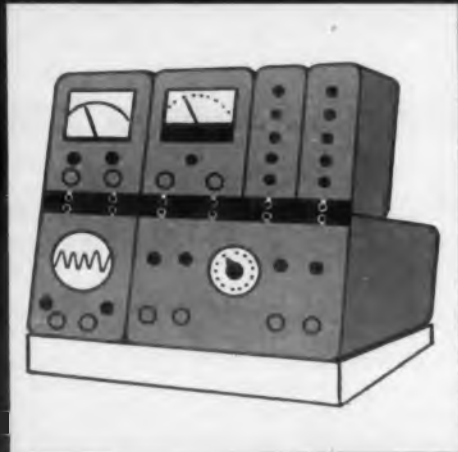
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Adjustable Precision R

SOCKET head screw adjustments on each end vary resistance from 1 K to 200 M. A course adjustment is made on one end and a fine micrometer adjustment, over the 1000 ohm range, on the other end. Intended end use is as a fixed precision resistor which may be set to the exact value desired while in the circuit.

Available in sizes of 1, 3, 5 and 10 w, the resistor, manufactured by Clark Electronic Laboratories, Palm Springs, California is designed to fit transistor clips. It will hold a final setting within one per cent tolerance and exhibits no measurable change because of aging.

The resistance material, a vacuum molded derivative of zirconium tetrachloride, has a zero temperature coefficient up to 150 C. Because of this the

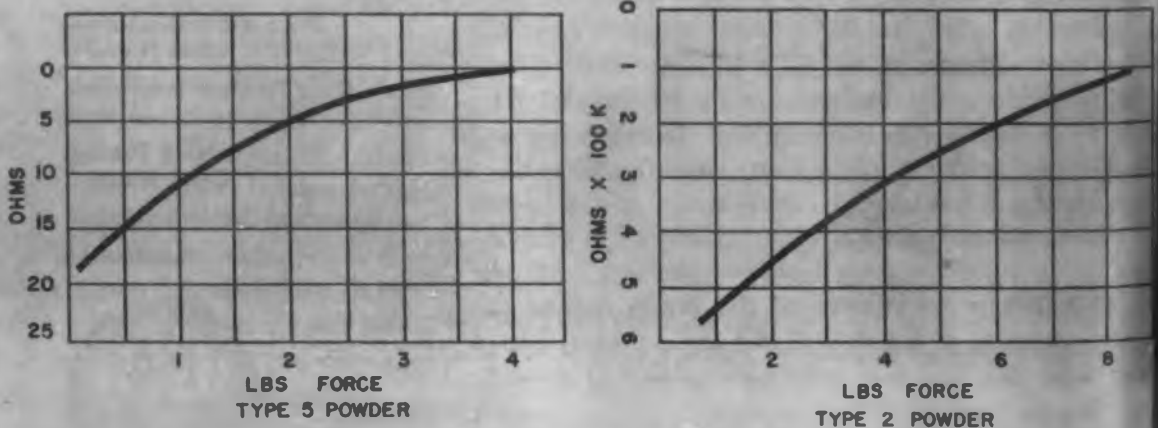


Fig. 1. Curves of two resistance powders show generally what may be expected in the way of resistance vs pressure as 23 C ambient. The curves may be changed due to area of material, and thickness.

Resistor

Resistor is temperature stable up to this value. Resistance is varied by changing the force applied to a small tablet or "Z" cell .125 in. diam. x .156 in. thick (Fig. 1). When the resistor is adjusted to its final in-circuit value, the socket head screw in the resistor end can be filled with cement to prevent tampering. Because of the high coefficient of friction between the set screw and the pressure cell no additional locking mechanism is needed to hold the set screw in place (Fig. 2). The resistor should find many applications in precision equipment where temperature stability and the accuracy—with the added advantage of adjustability—are desired. For further information on this adjustable resistor turn to Reader's Service Card and Circle 26.

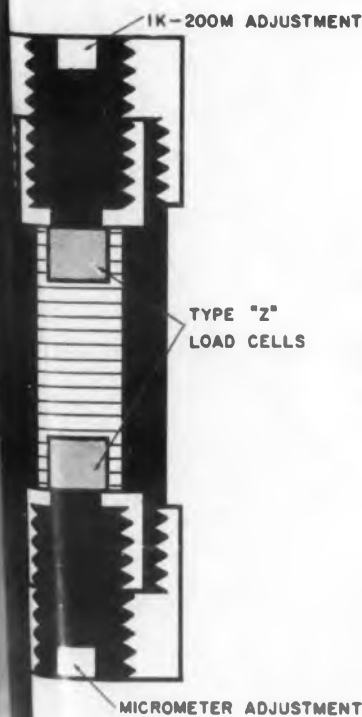


Fig. 2. Resistance is varied by turning socket head screws which change the pressure on the "Z" load cells.



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CIRCLE 27 ON READER-SERVICE CARD FOR MORE INFORMATION

RADAR jamming and electronic countermeasures are almost as old as radar itself. The recent publicity given to the new B-58 Bomber, the Hustler, stresses the number of black box electronic countermeasures systems carried on board for defense against radar equipped fighters or ground radar controlled defensive positions. This publicity serves to indicate that the radar designer must concern himself with the antijam capabilities of his equipment as well as its detection capabilities, for one without the other is useless for a military radar.

To determine a radar system jamming figure of merit expressed in nautical miles from the radar station to the jamming target has required prolonged and arduous calculations by the design engineer. The hand calculator shown here was designed to eliminate slide rule calculations. A few simple scale settings gives the distance at which the signal energy received at the radar is large enough to show through the jamming noise.

The original longhand and the new calculator methods for arriving at R_{ss} are shown side by side, for comparison. Given a hypothetical jamming situation with the following characteristics, we may arrive at a figure of merit:

$$\begin{aligned}
 P_R &= 10^6 \text{ w} \\
 G_R &= 43 \text{ db} \\
 P_j &= 2 \text{ w/mc} \\
 G_j &= 0 \text{ db} \\
 \tau &= 1 \text{ } \mu\text{sec} \\
 S/N &= 5 \\
 \sigma &= 50 \text{ meters}^2
 \end{aligned}$$

Longhand Solution

Convert G_R into a ratio
 $43 \text{ db} = 20,00 = 2 \times 10^4$

Multiply $P_R G_R$
 $10^6 \times (2 \times 10^4) = 2 \times 10^{10}$

Convert G_j into a ratio
 $0 \text{ db} = 1$

Multiply $P_j G_j$
 $2 \times 1 = 2$

Calculator Solution

Find 10^6 on P_R scale

Set 43 on G_R scale opposite 10^6 on P_R scale

Hold previous settings and find 2 on P_j scale

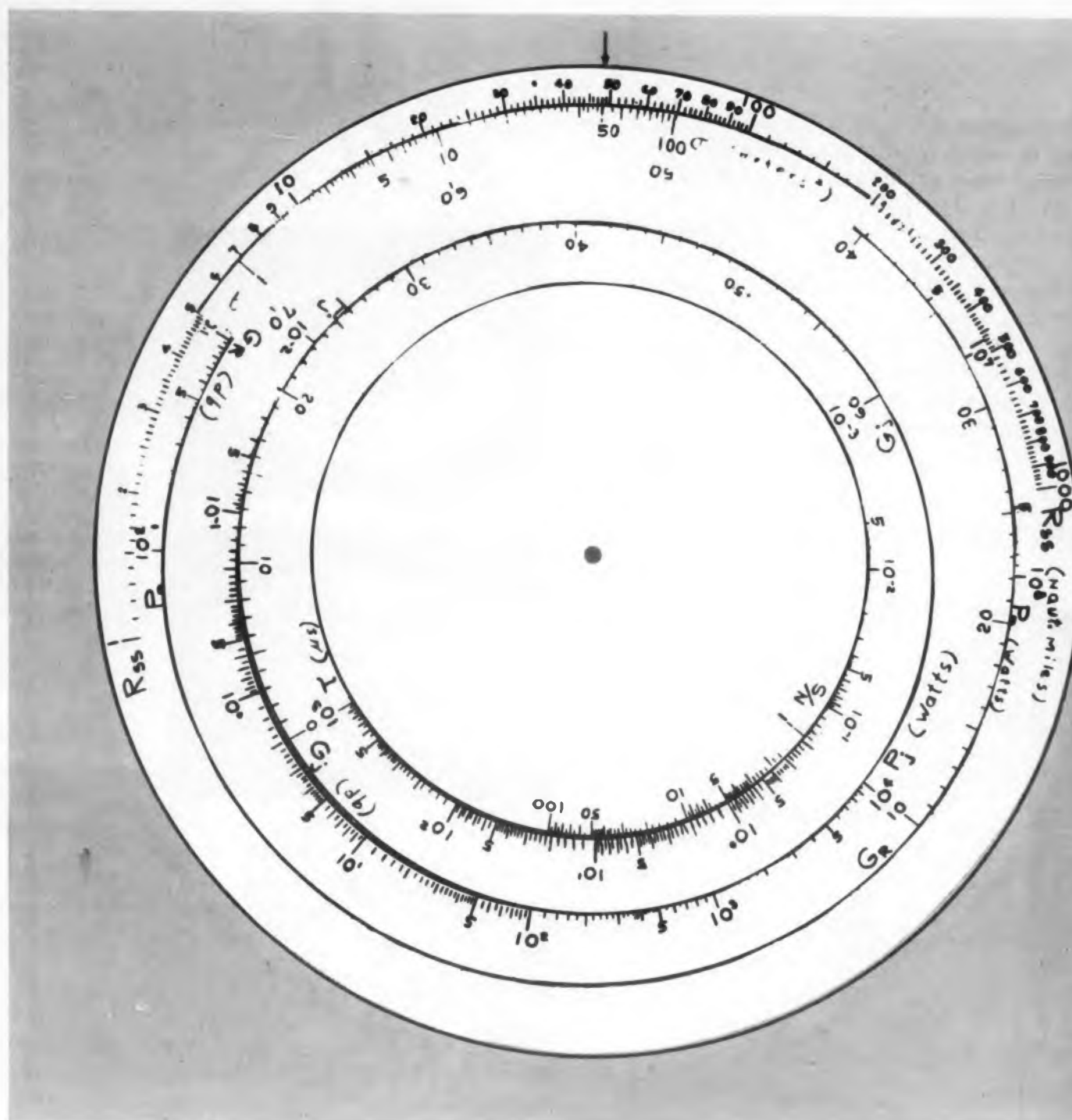
Set 0 on G_j scale opposite 2 on P_j scale

Copyrighted hand computer for calculating the range at which a radar target signal will appear through the target's jamming noise. This range, given in nautical miles, is known as the jamming figure of merit for the radar.

Jamming Figure of Merit for Radar Designers

A. Mandell* and W. G. Madison

Boston Research Lab
 Avco Mfg. Corp., Boston, Mass.



Longhand Solution

Generate the quotient

$$\frac{P_R G_R}{P_j G_j} = \frac{2 \times 10^{10}}{2} \\ = 1 \times 10^{10}$$

Multiply by $\tau = 1 \mu\text{sec}$
 $10^{10} \times 1 = 10^{10}$

Multiply by $\sigma = 50 \text{ m}^2$
 $10^{10} \times (5 \vee 10^1) = 5 \times 10^{11}$

Generate $4\pi = 12.57$

Generate $4\pi (S/N)$
 $12.57 \times 5 = 62.85$

Form the quotient of
 steps 7 and 9

$$\frac{5 \times 10^{11}}{62.85 \times 10^1} = 7.955 \times 10^9$$

Extract the square root
 $\sqrt{7.955 \times 10^9} = 8.92 \times 10^4$

Convert meters to
 nautical miles

$$R_{ss} = 48.168 \text{ naut. mi.}$$

An additional advantage of this calculator may be pointed out. Let us assume that the designer of our hypothetical radar feels that an R_{ss} equal to 75 nautical miles is the minimum acceptable. By the use of the calculator, he can easily see what parameters must be changed, and by how much. He might decide to change τ to 2.3 μsec , or P_R to 2.4 $\times 10^6 \text{ w}$, or G_R to 46.8 db, or he might alter a combination of these parameters, without recomputing the entire equation. For more information on the calculator, write to the company.

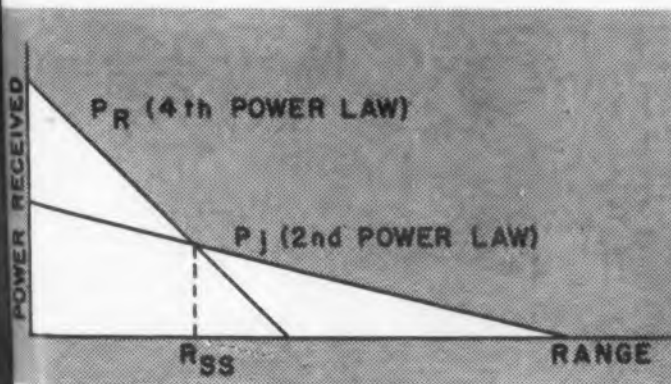


Fig. 1. R_{ss} , the figure of merit in nautical miles, is found at the cross-over point of the radar transmitted power and the jammer transmitted power per mc curves. The ordinate and abscissa are log scales in this illustration.

Calculator Solution

Hold all previous settings and find 1 on the τ scale

Set 5 on the S/N scale opposite 1 on the τ scale

Find 50 on the σ scale

Find $R_{ss} = 48+$ naut. mi. opposite 50 on the σ scale

Working Derivation of Merit Figure

A jamming figure of merit can be derived for a radar from the well known radar and beacon equations¹.

$$\text{Radar eq. } S_R = \frac{P_R G_R^2 \lambda^2 \sigma}{(4\pi)^3 R^4} \quad (1)$$

$$\text{Beacon eq. } S_b = \frac{P_R G_R G_b \lambda^2}{(4\pi)^2 R^2} \quad (2)$$

where S_R and S_b are the signal powers received by the radar and the beacon respectively in watts.

P = Radar transmitted peak power (watts)

R = Range (statute miles)

σ = Effective target cross section (ft^2)

λ = Wavelength (ft.)

G = Antenna gain ratio

The beacon equation is for one way transmission of energy, whereas the radar equation covers transmission of energy from a radar to a target and then the return of reflected energy from the target back to the radar.

To convert these equations into usable form, it is necessary to modify the beacon equation for use as a jammer equation. Our beacon equation will now be used to cover a situation whereby energy is transmitted from a jammer to a radar. The S_b will be relabeled as N for noise since the signal received at the radar will now be a noise jamming signal. In the remainder of the equation, conversions of subscript are made so that the jammer equation becomes:

$$N = \frac{P_j G_j G_R \lambda^2}{(4\pi)^2 R^2} \quad (3)$$

where the subscript j and R refer to jammer and radar respectively.

We may now solve for the S/N ratio using equations 1 and 3 which will just allow for detection of the target aircraft (the jammer). This detection occurs at a reduced range which is known as the crossover point, R_{ss} . Referring to Fig. 1 we see that as long as the target carrying the jammer remains beyond the crossover point in range his reflected radar signal is weaker than his jamming signal. Thus, until the jammer closes range to the crossover point, he will be effectively self-screened by the jamming energy he is transmitting.

Finally solving for R_{ss}

$$R_{ss} = \left[\frac{P_R G_R \sigma \tau}{P_j G_j 4\pi (S/N)} \right]^{\frac{1}{2}} \text{ meters} \quad (4)$$

P_R = radar transmitted peak power in watts

G_R = radar antenna gain ratio

P_j = jammer transmitted average power for megacycle

G_j = jammer antenna gain ratio

σ = effective target area cross section in square meters

τ = the radar pulse width in microseconds

S/N = the ratio of signal power to average jammer noise power required for 50 per cent detection probability.

This ratio usually runs between 1 to 5 and is a function of the number of radar pulse hits on the target per radar scan². For a radar with a large number of hits per scan, say approximately 100, then $S/N \approx 1$. For a radar with hits per scan ≤ 5 then $S/N \approx 5$.

An examination of equation 4 shows the various radar characteristics such as peak power, antenna gain and pulse width which are under the design control of the radar engineer. Implicit within the S/N ratio are such other characteristics as the prf, the beamwidth, and the antenna rotation speeds.

Another interesting use can be made of equation (4) by using it to compare the jamming effectiveness of presently operational radars against a particular jammer³. For some specific jammer values, a radar operator can calculate the reduced range of his equipment as against some other model of equipment. It is easy to see which characteristics of a radar should be improved to cope with a poor jammer detection range. One word of caution—the usefulness of equation 4 and the slide rule is for making comparative evaluations between radar equipments of different design characteristics, rather than an exact quantitative evaluation of the performance resulting from a specific radar design.

To simplify the use of equation 4, the circular slide rule calculator shown was designed. The use of this slide rule greatly simplifies the solution of R_{ss} in nautical miles. It is also just as easy to assume values for R_{ss} and then determine the design characteristics for the radar. In the use of the slide rule, the gain figures for G_R and G_j may be substituted directly in the more common db figures rather than antenna gain ratio.

The advantage inherent in the use of this calculator may be clearly seen if we take note now of the basic equation 4. We see immediately that the two gain factors (G_R, G_j) must be expressed as a ratio rather than db. Another disadvantage to the use of the equation directly is the inconvenience of the unit in which R_{ss} is expressed. R_{ss} comes out in meters instead of nautical miles.

The authors felt that this carrying of constants, working in inconvenient units, and taking of roots is at best rather messy and may lead to gross errors of computation as well as unnecessary consumption of time. They feel honor bound to point out that, working independently with slide rules, they rarely if ever arrived at the same value for R_{ss} on the first try.

Life does become somewhat more livable if it is desired to determine some of the other parameters, say S/N , since there is no square root to contend with:

$$S/N = \frac{P_R G_R \sigma \tau}{4\pi P_j G_j R_{ss}^2}$$

Even in this case there are still some rather nasty scale factors to contend with, and the unfamiliar forms of the parameters are still present. The expression for R_{ss} lends itself to logarithmic interpretation with ease, however. In the hand computer multiplicative constants are represented by a scale displacement, powers and roots are represented by scale compression and expansion, and the entire computation is performed by making seven settings.

1. Volume 1, Radiation Laboratory Series, Chapter II equations 3b and 4.

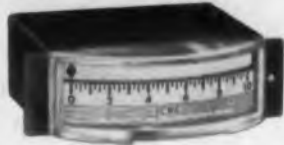
2. This data from an unpublished paper on detection probability by N. Slawsky.

3. For a rigorous mathematical derivation of equation (4) see Proceedings of the I.R.E. December, 1954, U. Tiberio, "The Reduced Range in a Radar Subjected to an External Noise Generator."

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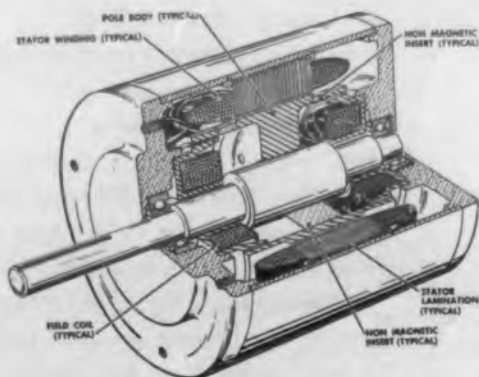
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Brushless Alternator



Brushless Alternator has no rotating windings.

Operating Theory

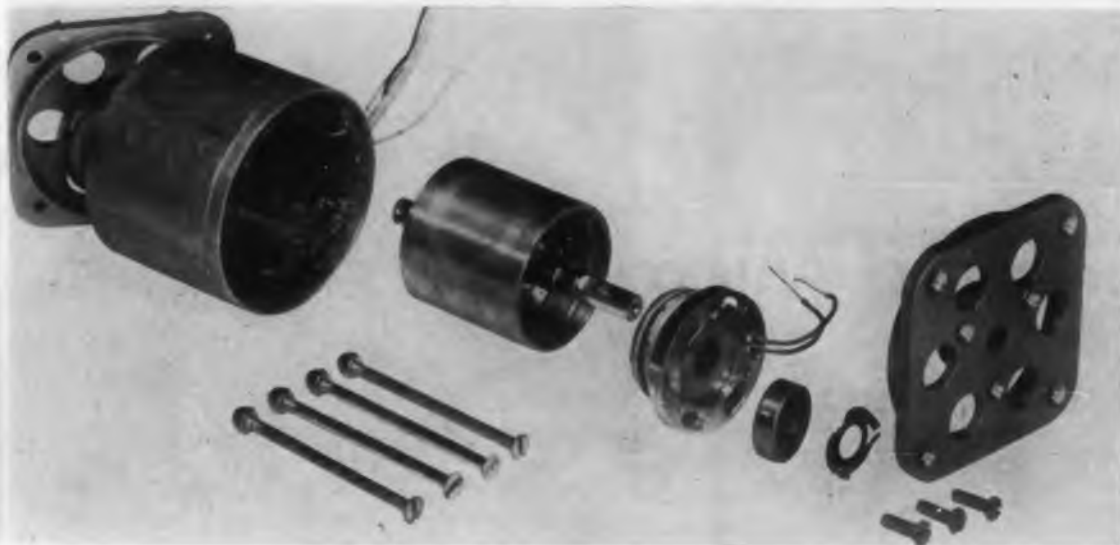
The armature or stator is the conventional type found in ordinary wound synchronous machines. A rotating portion and two duplicate stationary portions make up the field structure. Each of the stationary parts has a donut shaped field coil wound on a tubular steel core. Flux created in each core traverses a short airgap into the shaft and flows from both ends to a spider at the center of the machine.

Supported on the spider is a tube or field shell, consisting of magnetic and non-magnetic parts brazed or welded together. The magnetic inserts become poles of one polarity and the tube poles of the opposite polarity. The tube is positioned over the spider so that each of the magnetic inserts are over an arm of the spider. Flux coming up the spider from the shaft enters the insert and, just as in any conventional wound synchronous machine, crosses the rotor-stator airgap, goes around the stator and recrosses to the field at the opposite pole. Here it divides and goes axially to the outer edges of the tube where all poles of this polarity are joined forming a ring (actually the original tube). The flux here transfers to the stationary iron parts across homogenous airgaps to complete the path.

A SMOOTH metallic cylinder is the only rotating part of the brushless alternator. Field flux is generated in stationary iron members, by stationary exciting coils and the flux transferred via homogenous cylindrical gaps to a rotating salient pole field structure. Retaining all the advantages of a d-c excited salient pole synchronous alternator, the rotating assembly has no windings, and no sliprings or brushes are required (Fig. 1). By eliminating the rotating field winding, alternator failure caused by high speed is almost non-existent.



Fig. 1. Smooth metallic cylinder which replaces salient poles. Tests have been performed at speeds up to 60,000 rpm with excellent results.



Exploded view of Brushless Alternator

Manufactured by Bekey Electric Co., 1327 S. Main St., Los Angeles 15, Calif., the brushless machine can be used as a variable speed motor by controlling the frequency of excitation of the stationary field coils and supplying the stators with constant frequency power. The power required in the controlling field coils is only 2 to 5 per cent of the rated motor power.

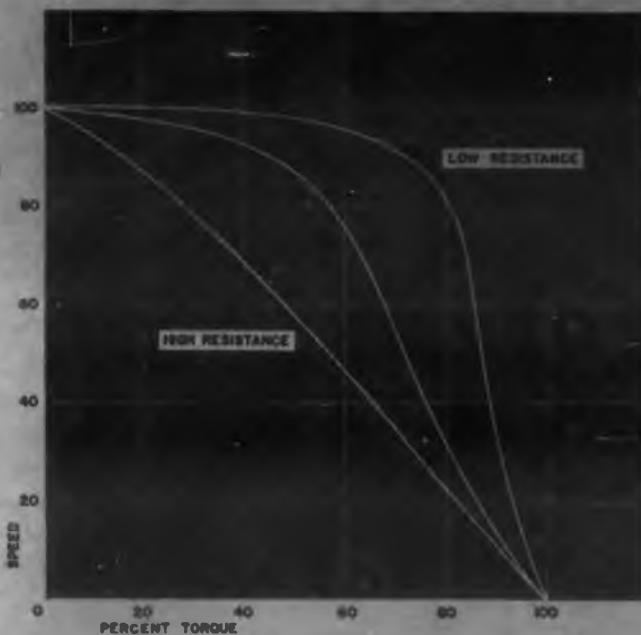
When used as a brushless induction motor torque and power output may be controlled by varying the d-c excitation on the field coils, without affecting the current

drawn by the stators from the a-c power line, much like saturable reactors, (Fig. 2).

It may be used as a constant speed motor operating from a variable frequency power line, by exciting the field coils with the difference between a standard frequency and the power line frequency. The resultant motor speed is as constant as the standard frequency source. Accuracies of ± 0.01 per cent may be readily achieved.

For further information on this brushless alternator, turn to the Reader's Service Card and Circle No. 29.

Fig. 2. Speed-Torque characteristics of Brushless Machine operating as induction motor, using rotor resistance as parameter.



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MODEL C
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MODEL E
4-pole, shaded pole AC Induction Type



MODEL D
4-pole, 4-coil shaded pole AC Induction Type



MODEL O
2-pole Capacitor Reversible Type AC only (for 6, 12, or 24 volts)



MODEL F
2-pole, shaded pole AC Induction Type

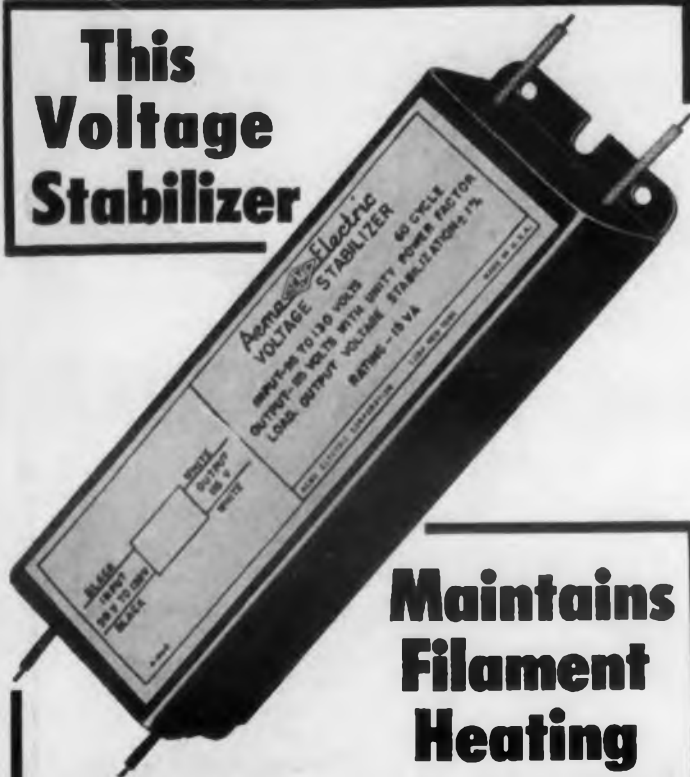


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Acme Electric
TRANSFORMERS

CIRCLE 31 ON READER-SERVICE CARD FOR MORE INFORMATION

Broadband Microwave Amplifier

THE PLATINOTRON is a new type of crossed-field vacuum tube used to amplify or generate microwave energy. It can be used as a compact, highly-efficient broad-band amplifier capable of handling high peak or average powers. Suitable feedback or stabilizing components enable the platinotron to be used as a frequency stabilized, self-excited oscillator that operates with high efficiency and high power output.

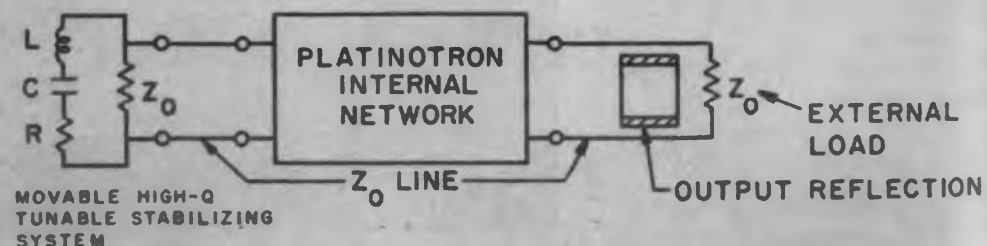
When used in this fashion the tube is referred to as the Amplitron or Stabilitron respectively, by the Raytheon Mfg. Co., Microwave and Power Tube Operations, Waltham 54, Mass. Mechanically the

platinotron resembles the magnetron but it has two, rather than one external rf connection. Unlike the magnetron it has no resonant circuit nor does it have an electron beam of uniform velocity. The operating frequency of the platinotron is determined by external influences such as an injected rf signal, reflections from a mismatched transmission line, or reflections from a high-Q cavity. The tube exhibits bi-directional properties as shown in Fig. 1. If rf energy is fed into the input connection of the tube, it appears in amplified form at the output connection. If rf energy is fed into the output, it appears with no gain and little or no loss at the input.



Fig. 1: The bi-directional properties of the platinotron allow rf energy fed into the output to appear at the input with little loss.

Fig. 2: Oscillator system using a platinotron, a feedback mismatch in the output circuit, and a tunable high-Q stabilizing system.



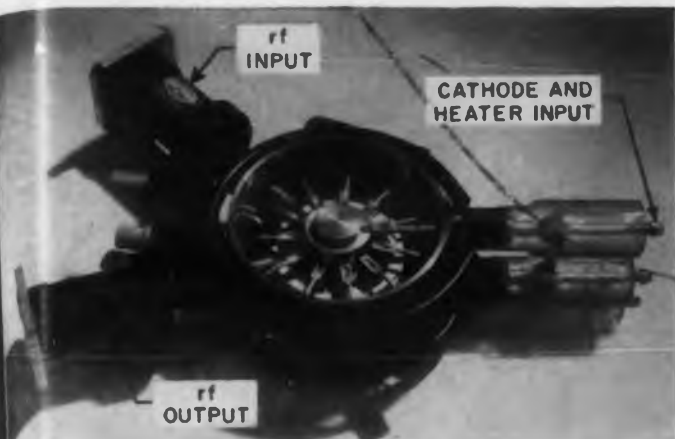


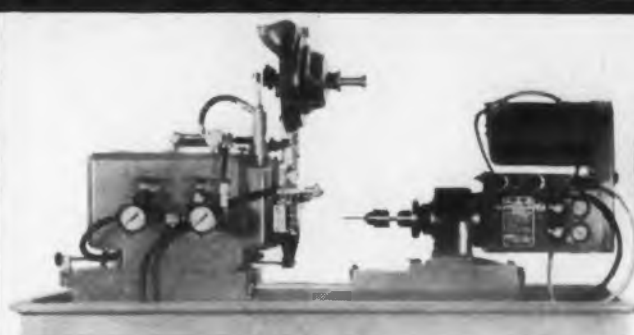
Fig. 3: Physical appearance of the L-Band platinotron, (with anode cover removed).

The oscillator system consists of a platinotron, a high-Q tunable stabilizing system, and a feedback reflection or mismatch in the output circuit (Fig. 2). Part of the signal that is amplified through the platinotron is reflected by the feedback mismatch in the output circuit of the platinotron, and travels through the tube back to the stabilizing system. This stabilizing system re-reflects only the energy that is at the resonant frequency of the stabilizing cavity. The system will oscillate only at the frequency of the high-Q tunable cavity. With an overall efficiency ranging from 45-60 per cent, the system has such great frequency stability that it could be used as a source of transmitted power in radar systems.

When used as an amplifier a nominal 10 per cent bandwidth is obtainable with efficiency values from 60-75 per cent across the tuning range. Pulse widths up to 20 μ secs duration can be used and phase pushing is about 1/10 that of conventional high-power amplifiers. Power supply regulation and modulator pulse shape are not critical elements in amplifier performance. Only a small permanent magnet is required, and both the platinotron and its driver may be operated from the same power supply and modulator.

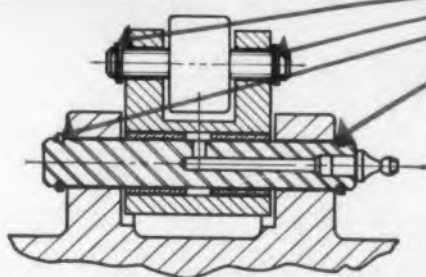
The amplifiers have been operated at L-Band, S-Band, C-Band and X-Band frequencies, producing as much as 1.5 megawatts in the L-Band 4.5 megawatts of peak power in the S-Band. As an oscillator, the platinotron has been operated at L-Band, S-Band and C-Band frequencies and has been used with search radar systems. The bi-directional properties of the amplifier make it possible to duplex on its input side and use existing radar complexing equipment. This arrangement allows the complexer to operate at the power level of the original rf driver, even though the system is operating on much higher transmitted peak power levels. The amplifier tubes have also been successfully cascaded for high-gain applications. For more information about this broadband microwave amplifier, fill out Reader's Service Card and circle No. 32.

Waldes Truarc Retaining Rings Eliminate Machining and Parts—Cut Assembly Time on Drill and Tapper



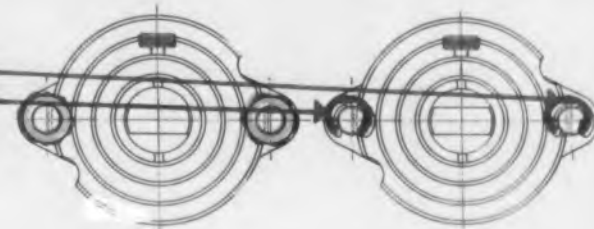
Beco Model 410 Drill and Tapper

The Batchelder Engineering Co., Inc., Springfield, Vermont uses 4 different sizes of 2 different type Waldes Truarc rings in their new BECO Model 410 Automatic Drill and Tapper. Truarc rings speed assembly, reduce machining, improve design.



Bell Crank Pivot Assembly

Truarc Rings (Series 5100) in Bell Crank Pivot assembly permit grease hole not possible with cotter pin fastener. Use of nuts would have increased machining and assembly costs considerably.

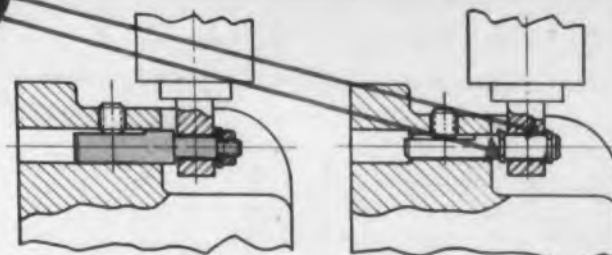


ALTERNATE DESIGN

TRUARC DESIGN

Clamp Cylinder Rod Stop Assembly

Truarc "E" Rings (Series 5133) replace stop nuts in the Clamp Cylinder assembly. They eliminate need for threading 2 rods...the danger of cross-threading nuts...and costly rejects. Truarc Rings cut assembly time and cost.



ALTERNATE DESIGN

TRUARC DESIGN

Hopper Cylinder Anchor Pin Assembly

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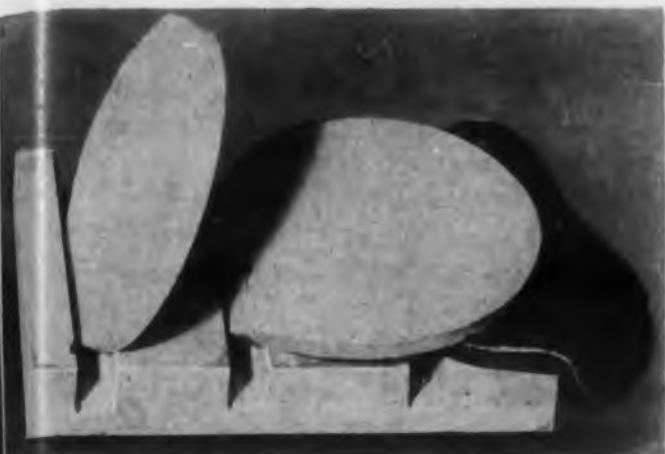
Temperature Test—Supramica 560 ceramoplastic insulation (left) is compared to Supramica 555 ceramoplastic (center) and Mycalex 410 glass-bonded mica (right)—the best previously available materials with comparable properties.

500 C Ins

CONTINUOUS operating temperatures in excess of 500 C cause no damage to Supramica 560, moldable ceramoplastic insulating material. Its ability to withstand extremely high temperatures promises to free design engineers from many of the functional limitations imposed by conventional insulating material.

Manufactured by the Mycalex Corporation, America, Clifton Boulevard, Clifton, New Jersey, Supramica 560 retains the electrical properties common to other ceramoplastics. It can be precisely molded to very close tolerances and is dimensionally stable during and after fabrication. Because a thermal expansion coefficient close to that of steel, functional or reinforcing inserts may be molded without risk of their loosening and causing electrical breakdown.

The specific gravity of Supramica has been reduced to 2.8, only slightly higher than that of mineral-filled alkyds and polyester glass compounds. Electrical and physical characteristics of the insulator are: dissipation factor at 1 meg—0.0035; dielectric constant at 1 meg—6.8; loss factor at 1 meg—0.024; volume resistivity ohm-cm— 5×10^{13} ; specific gravity 2.8; water absorption, 24 hours—Nil; hardness (Rockwell M)—125; thermal expansion per degree C at 20 C— 13×10^{-6} .



75 minutes at 550 C plus 15 minutes at 650 C Supramica 560 ceramoplastic shows no noticeable effect—Supramica 555 has completely cracked through—Mycalex 410 has collapsed.

Insulator

Lighter in weight than comparable materials available, it is a good insulation for relay bases, connectors, tube sockets and many other parts of high temperature components. The combination of lighter weight and greater thermal endurance is of particular advantage in quality components for airborne and missile applications. For further information on this insulator, turn to Reader's Service Card and Circle 35.

Dimension molded parts before high temperature test are shown at right. Dimensional change and distortion are shown below, after subjected to 75 minutes at 550 C plus 15 minutes at 650 C.



Dimensional Increase During Test

	Mycalax	Supramica	
		555	560
Length	12%	5.5%	0.4%
Width	18%	4.1%	No change



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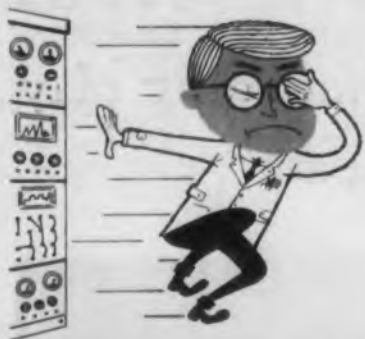
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Here Mr. Wells is shown at the attractive console of a cabinet composed of many basic modules. Assembly was accomplished using only a screw driver.

Designing with Modular Enclosures

THE MODULAR cabinet has the advantage that it involves no packaging development cost and saves time when used for prototypes to prove out or demonstrate the feasibility of a design. It can also be used for production runs in limited quantities; and, if the appearance and general design proves completely satisfactory, the modular package can often be put into full production at substantial time and cost savings. Some typical modular units and combinations are illustrated here. Those shown are manufactured by Elgin Metalformers Corp., Elgin, Illinois.

In an interview with electronic engineer James G. Wells, who with Samuel K. Frankel was instrumental in developing modular cabinets at Elgin Metalformers Corp., answers to pertinent design questions were obtained.

What general rules govern the use of modular construction?

Modular packaging is useful in meeting the prob-

lem of a very fast development and research program. The packaging must be so flexible that it can be expanded or contracted at will to meet frequent changes in design. Periods of thirty to ninety days are frequently required to produce a custom cabinet for equipment from the time of conception to delivered units, ready for an engineer to insert his gear. With a modular system that offers flexibility and a highly versatile selection of parts and components that can be shifted around with the change of engineering design, trend, or practice, economy in engineering planning is facilitated.

Another advantage of modular cabinet construction is that the modules are small to handle and make for economy of material handling. Also modular cabinets can be readily "plugged" into other modules to complete a system, and "unplugged" for moving. This feature reduces the maintenance and service problems.

The modules, being small, can go through the standard 30 inch doors and areaways which are

normally used, thus avoids knocking out holes in doors or taking out sections of windows to bring large consoles or system cabinets into the place of use. Using the modular concept, it is possible to vary the design at will to fit a particular space situation without going to large additional designing expense and special tooling cost.

In such areas of activity as the computer field, where many like circuit units are employed, modular cabinet design is particularly applicable.

Is there a cost saving by using modular cabinets instead of those of custom design? What factors are involved?

There is a break-even point on cost. Where the volume required is no greater than what would

constitute a reasonable order for the modular cabinet manufacturer, custom cabinets cannot generally be produced more cheaply. This is in part because much of the tooling can be written off against many orders and need not be applied to a specific order only. The same dies can be used for many customers' cabinets. Also, special design and engineering cost is avoided. Such costs for a custom cabinet design would have to be written off against the number of units involved.

How would a design engineer go about selecting a modular cabinet to fit his particular design?

There are several factors which an engineer must consider when his project has as its ultimate end a product design completely packaged: 1. the end

use of the product; 2. the environment under which it will be used; 3. and most important of all, the overall circuitry of instrumentation to be included. All of these factors taken together will determine the approximate volume, shape, and dimensions of the package.

Not only should some advice from the mechanical engineering group be sought but also advice from the sales group to assure that the eventual design will meet customer demands. Next step is to investigate modular cabinets available on the market. If quantities required are small to start with, modular cabinets should certainly be considered. Their use in such instances will almost always result in substantial savings. This is because they eliminate a heavy investment in design and development



A modular rectangular upright rack. It is available in six different sizes from 40 1/4 to 70 in. of vertical panel space—which is available on the front and back sides of each rack. On this installation a drawer and a combination of various steel formed panels are shown. The racks are completely modular and can be bolted together, side by side, by removing the side panels. One piece hinged doors covering the entire front or back are also available. Writing tops can also be installed.

An assembly using three rectangular upright frames with one pair of side panels for the rear section, two frames with drawers, and one center section writing top for the front section.

This triple-unit control console assembly demonstrates one of the countless variations possible when combining modular components. Here dummy front panels are shown in the turret sections. The chassis slide out easily by using a chassis guide kit. Three side panels may be removed and several more units added to the assembly to enlarge and expand a system at any future time. The front sections illustrate the use of several types of chassis and panel drawers, and plain formed panels. All the hardware shown is stock. With casters, the units are easily moved around. The come-apart feature of a system of this kind offers a solution to the shipping problem. Ample outlets are built to facilitate interconnecting cable plugs, etc. Only moments are required to lock the units in place upon installation.



Single equipment-drawer compartment with a turret assembly to make a low silhouette console. The top panel of the compartment has been removed and the turret mounted over the opening by means of standard joining channels. The 19 by 10½ opening will easily take a 13 in. depth chassis. The turret is reversible so that the 7 in. opening may be presented to the front.



Basic frame of Equipment-Drawer Compartment showing "cradle" slide installed. The sliding cradle takes a chassis or drawer up to 17 in. wide. The case-slides are adjustable in 1 and ¾ in. steps in height. Holes are on standard "Universal" centers for communication panels and are sized to take the Tinnerman fastener system.



A television and audio monitor console assembled from standard basic units.

of the package. Checking catalogs of the modular cabinet manufacturer will help determine if required cabinet features are available in such design.

Does the fact that modular cabinets have extra holes that are not being used, and that certain facilities are provided that may not be fully utilized, increase the cost of such cabinets to a manufacturer?

No. Because, as a mass-produced item the overall tooling of these features is divided among a large quantity of cabinets over a long period of time.

What, if any, custom features can be provided without added cost?

Changes in height, width or depth of the modular cabinet can be made economically, but at some additional cost, as long as standard tooling can be used. As an example: To change the width, the only pieces that would have to be changed are the four cross strut pieces used in the frame. The doors, for instance, can be made any size without changing the tooling. EMCOR Flexible Electronic Enclosures, as designed, follow standards established by RETMA, Western Electric and the furniture industry. The overall height and finishes used are based on standards of the furniture manufacturers. The standard cabinet is based on a 19 inch panel width, but cabinets are also available to other standards, such as Naval Standards—21 inch, Telephone Standards—23 inch, and the Communication Standard for large paneling—24 inch.

Can one have a selection of hardware or must a designer accept standard hardware?

Hardware is not of EMCOR manufacture. It can

be varied, but a variation from standard high quality hardware does cost extra. However, it can be had readily in accordance with special requirements.

When should a designer often refrain from use of modular construction?

Sometimes when it is particularly important for a company to have product identity which is singularly theirs. However, it is not impossible to get

this product identity with modular cabinets without too much cost. For instance, one can have a special paint color, different type hardware, or chrome stripping. Such changes will add cost, but in many cases it may be worth the additional expense in order to get the special effect required. One should consider as a designer, however, whether the additional cost involved in getting this product identity is offset by the advantages obtained.



Basic frame assembly for sloping-panel console module element, showing details of construction.



Possible triple-unit control console assembly, using three sloping-panel console units as frames for the back section. Drawers and doors shown may be re-arranged, or different sizes can be selected as desired.



Sloping-panel console unit with writing top attached. The ball-cornered side panels on the top are removable and the same mounting holes are used for fastening to other tops, or equipment/drawer compartments, in multi-unit assemblies. A work top is shown in the 19 x 14 in. well space. This space has side-mounted angles with universal hole-mount centers to accept any communication type panel or instrumentation.

What information do you need from a design engineer in order to give him the kind of a cabinet package that he requires?

The amount of instrumentation involved, panel space needed, and cubical area required for the electronic circuitry and other equipment to be included. This latter might involve equipment not mechanically linked to the panel instrumentation—such as blowers, power supplies, and termination boards.

Also, it is desirable to know whether the equipment is to be operated intermittently or continuously, whether automatic, or with an operator or operators. Does the operator stand up or sit down, and what other human engineering aspects are involved? Is there a floor space problem? How much room is available for the equipment and what is the room shape?

In what way, if any, is it necessary for the cabinetry to match other equipment along side of which it may be employed? What is the general effect desired in the office or area where the equipment is to be used? In what manner might the design require expansion or contraction at some later time—such as horizontally, vertically, in depth, etc?

Under what illumination conditions will the equipment be operated? For instance, for high overhead illumination, eye fatigue in reading meters might make it desirable to slant the meter panel to avoid glare. The modular cabinet manufacturer could recommend an arrangement which would correct this problem. The modular assembly design could assure that all such factors that are important to the designer would be taken into account.



Westinghouse Silicon Rectifier WN-5082 with maximum peak inverse voltage ratings of 50-400 v. (300 to 5000 amperes in bridge assemblies.)



Silicon^(S) Rectifiers win in grueling use tests

THE PROBLEM: Use six (6) Westinghouse 5082 diodes in a 3-phase full-wave bridge for an arc welder—the most rugged, most challenging application that can be found. See how they stand up under this rigorous duty cycle, high short-circuit peaks, alternate heating and cooling, and transient voltage spikes. Compare the performance with other types of rectifiers.

THE PERFORMANCE: Hundreds of these arc welders are today successfully performing for satisfied customers. Over 100,000 grueling duty cycles in industrial use have proved the value of Westinghouse Semiconductor Department's High Power Laboratory where this application was pretested round-the-clock with 35,000 duty cycles.

THE CONCLUSION: Westinghouse Silicon Rectifiers provide important advantages to builders and specifiers of rectifier assemblies . . . improve equipment design and operational efficiency with:

- More power in less space
- Higher temperature operation
- Lowered installation costs
- Unlimited life span
- Minimum maintenance expense
- Reduced power loss

Get the facts first hand!

The coupon will bring you complete engineering experience . . . suggested circuits . . . positive proof of new reliability, efficiency and economy.

WESTINGHOUSE ELECTRIC CORPORATION
P. O. Box 868, Pittsburgh 30, Pa.

Please send me data on the new Westinghouse WN-5082 Silicon Diode.

Please send me data on other Westinghouse Silicon Diodes. (Describe types or applications) _____

Name _____

Title _____ Firm _____

Address _____

City _____ Zone _____ State _____

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

CIRCLE 38 ON READER-SERVICE CARD FOR MORE INFORMATION



Westinghouse Type RA Single Operator D-C Arc Welder



ELECTRONICS IN BRITAIN

The British Electronics Industry is making giant strides with new developments in a variety of fields. Mullard tubes are an important contribution to this progress.

The expert choice for



medium
power,
high
fidelity
equipment

EL84

Principal Ratings

Heater	6.3V, 0.76A
Max. plate voltage	300V
Max. plate dissipation	12W
Max. screen voltage	300V
Max. screen dissipation (max. signal)	4W
Max. cathode current	65mA

Base

Small button noval 9-pin

Supplies available from:—

In the U.S.A.

International Electronics Corporation, Dept.
ED5, 81 Spring Street, N.Y. 12, New York, U.S.A.

In Canada

Rogers Majestic Electronics Limited, Dept. J.E.,
11-19 Brentcliffe Road, Toronto 17, Ontario,
Canada.

British high fidelity experts know that for medium powered equipment there is no finer tube than the EL84. A pair of these tubes provide a power output of 10W at a distortion level of less than 1% while their transconductance value of 11,300 μ mhos results in exceptional sensitivity. The EL84 may also be used for higher powers. For example, two tubes in push-pull will provide outputs of up to 17W at an overall distortion of 4%.

A single EL84 has a maximum plate dissipation of 12W. It provides an output of 5-6W for an input signal of less than 5V r.m.s. at plate and screen voltages of 250V.

Supplies of the EL84 for replacement in British equipments are available from the companies listed.

Mullard

ELECTRONIC TUBES

used throughout the world

MULLARD OVERSEAS LTD., MULLARD HOUSE, TORRINGTON PLACE, LONDON, ENGLAND



Mullard is the Trade Mark of Mullard Ltd., and is registered in most of the principal countries of the world.

CIRCLE 39 ON READER-SERVICE CARD FOR MORE INFORMATION



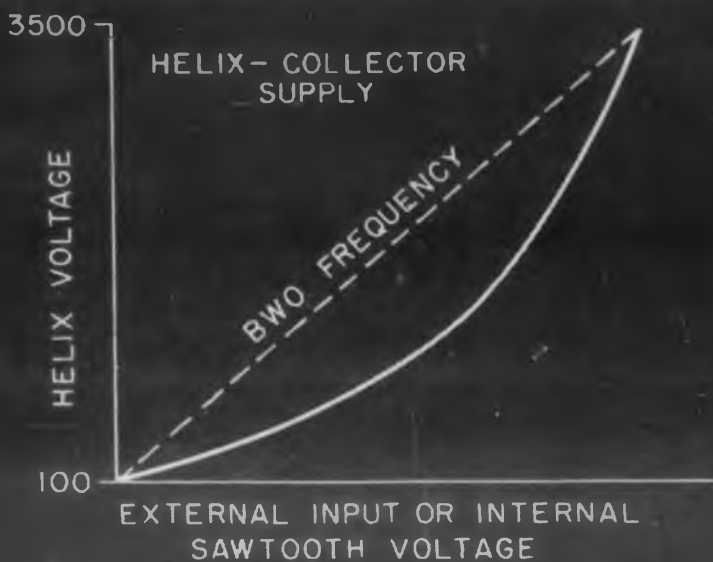
Sweeping Power Supply

THIS SWEEPING power supply, for general laboratory use with traveling-wave tubes, delivers an exponentially increasing output with linearly increasing input. Power is available from the supply for the helix, collector, anode, and heater, as well as solenoid and blower. Special overload circuits are included to prevent damage to the traveling-wave tube or solenoid from failures or misadjustment.

The helix-collector supply of this instrument, manufactured by Alfred Electronics, 897 Commercial Street, Palo Alto, Calif.—employs a non-linear feedback amplifier to provide voltage in the range of 100 to 3500 v. By means of panel controls the supply may be selected to provide any of four types of output—dc, dc plus a small sinusoidal 60 cycle modulation of helix voltage only, nonlinear amplification of an external input signal, or voltage increasing exponentially with time. Both the amplified signal and exponential sweep can cover the entire voltage range or any portion of it. The sweep may be single or recurrent at rates suitable for either chart recorder or oscilloscope display.

Known as the Model 601 Sweeping Power Supply, the unit is particularly suitable for variable frequency operation of backward-wave and similar voltage-tuned microwave oscillator tubes. Oscillator tubes having logarithmic frequency vs helix-collector voltage characteristics will yield linear frequency output vs time or external input voltage. panel voltmeter reads helix-collector voltage (frequency) or its logarithm (linear frequency).

The anode supply output may be dc or modulated by either an internal square wave or an external source. External connection has response from approximately 50 kc and permits feedback of



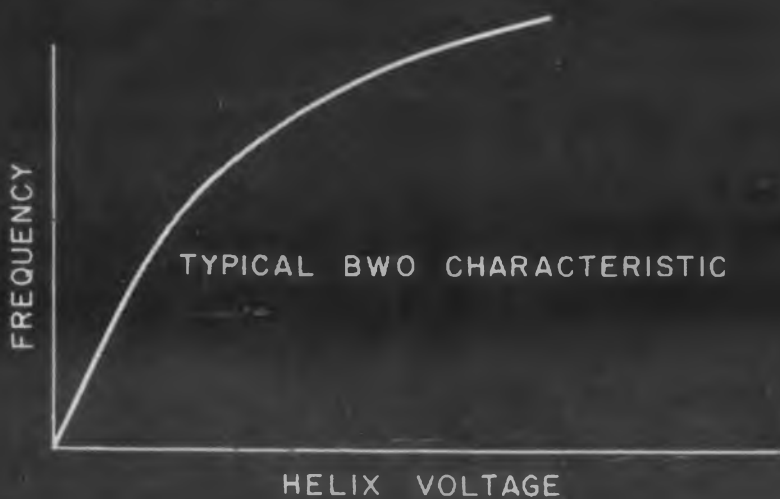
Sweeping Power Supply

General purpose oscillator output for automatic amplitude control. The heater power source is magnetically regulated for stable traveling-wave tube operation. The solenoid supply provides well filtered dc for focusing modulation.

Specifications

As constructed, the Model 601 Sweeping Power Supply can be used on a bench; or, by removal of the outside sheet-metal sides, it may be mounted in a standard relay rack. Size is 19-1/4 in. high, 20 in. wide, and 16-1/2 in. deep. Weight is 112 lb. Power output required is approx. 1100 va at 105 to 125 v, 60 cps.

For additional information about this product, contact the Reader's Service Card and circle No. 40.





**INSULATED
HIGH TEMPERATURE
HOOK UP and LEAD WIRE**

*For MILITARY and COMMERCIAL
END USE EQUIPMENT and
ELECTRONIC COMPONENTS*

Conforming to MIL-W-16878B

Lenz High Temperature Hook-Up and Lead Wires contain thermo-plastic insulation that will retain its high dielectric characteristics over a temperature range from -55°C to $+105^{\circ}\text{C}$.

- Type B 600 Volts r.m.s.
- Type C 1000 Volts r.m.s.
- Type D 3000 Volts r.m.s.

This wire can be furnished in various jackets or shielding, and can be incorporated in multiple conductor cables. Available in solid colors or striping and built to Lenz unsurpassed standards.

Conforming to MIL-W-76A

General purpose Hook-Up and Lead Wires for internal wiring of electric and electronic equipment, with thermo-plastic insulation for use at temperatures to 80°C .

- Type LW 300 Volts r.m.s.
- Type MW 1000 Volts r.m.s.
- Type HW 3000 Volts r.m.s.

Can be furnished with nylon jackets, glass braid, lacquered, and shielding. Can be incorporated into multiple jacketed cables to suit your specifications. Available in solid colors or striping to meet your code requirements.

**CONSULT LENZ FOR ALL YOUR
ELECTRONIC WIRE AND CABLE NEEDS**

In Lenz, you will find a dependable, experienced organization that will cooperate with you in the production of wires and cables to your requirements. Its high quality standards, intimate knowledge of the industry's needs and extensive facilities for wire insulating and cabling make Lenz an ideal source for all your wires and cables.



CABLES

and

WIRES

LENZ ELECTRIC MANUFACTURING CO.

1753 North Western Avenue

Chicago 47, Illinois

CIRCLE 41 ON READER-SERVICE CARD FOR MORE INFORMATION

General NEW HI-SPEED NPN SWITCHING TRANSISTORS Assures Computer Reliability

Computer engineers long seeking NPN transistors in applications requiring high current and fast switching will specify General Transistor's new 2N356, 2N357, and 2N358 for peak reliability.

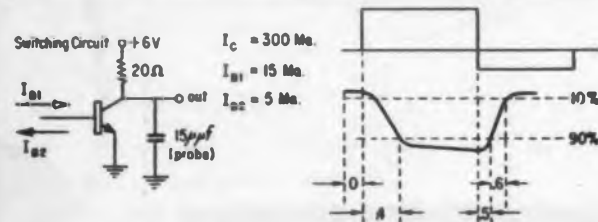
2N358: As developed by General, a typical switching speed of .4 of a microsecond at 300 milliampères of collector current is possible with only 15 ma. of drive current.

The series resistance of these GT transistors, when conducting, is $\frac{1}{2}$ ohm; the nonconducting series resistance is as high as 5 megohms with a result that approaches optimum efficiency at high current levels.

Computer manufacturers know they can depend on General's engineering and development as well as their quality and service. That's why GT is the largest supplier of transistors for computers.

2N358 CHARACTERISTICS

Parameter	Conditions	Min	Typical	Max
Collector-Base Voltage	$I_c = 25\mu a$ $V_{cb} = 5V$	20V	30V	
Collector Cutoff Current	$I_c = 300ma$ $V_{ce} = .25V$	20	30	50
D.C. Current Gain	$I_c = 1ma$ $V_{cb} = 5V$		9mc	
Alpha Cutoff Frequency	$I_c = 1ma$		9mc	



Write for GT's special NPN Computer Transistor Specifications Bulletin.

GENERAL TRANSISTOR CORP.

Jamaica 35, N. Y.—OLympia 7-9700
Cable: Transistor New York



2N356, NPN
2N357, NPN
2N358, NPN

CIRCLE 42 ON READER-SERVICE CARD FOR MORE INFORMATION

Meeting Report

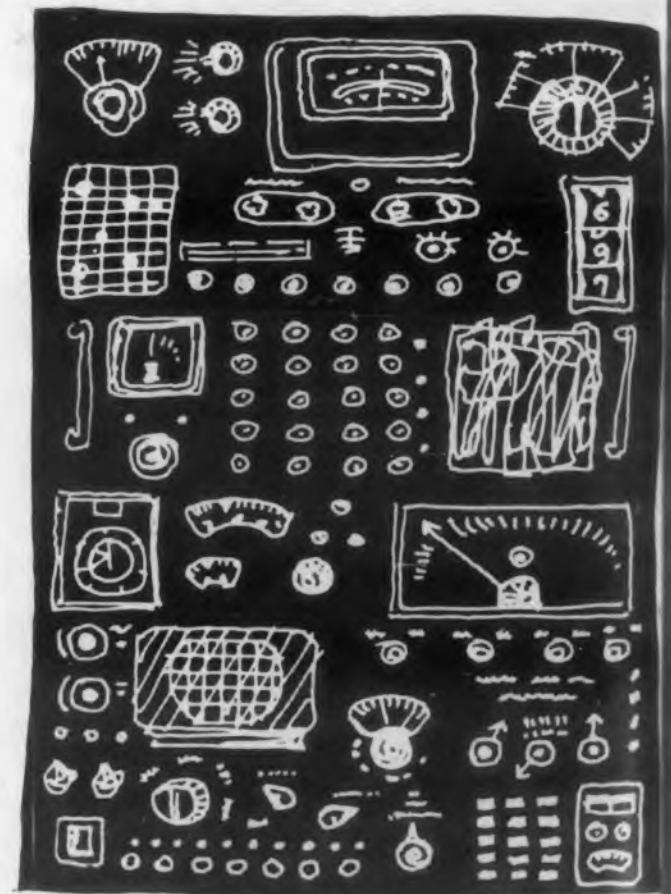
Design For Service—

Theme of Second

Instrumentation

& Control

Conference



TOO MUCH "down time" is experienced with electronic instruments because of service difficulties. This was the message to designers given by speakers and attendees at the *Instrumentation and Control In The Process Industries Conference* at Chicago in February. Sponsored by Armour Research Foundation and under the chairmanship of V. H. Disney, Manager of Armour's Electrical Engineering Research Department, the Conference was obviously held to examine ways of dealing with the electronic "monster" that is rapidly infiltrating the numerous process industries in the name of automation. The two-day conference at Chicago's Hotel Sherman, Feb. 6 and 7, 1957, was primarily attended by Process Industry executives. There was a message, however, for electronic design engineers.

It should not be inferred that there is any objection by the Process Industries whatsoever to electronics coming in to help solve the industrial control problems—quite the opposite. They recognize the advantages that accrue by using automatic control equipment for many applications and naturally want to get the most for their money. There are problems presented, however, because there are few if any electronic specialists on the payroll of most process industries who understand the inner workings of the "brains" that control the processes. When anything goes wrong, "down time" is very costly; so are technicians flown in from the companies that supply the electronic gear.

Short Course Needed

Typical of comments made were some by Keator McCubbin, Vice-President of Blaw-Knox Co. He made the following observations and suggestions:

The ultimate user is inadequate to cope with the maintenance problem of automation and computer equipment. A practical short course in instrument servicing could be given to users that would take the mystery, false glamour and feeling of insecurity away—a problem that has existed for ten years.

Manufacturer's Reps should be better trained on practical trouble shooting in the field.

Instruction manuals often cover too many different models of instruments in one volume. A separate volume on each model would speed servicing. An alternative, if necessary, would be to code appropriate paragraphs that apply to specific instruments for easy reference. Manuals are generally adequate but confusing.

Standardize Components

Delays and difficulties in obtaining parts for automatic control and computing equipment, as well as service, adds to production as well as maintenance and repair expense. Standardization of electronic parts and equipment, which would reduce the number of different repair parts to stock, should help materially. Modular plug-in units were also suggested to help in this regard.



"YOU FRAMED ME, NICK, AND I TOLD YOU I'D GET SQUARE. NOW . . ." And then the film broke! Film breakage—cause of movie audience irritation in the "old days"—is a minor problem today. Tomorrow

it will be a rarity. *Reasons:* Newly developed, polyester base motion picture film of unusual strength and durability (duPont "Cronar," for example) and better film splicers like that shown here.



NATIONAL HELPS NEW SPLICER BOND FILM INSTANTLY—without disturbing original molecular orientation. Non-acetate film cannot be spliced satisfactorily by conventional methods. So the new device, developed by Shepard Laboratories, Inc., Summit, N. J. uses intense high-frequency heat to fuse the film instantly—without "burning" or affecting grain, high strength or durability. Side result: a superior splicer for all types of film.



IMPROVES PERFORMANCE—KEEPS COSTS DOWN. PHENOLITE®, used in electrode supporting blocks, offers complete resistance to carbonizing. Copper-clad PHENOLITE for printed circuits cuts costs and improves circuitry. Shepard tells us: "PHENOLITE passed our tests . . . Reasonable price holds our costs down."

NATIONAL CAN HELP YOU

reduce unit product cost or improve product performance at no added cost. Here's why: You can select the "one best material" from over 100 grades of PHENOLITE®, Vulcanized Fibre and National Nylon—without compromise in properties or cost. You can simplify production and purchasing with the timed delivery of 100% usable parts—from a single, reliable source. You gain competitively with National's new materials and grades—the direct results of programmed materials research. You benefit by calling National first. Check Sweet's PD File 2b/Na, the Telephone Directory Yellow Pages, or write Wilmington 99, Delaware, Dept. B.

NATIONAL
VULCANIZED FIBRE CO.

WILMINGTON 99, DELAWARE
In Canada: NATIONAL FIBRE CO. OF CANADA, LTD., Toronto 3, Ont.

See National at the DESIGN ENGINEERING SHOW—New York—May 20-23, Booth No. 837
CIRCLE 43 ON READER-SERVICE CARD FOR MORE INFORMATION

New small basic switch is low cost; directly interchangeable with AN3234 Specs

The new Electro-Snap F2 Series snap action switches are extra-compact with extremely high electrical capacity for their size. Mechanical and electrical life at 1/32" overtravel is 150,000 operations, minimum, with accurate repeatability and constant stability of tolerances. Self-aligning springs provide contact wiping action rare in a switch of this size.

Durable case of special plastic gives the switch an ambient temperature rating of -100° to +275° F. or +375° F. Available, at low cost, in three basic models with a wide selection of actuators.

SERIES F2 BASIC SWITCH: F2-3: Single Pole, Double Throw
F2-2: Single Pole, Normally Open; F2-1: Single Pole, Normally Closed

OPERATING CHARACTERISTICS

Electrical Rating: 10 AMP. 125/250 V. A.C. 60 cycles
30 V. D.C. inductive and resistive (6 AMP. 30 V. D.C. for Airborne Application)
Operating Force, 7 to 12 oz. Movement Differential, .011 ± .005
Reset Force, 4 oz. Min. Overtravel, 1/32 Min.
Pretravel, 3/64 Max.

WRITE FOR DETAILS IN DATA SHEET FS-5



ELECTRO-SNAP
SWITCH & MFG. CO.
4216 W. LAKE ST., CHICAGO 24, ILLINOIS



F2 SERIES

New subminiature sealed switch is environment-free; mounts interchangeably with MS25085



MODEL EF-3

Single Pole, Double Throw
Move. Differential, .004 Max.
Overtravel, .003 Min.
Oper. Force, 5 to 17 oz.
Release Force, 60 gram
Elec. Life Ratings:
150,000 ops. @ 125/250 V. A.C.,
2.5 AMP.
100,000 ops. @ 125/250 V. A.C.,
5.0 AMP.
50,000 ops. @ 30 V. D.C.,
(2.5 AMP., IND.; 4.0 AMP., RES.)
Amb. Temp., -65° to +180° F.

Sealed in a corrosion-resistant, treated aluminum enclosure, this tiny switch is environment-free; highly vibration and shock resistant. It carries 5 amps. at 125/250 V.A.C. with an electrical life rating of 100,000 operations. Low operating force and small movement differential make it ideal for bi-metal temperature, diaphragm operated and other "feather-touch" devices, while small size permits mounting singly or ganged in restricted space. Rugged and dependable, it has positive snap action.

WRITE FOR DETAILS IN DATA SHEET ES-5



ELECTRO-SNAP
SWITCH & MFG. CO.
4216 W. LAKE ST., CHICAGO 24, ILLINOIS

CIRCLE 44 ON READER-SERVICE CARD FOR MORE INFORMATION

Design Aid

Transformer Design Nomograph-1

Martin Berger, Minitran Corp.
5 Oliver St.
Newark, New Jersey

THIS Iron Core Inductance nomograph is intended for use in designing small audio transformers and filter inductances. It is the first of a series of five transformer design nomographs that will appear in ELECTRONIC DESIGN. It is meant for practical use and therefore assumes ordinary methods of construction. Where core sizes are given, the following is applicable.

- ▶ For laminated structures of flat stampings, a square stack is implied; a stacking factor of 0.9 is already taken into account. The reference numbers to the laminations given are those of Allegheny-Ludlum.
- ▶ For the toroids, nomenclature used is Magnetic Metals' case numbers, with a stacking factor of 0.9 taken into account.

The user of the nomograph is not limited to the core sizes shown. For other core sizes, it is necessary only to solve, by normal calculations, the particular problem represented by the nomograph for the unlisted core. The resulting data can then be entered on the nomograph for permanent use.

How To Use The Chart

The Iron Core Inductance nomograph relates core size, number of turns, permeability, and inductance. The inductance referred to is that value obtained when all losses appear as shunting ele-

ments. The value of μ referred to is the actual design μ of the core structure, taking into account the effect of air gaps. The μ value is found from manufacturers' curves applicable to the particular material and operating condition.

Two steps are required for the solution of a problem, the L/μ scale serving as an intermediate reference point.

Example No. 1. How many turns would be required to obtain an inductance (L) of 1.5 h on an EI-625 square-stack core, assuming an expected permeability of 10,000?

Laying a straight edge from 1.5 on the B side the L scale through $\mu = 10,000$ on the μ scale, crosses L/μ at 0.15×10^{-3} . Laying the straight edge between this point (0.15 on the L/μ scale) and the EI-625 mark on the *single-stack core scale*, it crosses the *turns scale* at 220 on the B side.

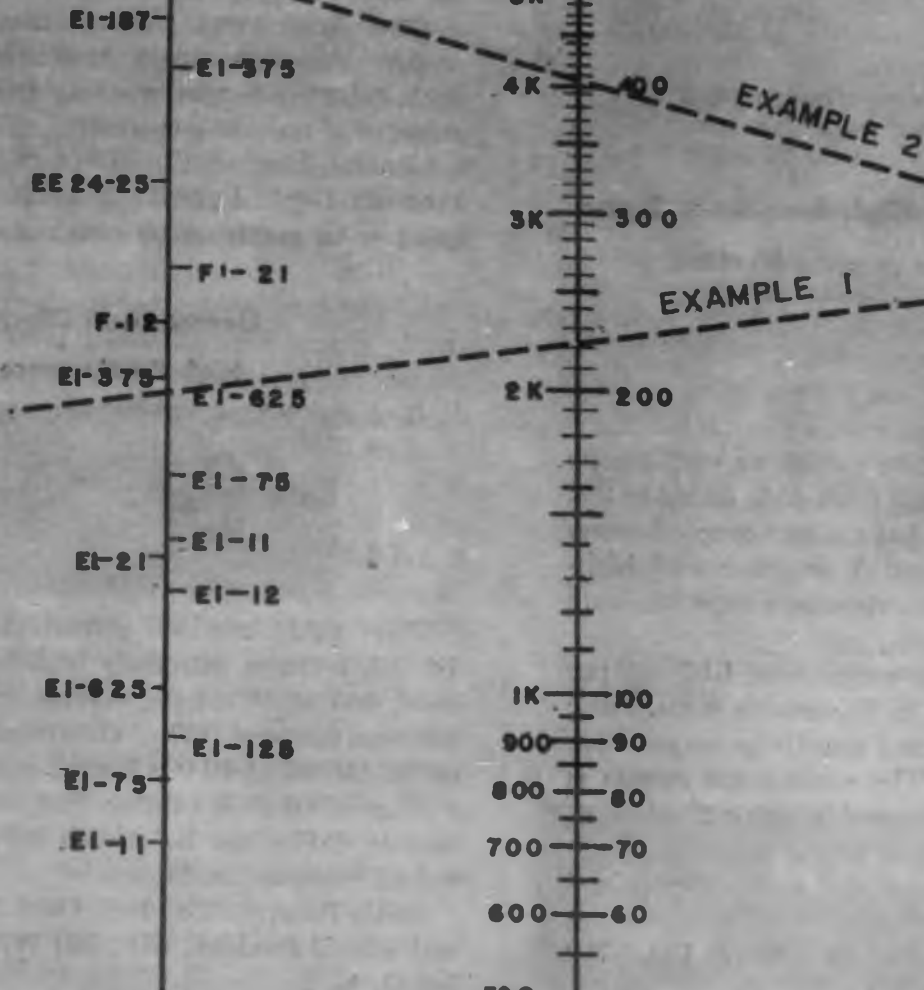
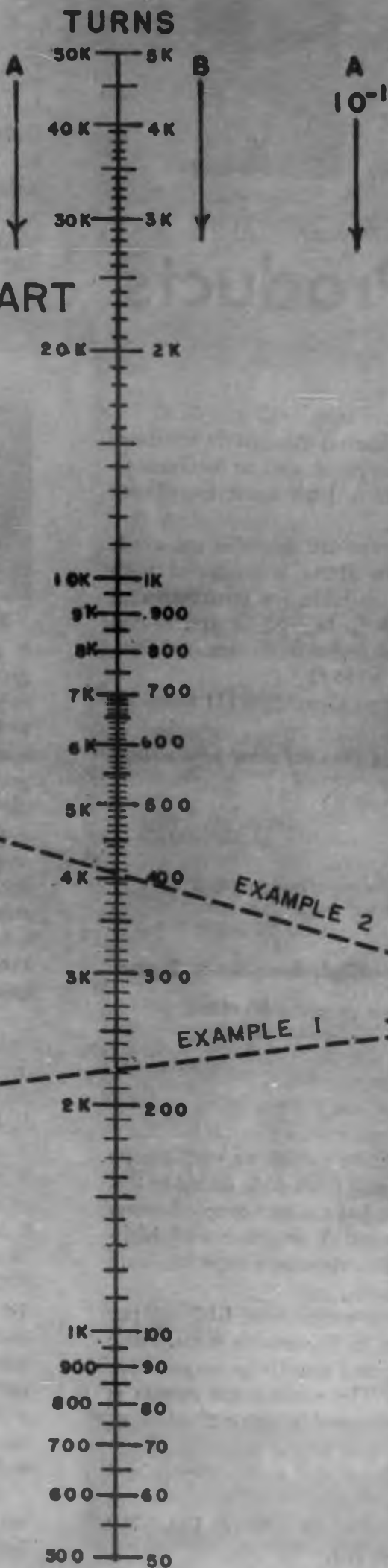
Example No. 2. An F-12 square-stack choke is to be airgapped because of d-c considerations. It has 40 turns and an expected design permeability of 11. How much inductance will it have?

A straight edge from F-12 on the *square-stack core scale* through 4K on the A side of the *turns scale* crosses the L/μ scale at about 0.18×10^{-1} . Laying the straight edge from this reference point through 1150 on the μ scale, 20 h is read on the L scale.

IRON CORE INDUCTANCE CHART

DOUBLE
STACK
CORE

SQUARE
STACK
CORE





NOTE. L IN HENRIES
 WHEN USING RIGHT
 HAND μ SCALE,
 L IN HENRIES X 100
 WHEN USING LEFT
 HAND μ SCALE

New Products

Pulse Generator Programmed



This generates and controls a wide variety of instantly adjustable pulse programs of variable word length, variable word spacing, with variable pulse delay time, and variable pulse width. It includes a self-contained power supply and separate audio oscillator output. It generates sine wave or pulses of continuously variable period from 8 to 100,000 μ sec, word length variable up to 64 digits. Switch control of internal or external sync is provided with 12 separate sync outputs available at front panel.

The pulse generator allows set-up of an independent pulse train of up to 24 pulses either positive or negative-going, direct or time delayed by switch selection. Direct pulse width, delayed pulse width and delay time may be continuously varied from 1 to 150,000 μ sec. Designation is Model 612A.

Wang Labe. Inc., Dept. ED, 34 Hurley St., Cambridge 41, Mass.

CIRCLE 46 ON READER-SERVICE CARD FOR MORE INFORMATION



Transistor Amplifier Plug-In

The Model 196 transistorized amplifier is a high gain, low-power, plug-in type amplifier designed for servo and audio applications. The unique feature of this amplifier is its gain stability over a range

of operating temperatures from -55 to $+55$ C.

This stable gain is achieved through dc feedback to stabilize the operating point, and ac feedback to achieve broad band-width, high input impedance and good wave form.

Two models of this transistor amplifier are available: Model 196 shown above is equipped with germanium transistors, suitable for environmental temperatures from -55 C. to $+55$ C. and Model 198 using silicon transistors for environmental temperatures from -60 to $+125$ C.

Taber Instrument Corp., Dept. ED, 111 Goundry St., N. Tonawanda, N.Y.

CIRCLE 47 ON READER-SERVICE CARD FOR MORE INFORMATION



High Frequency Scope 50 mc

Six modular plug-in units permit an oscilloscope frequency response ranging from dc to 50 mc in this system. The oscilloscope has a direct-coupled three-stage balanced distributed Y-amplifier and high-speed sweeps that can be driven at a repetition rate of 250 kc.

The calibrated sweeps range from 0.02 sec per cm to 0.01 μ sec per cm in 20 variable steps. Pulse rise time is 7 milli- μ sec, and sensitivity ranges from 0.2 to 200 v full scale. The oscilloscope system is composed of six interchangeable units: the indicator, Y-amplifier, sync and sweep assembly, high voltage power supply, sync and sweep supply and the Y-amplifier supply.

Allen B. Du Mont Labs., Inc., Dept. ED, 750 Bloomfield Ave., Clifton, N.J.

CIRCLE 48 ON READER-SERVICE CARD FOR MORE INFORMATION



Discharge Varistors For Inductive Surges

Referred to as the 9RV3A assembly, this resistor is manufactured as a family of ready-mounted groups of one to four varistors connected in series or in parallel. The 3-in. disks, which range from 0.062 to 0.375 in. thick, are bracket-mounted on a horizontal insulated bolt with a spring lock washer to provide contact pressure. The Thyrite addition supplements the 6-in. assembly designed to protect motors, generators, lifting magnets, magnetic chucks, solenoids, relays, large coils, etc., against high inductive surges resulting from sudden interruptions of inductive currents.

General Electric Co., Dept. ED, Metallurgical Products Dept., Detroit 32, Mich.

CIRCLE 49 ON READER-SERVICE CARD FOR MORE INFORMATION

Germanium Diode High Conductance



This gold bonded germanium diode, Type DR385, features extremely high forward conductance, and at 10 ma the voltage drop is controlled between 0.34 and 0.37 v. The reverse characteristic of the DR385 at 10 v is 1 meg, with a peak inverse voltage of 60 v. It exhibits fast transient response. Similar diodes can be offered fully tested to individual recovery conditions.

Radio Receptor Co., Inc., Dept. ED, Germanium and Silicon Products Div., 240 Wythe Ave., Brooklyn 11, N. Y.

CIRCLE 50 ON READER-SERVICE CARD FOR MORE INFORMATION

Pressurized Connector

For High Altitudes and Speeds

When this DPS connector is mated, it is sealed about the insert faces with a specially designed rubber seal. This seal is encased in the -34 shell so that the step down design of the mating -33 shell seats into and against it when mated. In addition to this feature, the -34 pin insert shell encloses a monobloc silicone insert which is designed in such a way that the tightening of the junction shell over the back of the insert effects a compression seal around the wires that have been inserted. These connectors are available in 4 different sizes with several insert arrangements for each size.

Cannon Electric Co., Dept. ED, P.O. Box 3765, Terminal Annex, Los Angeles 54, Calif.

CIRCLE 51 ON READER-SERVICE CARD FOR MORE INFORMATION



Ferrite Isolators
4600 to 9600 Mc

Five ferrite isolators make up this new line. All are non-metallic magnetic materials, which increase the reliability of microwave equipment by protecting the microwave power source against energy reflections from transmission line or antenna. Type FD-1037 is 3 in. long, has a frequency range from 8500 to 9600 mc, a VSWR of 1.13 to 1, average power 100 maximum with peak power of 125 kw max, provides a minimum isolation of 25 db and occasions a maximum insertion loss of 1 db. Characteristics of Model FD-1013 are: length, 2 in., frequency range 8500 to 9600, average power 100 watts max, peak power 100 kw max, isolation 10 db min, insertion loss 0.6 db max. FD-977 is 5 in. long, operates at 5400 mc, handles an average power of 20 w and peak power of 125 kw, and provides 15 db isolation with 1 db insertion loss. FD-962 has a frequency range of 7100 to 8000 mc, handles 20 w maximum average power, provides 35 db isolation and occasions 1 db insertion loss. Frequency range of FD-963 is 4600 to 5000 mc, average power 20 w, isolation 25 db, insertion loss 1 db. Frequency range of FD-963 is 4600 to 5000 mc, average power 20 w, isolation 25 db, insertion loss 1 db. Type FD-977 is for airborne weather radar primarily; types FD-962 and FD-963 were developed in the first instance for microwave link applications. Sylvania Electric Products, Inc., Dept. ED, 1740 Broadway, New York 19, N. Y.

CIRCLE 52 ON READER-SERVICE CARD FOR MORE INFORMATION

1, 1957 ELECTRONIC DESIGN • May 1, 1957

*first in
Performance
Reliability
and Quality*

Kepeco

*introduces
the first in
a series of*

NEW MAGNETIC TUBELESS VOLTAGE REGULATED POWER SUPPLIES



**MODEL
KM 236-15**

2-36 VOLTS 15 AMPS.

featuring

- **Output voltage within 0.5% during recovery time for line transients 105-125 volts.**
- **Short circuit will not damage supply.**
- **Full current may be drawn at any voltage from 2-36 volts.**

OUTPUT VOLTAGE DC: 2-36 volts continuously variable.

OUTPUT CURRENT DC: 0-15 amperes continuous duty.

REGULATION: In the range 2-36 volts the output voltage variation is less than 0.5% for line fluctuation from 105-125 volts, and less than 0.5% or 25 millivolts, whichever is greater, for load variations from minimum to maximum current.

RIPPLE VOLTAGE: Less than 0.5% or 25 millivolts RMS, whichever is greater.

FUSE PROTECTION: Input fuses on front panel.

OVERLOAD PROTECTION: An automatic current limiting device allows direct shorting of the output terminals without damage to the supply.

POWER REQUIREMENTS: 105-125 volts, 57-63 cycles.

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

METERS: Ammeter: 0-15 amperes, 4" rectangular
Voltmeter: 0-15 volts, 4" rectangular

CONTROLS: Power on-off switch, DC on-off switch, remote error signal on-off switch, coarse and fine voltage controls.

PHYSICAL SPECIFICATIONS: Rack panel construction. Panel height 12 3/4", width 19", depth 17". Color Kepeco standard gray hammertone. This unit is designed for relay rack mounting or bench use. Carry handles are provided.

OPERATIONAL CHARACTERISTICS: This regulated unit consists of a ferro-resonant line regulator followed by a magnetic amplifier regulator. The ferro-resonant line regulator furnishes well regulated transient free AC power. The high gain magnetic amplifier is used to regulate the DC output voltage to compensate for voltage changes in the power unit for varying load currents. The response time for pulse loads is less than 0.2 seconds.

WRITE FOR SPECIFICATIONS ON 30
AND 50 AMP. MAGNETIC SUPPLIES.



KEPCO LABORATORIES, INC.

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

CIRCLE 53 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products



Wide Band Amplifier
High Gain

The Model m-395 is a self-contained unit which features high gain over a wide bandwidth. It can be used as a preamplifier in conjunction with frequency counters, so that signals in the 50 to 100 μ v region may be counted as easily as high level signals.

The M-395 may be used to augment the power output of signal generators as a post amplifier for noise figure measurement and as a pulse amplifier in nuclear work. Specifications are as follows: Band-pass 1 kc to 50 mc; gain 70 db; input and output impedance 90 ohms; output voltage capability—more than 1 v rms and rise time 10 μ sec.

Instruments for Industry Inc., Dept. ED, 150 Glen Cove Rd., Mineola, N.Y.

CIRCLE 55 ON READER-SERVICE CARD FOR MORE INFORMATION



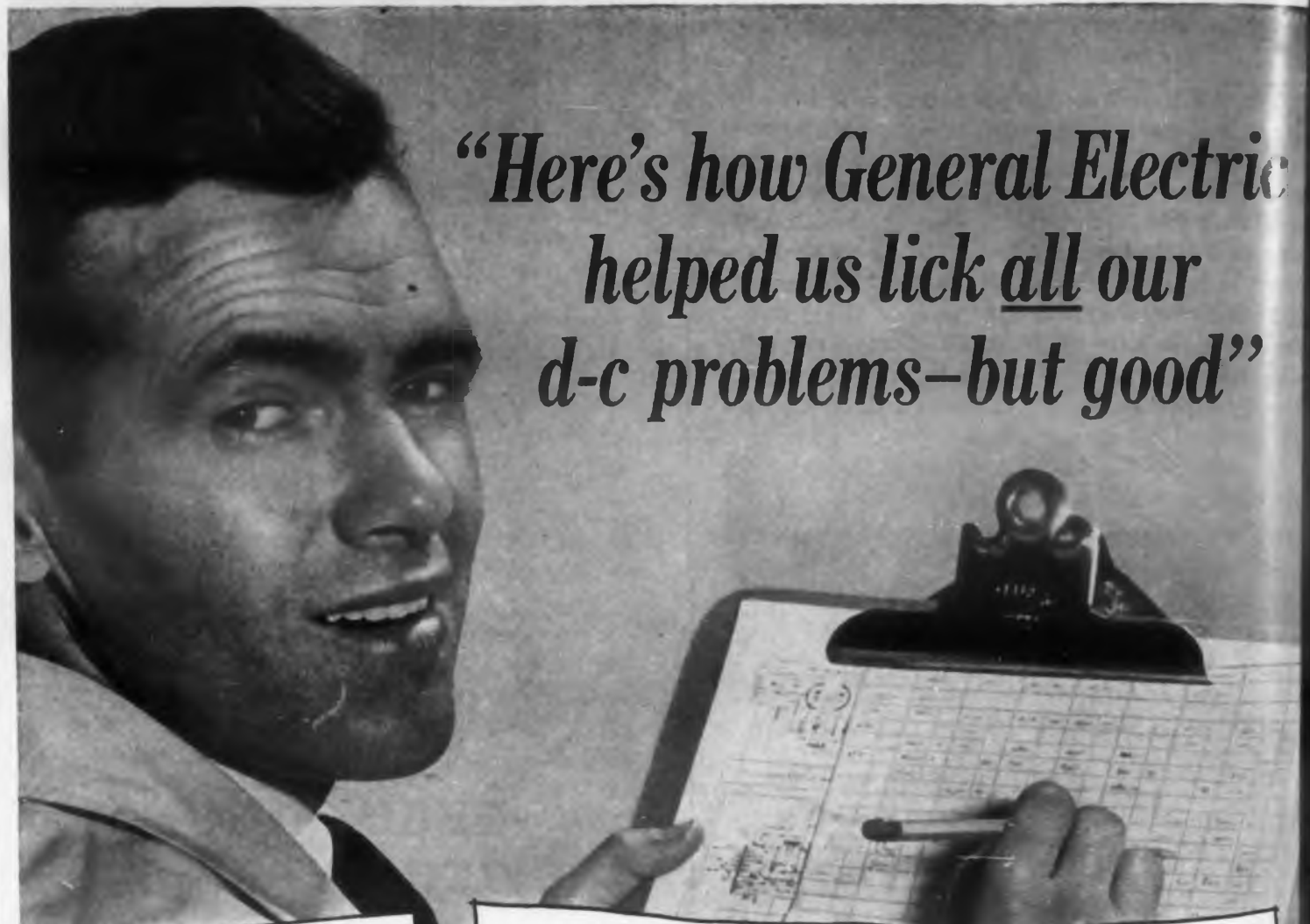
Potentiometer
Low Torque

A 0.003 oz in. torque has been achieved in the Model 85151 potentiometer. This 1 in. diam. precision instrument features a heavy duty 0.125 in. stainless steel shaft mounted on miniature shielded ball bearings. The shaft may be threaded, have milled flats, keyways, etc. Available in resistance ranges from 100 to 100,000 ohms, the Model 85151 has been ruggedly constructed to withstand high vibration and acceleration.

Metal alloy windings and brushes are used to give positive electrical contact with low brush pressure, maximum protection against atmospheric corrosion, and minimum operating noise.

G. M. Giannini & Co., Inc., Dept. ED, Pasadena, Calif.

CIRCLE 56 ON READER-SERVICE CARD FOR MORE INFORMATION



“Here’s how General Electric helped us lick all our d-c problems—but good”

AXIAL LEAD MODELS. The most adaptable type of Silicon Rectifier. Small, lightweight, taking ambients up to 165°C, they work anywhere, in any position. Their versatile lead mounting facilitates their use in all kinds of installations.

STACK MODELS. Assembled from Axial Lead cells mounted in fins, Stacks work singly or in groups to supply almost any power output. Each Stack is mounted with just two screws.

STUD-MOUNTED MODELS. Screw into the chassis, using it for heat removal to permit safe performance at higher currents and temperatures. Basically, the same design as Axial Lead models.

“G-E SILICON Low Current RECTIFIERS cover the field from ¼ amp up to 18 amps†... really stay on the job... and the price doesn’t hurt”

Every engineer who works with d-c power supplies for assemblies or components of moderate current demand finds a valuable source in the General Electric rectifier line. G-E Silicon Rectifiers—whether the Axial Lead or the Stud Mounting models in single cells, or in Stack assemblies with their remarkable range of current and voltage ratings—are part of our extensive range of

rectifier or other semiconductor devices. The table on output and performance figures only suggests the range of specifications available. For further data, or exact information on rectifiers for your specific needs, call your General Electric Semiconductor representative. Or write *General Electric Company, Semiconductor Products, Section S2357, Electronics Park, Syracuse, N. Y.*

CIRCLE 57 ON READER-SERVICE CARD FOR MORE INFORMATION



STUD RECTIFIERS. Fit them in wherever you need maximum current and temperature in minimum space with rigid chassis mounting.



STACK INSTALLATION. A typical way of mounting General Electric Silicon Rectifier Stacks. Just two screws fasten the entire assembly in place.

REPRESENTATIVE G-E SILICON RECTIFIER RATINGS

PIV	STUD*	LEAD**	STACKS***
50		1N536	4JA411F Series
100	1N1115	1N537	4JA411A Series
200	1N1116	1N538	4JA411B Series
300	1N1117	1N539	4JA411C Series
400	1N1118	1N540	4JA411D Series

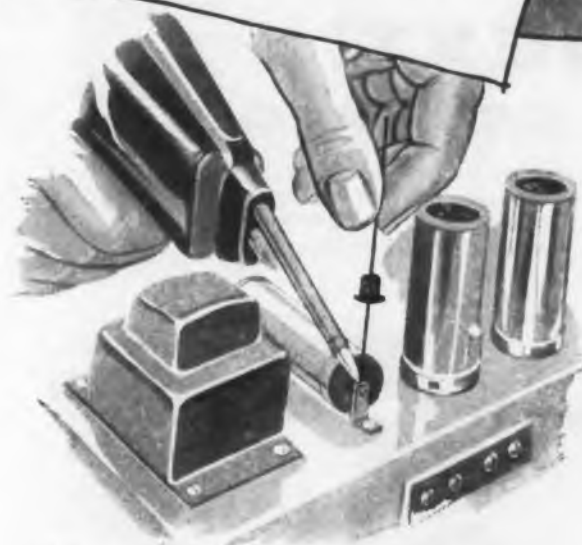
NEW... Following is new in production
500 1N1095

*Maximum Current— 600 ma @ 150°C Case Temperature
1500 ma @ 85°C Case Temperature

**Maximum Current— 250 ma @ 150°C Ambient Temperature
750 ma @ 50°C Ambient Temperature

***Maximum Current— 1/2 amp per fin @ 150°C Ambient Temp.
1 1/2 amp per fin @ 85°C Ambient Temp.

†For higher currents, G-E High Current Rectifiers may be used, or Stacks may be used in parallel.



AXIAL LEAD MOUNTED. See the versatility of G-E Axial Lead models. They're easy to mount anywhere you need low current silicon rectifiers.



Repeat Cycle Timer
Sequence Switching

These timers are available with cycling times from 1 to 24 hrs depending on the motor used. Operating voltages also cover a wide range. Timing accuracy is determined largely by the accuracy of the timing motor, which in turn is dependent upon line frequency or line voltage. When close tolerances are called for, chronometrically governed dc motors maintain accurate speed over a wide voltage range. Accuracy of cam setting is nominally specified as ± 6 . Timers meet various military specifications, including provision for radio noise filter where desired on d-c units. Materials and finishes are either corrosion resistant in themselves, or treated to resist corrosion.

A. W. Haydon Co., Dept. ED, Waterbury, Conn.

CIRCLE 58 ON READER-SERVICE CARD FOR MORE INFORMATION



Test Bridge
Dielectric Testing

This test bridge is designed specifically for measuring dielectric properties of sheet plastics such as Bakelite, Teflon and polystyrene, and for analysis of the electrical performance of oils and other liquids. Designated the type FT-VKB, it can readily measure, with appropriate accessories, the dielectric constant and dissipation factor of materials in either sheet or liquid form. At power frequencies the dissipation factor range can be extended to as high as unity by using a small range extension adapter. Capacitors and similar components can be checked as easily as materials.

Design permits satisfactory operation over a wide frequency range (50 cps to 300 kc). A balanced transformer is provided at the input terminals to permit operation with an oscillator or signal generator having either coaxial or balanced output. Accuracy is specified as ± 1 per cent.

Federal Telephone and Radio Co., Dept. ED, Instrument Div., 100 Kingsland Rd., Clifton, N.J.

CIRCLE 59 ON READER-SERVICE CARD FOR MORE INFORMATION

Progress Is Our Most Important Product

GENERAL  ELECTRIC

CIRCLE 57 ON READER-SERVICE CARD FOR MORE INFORMATION

1947

CERAMAG 2

The first ferrite used commercially in TV flybacks since Stackpole pioneered this application in 1946.



1948

CERAMAG 5 and 5N

Boosted flyback voltages without increasing transformer size. Denser, higher permeability materials with greatly improved temperature characteristics.



1950

CERAMAG 7 and 7A

Permitted larger picture tubes and even higher anode voltages thanks to their higher permeability under high flux conditions.



1953

CERAMAG 20

This is the famous Stackpole grade that shrank TV transformer size while maintaining high performance. Hysteresis losses were about 50% of previous grades. Permeability was approximately 60% higher.



**NEXT!
CERAMAG ?**

Look to Stackpole for the latest ferromagnetic developments that will set the pace in terms of higher efficiency . . . greater electrical and mechanical uniformity.



ONE AFTER ANOTHER, succeeding Stackpole Ceramag developments have set higher and still higher quality standards for ferromagnetics.

And the search never stops . . . for new grades, new manufacturing and quality control techniques that will provide tomorrow's TV receivers with Ceramag cores that are fully as far advanced as these previous Stackpole "firsts."

STACKPOLE
Ceramag
FERROMAGNETIC CORES

**THE POWER BEHIND
THE TV PICTURE..
...SINCE 1946**

Electronic Components Division
STACKPOLE CARBON COMPANY
St. Marys, Pa.

CIRCLE 61 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products



**Digital Tape Handler
Sorts and Memorizes**

This digital magnetic tape handler consists of ten separate identical units, or bins, each with a storage capacity of over 8 million bits. Each bin normally contains 500 ft of 1-in.-wide magnetic tape for 14-channel recording with 200-ppi density. Decimal sorting rates up to 100 information blocks per second are achieved. The handler may also be used as a random access memory requiring less than a minute for access to any of more than 22 million stored alpha-numerical characters. Each bin is equipped with its own recording playback head which may be relay-switched to a common output.

Designated Model 3219, this high-capacity, low access-time memory device is used with high speed computers, printers, industrial control equipment and electronic data-processing systems. Used in association with companion products of the same manufacturer, it can sort alpha-numerical information, record it in proper bins, and reassemble it in sequential order; it can be automatically controlled, or print high speed visual printouts.

Other features include dual speeds of 30 to 60 inches per second, simple threading, automatic stop at end of tape, accessibility of components, high reliability recording and playback heads, remote control, freedom from electrostatic charging, and modular construction.

Potter Instrument Co., Inc., Dept. ED, 115 Center Mill Rd., Great Neck, Long Island, N. Y.

CIRCLE 62 ON READER-SERVICE CARD FOR MORE INFORMATION

**Epoxy-Paper Laminate
For Printed Circuits**

Designated NELCO 130, this plastic material combines the electrical characteristics of epoxy-glass (NEMA G-10) with the mechanical and fabricating properties of phenolic-paper. The epoxy resin impregnated paper-base sheets offer blister resistance, cold-punching ability, low water absorption in a piece 1 x 3 x 1/16 in. after 24 hours in distilled water. NELCO 130 is available in sheets 36 x 42 in., 36 x 48 in., and half-sizes of these sheets.

New England Laminates Co., Inc., Dept. E, 481 Canal St., Stamford, Conn.

CIRCLE 63 ON READER-SERVICE CARD FOR MORE INFORMATION

Ceramic Foam
For 1600 Fuse



Designated Eccofam LM, this ceramic foam can be used continuously up to 1600 F. Density is about 10 lbs per cu.ft. Foam structure is extremely fine and uniform. The foam is supplied to the user in a form resembling damp sand, and is packed or tamped into the cavity to be filled. Complete filling of complex volumes and/or the embedment of electronic items in foam is thus accomplished. Other uses include thermal insulation and as the core material in sandwich structures, including radomes. At both room temperature and 1600 F compressive strength of Eccofam LM is above 400 psi. Dielectric constant is about 1.5 and dissipation factor is below 0.005.

Emerson & Cuming, Inc., Dept. ED, 869 Washington St., Canton, Mass.

CIRCLE 64 ON READER-SERVICE CARD FOR MORE INFORMATION



Magnetic Cores
Good Heating Stability

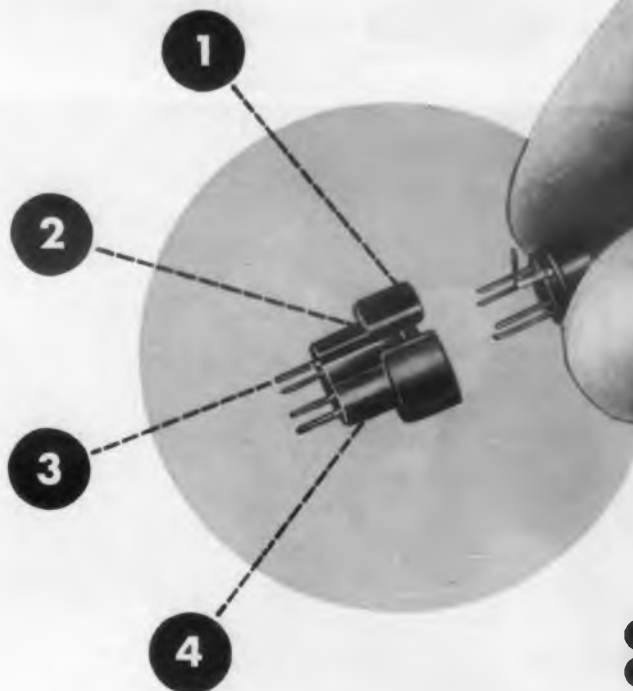
A new magnetic core, trademarked Hipermag is now available for magnetic amplifier reactors, transformers, current transformers and other magnetic devices. Hipermag cores are toroids wound with 1, 2, and 4 mil thick magnetic material. This material is an iron-nickel (50-50) alloy with a high degree of crystal orientation. The characteristics of the alloy include excellent temperature stability and a very high permanent flux accompanied by low coercive force. These properties include a very rectangular hysteresis loop.

Hipermag cores are tested by the Robert's Constant-Current Flux-Reset method. This method allows the test values to be used directly as constants in magnetic amplifier design. Saturation induction, and remanent induction, B_r , are 15,500 and 14,000 gauss for 60 and 400 cy and dc. The cores are available in sizes from 5/8 in. to 4 in. inside diam., 3/4 in. to 1 1/4 in. outside diam. and 3/16 in. to 2 in. high. Weight is from 2.80 to 2010.0 grams.

Westinghouse Electric Corp., Dept. ED, P. O. Box 2099, Pittsburgh 30, Pa.

CIRCLE 65 ON READER-SERVICE CARD FOR MORE INFORMATION

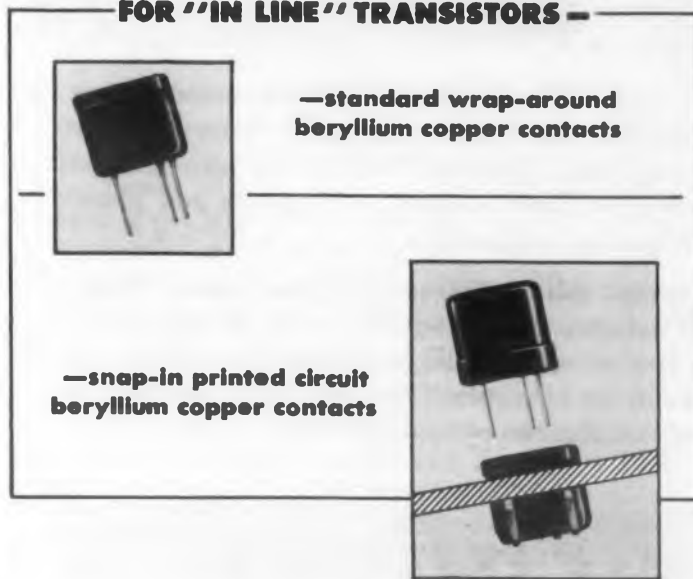
Transistor sockets
—from Sylvania



FOR "CLASS 30" TRANSISTORS —
designed to fit standard military 100-mil grid

- ① built-in polarity indexing
- ② ground strap provision
- ③ wrap-around beryllium copper contacts
- ④ mounts with standard retaining ring

FOR "IN LINE" TRANSISTORS —



Sylvania offers a new approach to the transistor socket designed for the proposed RETMA "Class 30" transistor package conforming with the 100-mil military grid.

Sylvania sockets, including those for "in line" transistors, are molded in general purpose phenolic. Beryllium copper contacts are silver plated or silver plated and gold flashed.

These socket developments are typical of Sylvania's close co-operation with the industry in supplying its up-to-the-minute requirements.

If you have a special socketing problem, a Sylvania representative will welcome an opportunity to discuss it with you.

Sylvania's Parts Division also offers complete facilities for tube bases, custom molded plastics, metal stampings, alloy, clad and plated fine wire, wire leads, and custom wire welds. Write for complete details. Address Dept. E22S.



SYLVANIA

PARTS DIVISION

Sylvania Electric Products Inc., Parts Division, Warren, Pennsylvania

LIGHTING • RADIO • TELEVISION • ELECTRONICS • ATOMIC ENERGY



CIRCLE 66 ON READER-SERVICE CARD FOR MORE INFORMATION

phone now!

for a prove-it-yourself
demonstration of the
Honeywell VISICORDER®



We're sure, once you've seen the fabulous new Visicorder demonstrated, that you'll be as enthusiastic as the thousands of others who have watched the Visicorder in operation.

That's why we're inviting you to be the judge... to call your nearest Honeywell Industrial Sales Engineer.* He will set up a Visicorder demonstration in your office, plant, or laboratory... at your convenience.

The Visicorder, in the short months since its introduction has become the most wanted oscillograph in America. Why? Because the Visicorder records at frequencies from DC to 2000 CPS, with sensitivities that compare to photographic oscillographs. Because

MINNEAPOLIS
Honeywell **H**
HEILAND DIVISION HONEYWELL
5200 E. EVANS AVENUE • DENVER 22, COLORADO

the stable, direct-reading Visicorder records are reproducible, and permanent under ordinary usage. Because the Visicorder bridges the gap between mechanical direct-writing oscillographs and photographic-type instruments.

So accept this invitation: Call your nearest Honeywell Industrial Sales Engineer today. He will arrange for you to operate the Visicorder yourself so that you can see for yourself how the Visicorder fits your most complex recording application.

also ANNOUNCING...

The high-frequency Visicorder galvanometers have been redesigned to provide sensitivity improvements as great as 4 times, and a new 1000-cycle galvanometer has been added. All high-frequency galvanometers shipped after March 15 are to the new specifications.

*Visicorder demonstrators are now based in these Honeywell Industrial Sales Offices: Albuquerque • Atlanta • Baltimore • Boston • Buffalo • Cleveland • Dallas • Dayton • Denver • Detroit • El Paso • Hammond, Ind. • Hartford • Long Island City • Los Angeles • Omaha • Pittsburgh • Philadelphia • Richmond • San Diego • San Francisco • Seattle • St. Louis • Syracuse • Toronto, Ont. • Union, N. J. • Washington D. C. • Amsterdam, Netherlands • and more on the way.

CIRCLE 67 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products



Sweep Generator
1,000 to 15,000 Mc

A high-power, broadband sweep oscillator, designated Model ESG, provides complete coverage from 1,000 to 15,000 mc at 60 cps with a power output of from 10 mw to 1 w, with 7 interchangeable microwave oscillator units. The instrument is designed for rapid testing of broad and narrowband microwave systems, and components.

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

CIRCLE 68 ON READER-SERVICE CARD FOR MORE INFORMATION



FM-To-Voltage
Converter
400 to 70,000 Cps

This converter operates on any of the 23 standard IRTWG telemetering sub-frequencies from 400 to 70,000 cps. A total of 62 different low-pass filter bandwidths, from 11 to 3490 cps, are separately selectable if the standard low-pass filter frequency is not desired, or the bandswitch may automatically put the standard low-pass filter value in the output. Transistor-powered, servo-actuated corrections are provided for arbitrarily-chosen zero and 100 percent information frequencies. No other adjustments or controls are needed. Designated Model FM-10 the converter features long-term stability that makes unnecessary any correction for component aging, thermal drift or gain variations. Absolute accuracy is 0.05 per cent, and dynamic accuracy is better than 0.2 per cent for the life of the equipment. The unit weighs 30 lb and occupies 10-1/2 in. panel space on a standard 19-in. rack. Provision made for automatic compensation of wow and flutter components in magnetic tape recording by means of associated equipment produced by the same manufacturer. An all-channel voltage-controlled oscillator, which together with its power supply occupies 3-1/2 in. of panel space, is also available.

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

CIRCLE 69 ON READER-SERVICE CARD FOR MORE INFORMATION



**D-C Micrometer
For Research Use**

Fifteen voltage ranges, from 100 μ v to 1000 v, 10 current ranges, from 100 μ amp to 100 milliamperes, can be read by this improved combination dc microvoltmeter, microammeter and amplifier. It employs a chopper-amplifier, and a zero-center indicating instrument which shows polarity on two mirrored scales that cover all ranges. The unit is available in either cabinet or 19-in. rack mount models. Output terminals on the front panel allow the instrument to be used as a low-drift dc amplifier with up to 80 db gain and very high input impedance. On the 100 microvolt-to-10 millivolt range input impedance is 10 megohms; on the 30 millivolt range it is 30 megohms, and on the ranges of 100 millivolts and above, 100 megohms. These stated impedances are accurate to 1.5 per cent. Output impedance is less than 2 ohms and output voltage is 1 v full scale across 1000 ohms or more. Meter accuracy is 3 per cent on all ranges. Drift after 15 minutes warm-up is less than 10 μ v. Designated Model 203, the instrument is offered as a highly versatile tool for research and development in such uses as, for example, recorder driver. Kin Tel, Dept. ED, 5725 Kearny Villa Rd., San Diego 11, Calif.

CIRCLE 70 ON READER-SERVICE CARD FOR MORE INFORMATION



**H-Plane Folded
Hybrid T
Wide Frequency Range**

These hybrid T's feature high performance and are available for a wide range of frequencies from 100 to 36,000 mc, for most waveguides from 3 x 1 to 0.360 x 0.220 in. O.D. They are precision cast in either aluminum or beryllium copper, and are normally supplied terminated in flat flanges, but are available on request with special adapters. Operational characteristics include broad bandwidth, low S.W.R., and high isolation. Microwave Development Labs., Inc., Dept. ED, Broad St., Wellesley 57, Mass.

CIRCLE 71 ON READER-SERVICE CARD FOR MORE INFORMATION

1, 1957 ELECTRONIC DESIGN • May 1, 1957

New Hipermag* cores ...

now up magnetic amplifier yields 35%

All core sizes in stock, delivery immediate

A large eastern manufacturer reports Westinghouse Roberts-tested Hipermag cores have increased Magamp* yields from 70% to 95%. Here are just three of the many reasons why.

- All the quality in Hipermag cores is proved out with the exclusive Westinghouse Roberts dynamic tester. This test provides four values actually measuring magnetic properties of cores under simulated amplifier conditions. Test values are equivalent to final core performance in your finished reactor.
- Westinghouse Hipermag toroidal cores are wound with Hipernik® V. Hipernik V is a highly oriented iron nickel alloy of exceptional temperature stability, high remanence and low coercive force, making these cores ideally suited to high-quality saturable reactors.
- For especially high shock resistance, cores can be hermetically-sealed, and their rugged nylon or aluminum cases filled with a Westinghouse-developed silicone oil. Prevents core damage. Minimizes magnetic change due to strains, pressure, shock or vibration. Provides foolproof protection when reactors are vacuum impregnated, encapsulated or resin treated.

A Westinghouse Hipermag specification will give you perfectly matched, quality cores in abundance—all sizes are in stock for delivery today! Also available in a full range are Hipersil® and Hiperthin* cores. Call Westinghouse Electric Corporation, or write Specialty Transformer Department, P. O. Box 231, Greenville, Pa.

•Trade-Mark
J-70797

YOU CAN BE SURE...IF IT'S

Westinghouse



CIRCLE 72 ON READER-SERVICE CARD FOR MORE INFORMATION

GASES PURIFIED AND GASES PURIDRIED

To feed an atmosphere furnace correctly, the oxygen-free hydrogen should be both pure and dry. Deoxo Catalytic Purifiers are widely accepted as the most effective and economical way to purify gases. In order to dry the gases just as effectively, BAKER has combined the features of the Deoxo Purifier with an extremely efficient, automatically operated drying unit. The combination, known as the Deoxo Puridryer, allows the furnace to be fed pure, dry hydrogen... so pure that it contains less than one part oxygen per million... so dry that it has a dew point of better than -100°F . AND, no inert gas purging is needed.

The Deoxo Puridryer can also be used with other gases, such as: Nitrogen, Argon, Neon and saturated hydrocarbons with the same excellent results.

Write for complete catalog material and details.



NITRONEAL[®] GAS GENERATOR economically and safely provides forming gas atmosphere for bright annealing of tube parts.



PRECIOUS METAL RUPTURE DISCS, resistant to most corrosive agents, provide adequate protection for pressurized apparatus.



SUPER-SENSITIVE DEOXO[®] INDICATOR measures the faintest traces of oxygen or hydrogen present as impurities in other gases

BAKER PRECIOUS METALS

BAKER & CO., INC.

113 ASTOR STREET, NEWARK 2, NEW JERSEY
NEW YORK • SAN FRANCISCO • LOS ANGELES • CHICAGO

ENGELHARD INDUSTRIES

RESEARCH MAINTAINS BAKER'S LEADERSHIP IN PRECIOUS METALS
CIRCLE 73 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products



Line Voltage Regulator
Militarized

Designed to meet or to exceed the general requirements of MIL-E-4158A, the Type 1570-ALS15 automatic voltage regulator is offered for use in military or critical industrial applications. Typical applications for which it is suited include those with high ambient temperatures or for portable installations where mechanical shock or vibration is encountered. Particular emphasis in the design has also been placed on flexibility, ease of maintenance, reliability, and long life.

The type 1570-ALS15 automatic voltage regulator is normally supplied to handle a maximum of 6 kva at 115 v with input line variations of ± 10 per cent. A ± 20 per cent range connection is also available with a maximum capacity of 3 kva. Accuracy of output voltage (adjustable over a ± 10 per cent range) is ± 0.25 per cent for the 6 kva connection. Frequency range is 55 to 65 cy. or from 45 to 55 cy., selected by a switch.

General Radio Co., Dept. ED, 275 Massachusetts Ave., Cambridge 39, Mass.

CIRCLE 74 ON READER-SERVICE CARD FOR MORE INFORMATION

Ultrasonic Impact Grinder

Tolerance of ± 0.0007 in.



Since this machine exactly reproduces the shape in the work piece, it brings to the machining of ceramics and other ordinarily unmachinable substances accuracy, freedom of design and reduction of cost. A low-cost instrument, it is designed for machining germanium, ceramics, ferrites and other hard or brittle materials and offers tolerances ± 0.0007 in. Power source for the unit is 115 v and water cooling is not required. Bench mounted pedestal and driver unit is 23 x 16 x 15 in. and driver 19 x 16 x 13 in. Weight is under 200 lb.

Raytheon Mfg. Co., Dept. ED, 100 River Street, Waltham 54, Mass.

CIRCLE 75 ON READER-SERVICE CARD FOR MORE INFORMATION



Toroid Coil
Molded

This series of molded toroids is cased in a mold-
ing compound which has successfully met govern-
ment specifications covering the complete range of
sizes and types. These coils are offered with one to
three sturdy terminals, as required, and have either a
wear bushing or threaded center to permit easy
backing. Q values from 30 to over 250 are available,
and inductance values up to 17.5HY are stocked for
prompt delivery.

Torotel, Inc., Dept. ED, 11505 Belmont, Hickman
Hills, Mo.

CIRCLE 76 ON READER-SERVICE CARD FOR MORE INFORMATION

Crossbar Scanner
Scans Data Points



For data handling and reduction this integrated
monitoring device is capable of rapid sequential or
programmed scanning of data points.

The Model 200SC1A is a self-contained instru-
ment capable of scanning in response to a contact
pulse 200 points in sequence one point per control
pulse. The 200 points are arranged in 10 groups of
20 points each. Facilities are provided to automati-
cally skip any group on command, to start at the
beginning of any of the ten groups, on command,
and to automatically stop at the end of any of the
ten groups. The scanner utilizes the three-dimen-
sional conductor arrangement of the crossbar switch
to make selections in three coordinates.

James Cunningham, Son & Co., Inc., Dept. ED,
Chester 8, N.Y.

CIRCLE 77 ON READER-SERVICE CARD FOR MORE INFORMATION



Which company offers maximum savings on custom-built delay lines?



In delay lines you waste money when you "over-specify." Avoid the costly pitfalls of "over-specification" of custom-designed delay lines by taking advantage of the engineering service and lab reports offered by ESC. As pioneer manufacturers and specialists in this field, ESC offers complete follow-through on the equipment applications of fixed and variable delay lines. "You tell us the problem . . . we'll recommend the realistic and economical specifications for your delay line requirements." The well-rounded equipment background of the ESC Engineering Staff makes this possible.



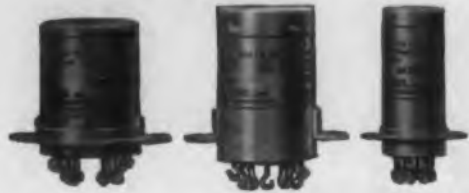
- 1st in sales!**
- 1st company devoted exclusively to the manufacture of delay lines!**
- 1st in research, design and development of custom-built delay lines!**
- 1st to submit the most definitive laboratory reports with all custom-built delay line prototypes!**

Exceptional employment opportunities for engineers experienced in pulse techniques.



ESC CORPORATION  536 BERGEN BOULEVARD • PALISADES PARK • NEW JERSEY

CIRCLE 78 ON READER-SERVICE CARD FOR MORE INFORMATION



BURTON BROWNE/New York

NEW! ANOTHER FILTERS EXCLUSIVE
 THE SAME SUB-MINIATURE RELAY FOR EITHER DRY CIRCUITS OR POWER
 HERMETICALLY SEALED



LATCHING OR GENERAL PURPOSE
 ALL MADE TO MIL-R-25018 (USAF) AND MIL-R-5757C
 LEADING MANUFACTURERS OF HERMETICALLY SEALED SUB-MINIATURE RELAYS

WRITE FOR COMPLETE CATALOG
FILTERS, INC.
 PORT WASHINGTON, LONG ISLAND, N. Y.
 PORT WASHINGTON 7-3850

CIRCLE 80 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products



Ceramic Tetrodes
 250 Watt

Designated the 4CX250K and 4CX250M, each of these external anode radial beam power tetrodes employ concentric UHF terminals and are of ceramic and metal construction. The 4CX250M has a 26.5 v filament, while the 4CX250K has a 6 v filament. Both tubes have a 250 w plate dissipation rating.

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

CIRCLE 81 ON READER-SERVICE CARD FOR MORE INFORMATION



Waveguide-To-Coaxial Adapters
 2.9 to 10 kmc

This line of waveguide-to-coaxial adapters provides an improved means of joining a waveguide to a coaxial system. It permits better packaging in radar systems and supplies a d-c return for crystal currents. And 180 deg reversal of rf phase may be obtained. VSWR is under 1.5 over a 30 per cent band. There are five models. Model 9900 has a center frequency of 2.9 kmc, is used with the 1-1/2 x 1 waveguide and is 4-3/4 in. long. Model 9907 has a center frequency of 5.6 kmc, is used with the 1 x 2 waveguide, and measures 2-1/2 in. long. Model 9908 has a center frequency of 6.0 kmc, for the 3/4 x 1-1/2 waveguide, and measures 2-3/4 in. long. Model 9909, center frequency 9.0 kmc, is used with the 5/8 x 1-1/4 waveguide, and is 1-3/4 in. long. And Model 9910, 10.0 kmc center frequency, is used with the 1/2 x 1 waveguide and has a length of 1-7/8 in. All of these five adapters are available either in brass or in aluminum.

Canoga Corp., Dept. ED, 5955 Sepulveda Blvd., Van Nuys, Calif.

CIRCLE 82 ON READER-SERVICE CARD FOR MORE INFORMATION



VHF Spectrum Recorder

Gives Permanent Record

This VHF spectrum recorder provides permanent, continuous and simultaneous visual recordings of all transmissions in the VHF range from 30 to 330 mc. The system, designated as type FT-FBS, consists of a high quality VHF band receiver, which mechanically and continuously sweeps the 30 to 330 mc band, and a moving-paper recorder swept laterally by a recording stylus which visually marks on the paper all transmissions taking place in the band being swept.

The spectrum recorder shows visually the frequency of all transmitters in operation in the 30 to 330 mc band, indicating whether the transmitters are on or off their assigned frequencies, the amount of drift, the time at which drift started and stopped and whether the drift is repetitive. Also shown is the bandwidth occupied by each transmitter and whether the transmission is fm, am or video; also the extent of the sidebands of modulated carriers, and the time during which each transmission occurs including repetitive transmissions of short duration such as those of taxicabs. Variations of field strength of transmitters at the point of observation can likewise be recorded.

Federal Telephone and Radio Co., Dept. ED, Kingsland Rd., Clifton, N.J.

CIRCLE 83 ON READER-SERVICE CARD FOR MORE INFORMATION



Photo at right shows operators inserting secondary coils and connecting leads to commutators for units like the compact Sangamo "GY" Flatpak—a rugged, small size dynamotor for mobile radio use.



Final assembly operation. Push line type of operations contribute substantially to overall efficiency and accelerated production . . . aids in fulfilling all delivery schedules, even for units like the Type SF below, which are built to the most exacting specifications.



Now... dependable power supply units on dependable delivery schedules

Sangamo expands facilities to meet growing demand!

Sangamo power supply units for the military and commercial fields—Dynamotors, Rotary Converters, Generators, Special DC Motors—are built to meet your most exacting specifications for quality and performance.

And... Sangamo has the facilities to insure prompt, efficient, volume delivery to meet *your* production schedules.

A new 200,000 square foot "controlled conditions" plant, in Pickens, South Carolina is equipped with the newest, most modern equipment to utilize the latest production techniques in the manufacture of these power supply units. This plant is geared for full-capacity production for units and components for mobile communication equipment. Look to Sangamo for your requirements.



SANGAMO
Electric Company
Electronic Components Division
SPRINGFIELD, ILLINOIS

CIRCLE 85 ON READER-SERVICE CARD FOR MORE INFORMATION



Synchro Indicator

Compact

A new aircraft synchro indicator Type 26800 can be used in any electronic system that provides a synchro output, or in any electrical system in which a remote position indication is desired. The hermetically sealed unit, one inch in diameter and weighing less than three ounces, meets the military specification MIL-25540A. The miniature indicator, designed for 26 v, single-phase, 400 cy operation, will operate on many standard pressure transmitters to indicate oil, fuel, hydraulic or water pressure.

Appendix Aviation Corp., Dept. ED, S. Montrose,

CIRCLE 84 ON READER-SERVICE CARD FOR MORE INFORMATION



Here, too, we make Nichrome*

Perhaps you didn't know that the world-famous alloy Nichrome is produced not only in The United States, but also in 6 Driver-Harris plants in England, Ireland, France, Italy, Austria, Spain, and in Canada by The B. Greening Wire Company. Also, Nichrome is a registered trade-mark in 55 nations.

At first, fifty-odd years ago, we manufactured electrical resistance alloys for furnace elements and domestic

heating appliances only. Today we produce 132 different high nickel alloys in many different forms and in hundreds of sizes, for almost every kind of domestic and industrial application—of which Nichrome is the most illustrious.

Whenever you buy Nichrome, you are assured of the unsurpassed and unvarying *quality* which has made Nichrome the supreme world standard for electrical-resistance and heat-

resistant alloys. This uniformly high quality, which we jealously guard as our most priceless possession, results from the technical excellence, the productive skill, and the quality controls the Driver-Harris craftsmen have gained in over 50 years of experience—and which are maintained with equal rigor in all Driver-Harris plants here and abroad. The result is a continuous benefit to the entire electrical, electronic, and heat-treating industries.

*T.M. Reg. U. S. Pat. Off.



Nichrome is made only by
Driver-Harris
COMPANY

HARRISON, NEW JERSEY

Manufacturing plants also in: ENGLAND • CANADA • IRELAND • FRANCE • ITALY • AUSTRIA • SPAIN

MAKERS OF THE MOST COMPLETE LINE OF ALLOYS FOR THE ELECTRICAL, ELECTRONIC, AND HEAT-TREATING INDUSTRIES
CIRCLE 86 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

Antenna Switch Selects Best Signal



This transistorized antenna switch automatically selects exposed antennas and assures uninterrupted in-flight communications. The antenna switch automatically accomplishes two important functions for airborne communications and navigations. First, it automatically monitors an incoming signal, and selects the antenna for dependable reception in areas where the signal is not uniform or where weather conditions cause severe signal fading. Secondly, the antenna switch performs a memory function by automatically selecting for transmission the last antenna used for reception.

Rectangular in shape, the miniature antenna switch's size, including shock mount, is 120 cu. in. or 4 x 5 x 6 in. The instrument's total weight is 2-1/2 lbs. Its power consumption is 70 mw. The device operates at 70,000 ft altitude, and is capable of withstanding 30g.

Autonetics, Div. No. American Aviation, Inc., Dept. ED, 9150 E. Imperial Hwy., Downey, California
CIRCLE 87 ON READER-SERVICE CARD FOR MORE INFORMATION



Calorimetric Wattmeter 1150 to 1750 Mc

This dummy load wattmeter is composed of two tapered fluid elements of molded fibreglas construction centered inside a four-foot section waveguide. A constant volume of liquid is pumped through the fibreglas elements and absorbs the microwave energy. The temperature difference between input and output is measured by a thermocouple.

pile and indicated on a remote meter in terms of milliwatts of energy absorbed. The energy is removed by a heat-exchanger, and the liquid recirculated. A water-tight transit case, constructed of light-weight laminated plywood and aluminum, stores the entire unit. The light load element is readily lifted, attached to and supported by standard waveguide supporting elements, while the heat exchanger and remote power indicator may conveniently be located at a distance. The combination fluid sight gage and standpipe, which provides for purging the system of air and maintains atmospheric pressure at the flow output, is detachable, and can be stored with no loss of fluid. Operation is in the 1150-1750 mc range, with a VSWR of less than 1.15. Power capacity is 1500 w maximum average, 5 megawatts peak pulse power. WacLine, Inc., Dept. ED, 35 S. St. Clair St., Dayton 2, Ohio.

CIRCLE 88 ON READER-SERVICE CARD FOR MORE INFORMATION

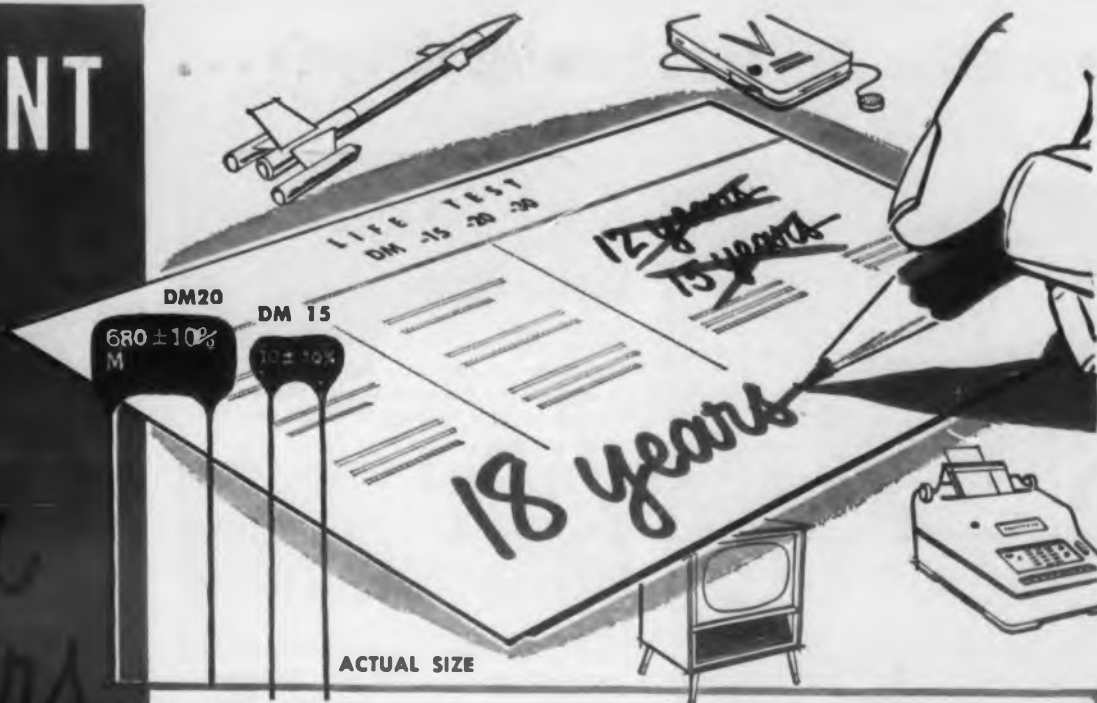
IMPORTANT NEWS

for design engineers



WHAT IS YOUR CAPACITOR APPLICATION PROBLEM?

Make your own test of El-Menco Dur-Mica Capacitors



ACTUAL SIZE

El-Menco Dur-Micas

now rated for even

LONGER LIFE!

El-Menco Dur-Mica Capacitors Can Now Assure You Of Dependable Performance Up To 18 Years!

Not An Extravagant Claim, But A Tested Fact. The latest series of rugged trials by El-Menco engineers found El-Menco DM15, DM20 and DM30 Dur-Mica Capacitors outlive and outperform all others. Under accelerated conditions of 1½ times rated voltage at 125°C ambient temperature; El-Menco capacitors continued to perform reliably after 12,000 hours. Translated into normal conditions, this indicates a lifetime of from 15 to 20 years!

MEET ALL ENVIRONMENTAL AND ELECTRICAL REQUIREMENTS OF BOTH CIVILIAN AND MILITARY SPECIFICATIONS.



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

El-Menco Dur-Mica DM15, DM20 and DM30 Capacitors Mean:

1. LONGER LIFE
2. POTENT POWER
3. SMALLER SIZE
4. EXCELLENT STABILITY — SILVERED MICA
5. PEAK PERFORMANCE

In addition to longer life, El-Menco Dur-Mica Capacitors with tougher phenolic casing assure greater stability over wide temperature range.



WITH NEW CRIMPED LEADS. Crimped, parallel leads simplify application in television, printed circuits, electronic brains, computers, guided missiles and other civilian and military uses.

El-Menco

THE ELECTRO MOTIVE MFG. CO., INC.

WILLIMANTIC CONNECTICUT

- molded mica
- mica trimmer
- tubular paper
- ceramic
- silvered mica films.

Arco Electronics, Inc., 64 White St., New York 13, N. Y. Exclusive Supplier To Jobbers and Distributors in the U.S. and Canada

CIRCLE 90 ON READER-SERVICE CARD FOR MORE INFORMATION

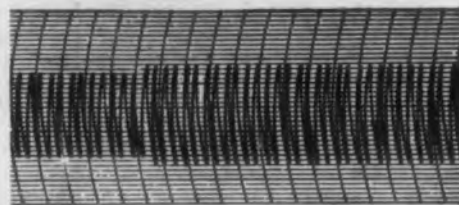


Decade Counter Tubes High Speed

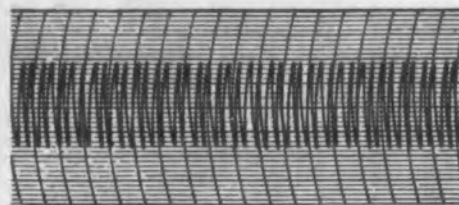
Designated types 6909 and 6910, these tubes are rated for 100 kc operation, and are particularly suited for nuclear and radiation measuring equipment, as well as for other industrial controls where there is a great demand for high-speed counting devices. Both tubes have reliable operation from 1 to 10,000 cy, with low power dissipation at approximately 1/2 ma. The glow of the high-speed tubes is clearly visible, with neon characteristics. The tubes have a short resolution time between pulses—on the order of 5 µsec—which permits random counting of signals such as those from a geiger radiation tube. Tube life is at least 2000 to 2500 hours. Sylvania Electric Products, Inc., Dept. ED, 1740 Broadway, New York 19, N.Y.

CIRCLE 89 ON READER-SERVICE CARD FOR MORE INFORMATION

Regulation in less than 1/50th cycle . . .



Output of typical electromechanical regulator in response to step change in input voltage. Average correction rate of 6v. per sec.



Output of Curtiss-Wright Distortion Eliminating Voltage Regulator from same input. Full recovery in 330 microsec.

Simultaneous two-pen recording of 60 c.p.s. voltage

PLUS Pure Sine Wave Power CURTISS-WRIGHT LINE REGULATOR

- Electronically regulates r.m.s. and peak voltage simultaneously to $\pm 1\%$.
- Reduces typical power line distortion to less than 0.3%.
- Furnishes 1.4 KVA of distortion-free power.
- Introduces no phase shift between input and output.
- Simultaneously provides additional 4 KVA of $\pm 1\%$ electromechanically regulated power.

Faster recovery time (less than 1/50th cycle, or 330 microseconds) plus the unique ability to eliminate line distortion — these are the reasons why the Curtiss-Wright Distortion Eliminating Voltage Regulator has been chosen by more and more laboratories and production test departments. Besides general laboratory use, this line regulator provides sim-

pler, more accurate calibration of meters . . . better design of transformers, synchros, motors . . . easier testing of such components, with fewer rejects . . . easier, more accurate measurement of magnetic properties and receiver sensitivity . . . better a.c. computer performance . . . elimination of fast line transient effects. Write for details.

Electronic Equipment
Sales Department



CIRCLE 92 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products



Recording
Oscillograph
Miniature

A recording oscillograph so small and light that it can be installed inside a missile, record all desired information, and be recovered after the flight by parachuting or other techniques, has been developed. Designated 561, it embodies improvements over its maker's previous model, 560, particularly in the wider range of recording speeds and the addition of trace identification. It has 14 channels, a magazine capacity of 95 feet of recording paper, beam-type interrupter identification, and recording speed range of 0.5 to 80 in. per sec. The oscillograph withstands constant accelerations above 25 g, shock accelerations above 1500 g for 20 milliseconds, temperatures from -65 to $+165$ F, and altitudes up to 100,000 feet. Power required is 28 v dc at 12 amp max. Dimensions are 6-11/32 in. x 5-3/16 in. x 9-3/16 in. Weight is 15-1/2 lb.

Midwestern Instruments, Dept. ED, Tulsa, Okla.
CIRCLE 93 ON READER-SERVICE CARD FOR MORE INFORMATION



Toroid Coil Winder
High Speed

The "Mid-Jet" toroid coil winder reduces the operation of winding toroid coils of very small dimensions to a practical and simple routine. The winder provides precise winding control that results in exceptional uniformity of characteristics. It will effectively wind single and multistranded wires such as Litz, Teflon, cotton covered, etc. Other features are: automatic core rotation, precision winding, automatic sector winding that allows full control of the section of the core wound and a power driven dereeler for loading the shuttle and increasing machine production capacity. Winding speed ranges up to 200 turns a minute.

Electro Devices, Inc., Dept. ED, 580 Main St.,
Wilmington, Mass.

CIRCLE 94 ON READER-SERVICE CARD FOR MORE INFORMATION

DO YOU NEED

a really
RUGGED*
COMPACT
SENSITIVE
LIGHT-BEAM
GALVANOMETER



*Will take
25 G's!

this is it...

Here is a new series of light-beam galvanometers that were developed to withstand the extremely severe conditions of shock and vibration encountered in field servicing and testing of jet aircraft.

Through unique folding of the light beam, great compactness is achieved while retaining sensitivity to the highest degree . . . equal to that of laboratory instruments!

These Howell Galvanometers feature excellent readability. They are readily adaptable to existing instruments. They are competitively priced.

SPECIFICATIONS:

Sensitivity to .105 microamperes per millimeter
Resistances: 20, 100, 500 and 1000 ohms. Short
period; high speed response. SIZE: ONLY 2.6"
x 3.62" x 3.615" Sealed construction.

For full information
please write or wire



HOWELL INSTRUMENT Company
3101 Trinity St. • Fort Worth 7, Texas

CIRCLE 95 ON READER-SERVICE CARD

Using Thermistors

Edited by
FENWAL ELECTRONICS

Thermistors, with their almost incredible sensitivity to temperature change, now get news column all their own.

The cases in point for the first column: temperature measurement and temperature control.

Three basic circuits for temperature measurement with thermistors:



FIG. 1

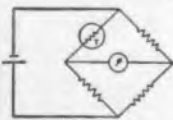


FIG. 2

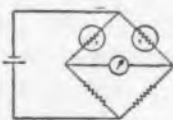


FIG. 3

The first is a battery, a thermistor, and micro-ammeter. The second, more sensitive, has a thermistor as one leg of a bridge circuit. The third incorporates two thermistors in a bridge, making possible even more precise temperature differential measurements.

Two basic circuits for temperature control with thermistors:



FIG. 4

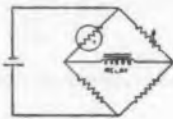


FIG. 5

The first has a thermistor in series with a relay, a battery, and a variable resistor. By adjusting the resistor, it is possible to make the relay operate at any desired temperature of the thermistor.

The second is more sensitive, and has a thermistor as one leg of a bridge circuit, a variable resistor in another leg, and a polarized relay across the output. Even more sensitive control can be had by applying AC to the bridge and placing a high-gain amplifier between the bridge and the relay.

Designers: if you are not already familiar with the tremendous possibilities of thermistors, write for details to FENWAL ELECTRONICS, INC., 4 Mellen St., Framingham, Massachusetts.



Makers of Precision Thermistors
CIRCLE 96 ON READER-SERVICE CARD



Printed Circuit Coil Forms Berg Lugs Attached

Printed circuit coil forms and collars, with from two to six Berg lugs attached to each coil form, are now available. Lugs can be located in any desired angular configuration. They are firmly and permanently staked to provide a mechanically strong and electrically efficient connection. Berg lugs are used because they can be staked to thin or heavy wall coil forms of many diameters, to provide completely reliable soldered joints. Three different types of lugs are available; one is dimpled to hold the coil form upward before soldering and two others can be bent over before soldering. All lugs are available in standard hot tin finish. A special multiple-strip coil form lugging machine is used to assure efficient and uniform staking of lugs. These printed circuit coil forms and lug collars are available in a full range of od's, id's and lengths.

Resinite Corp., Dept. ED, 6980 North Central Park Ave., Chicago 45, Ill.

CIRCLE 97 ON READER-SERVICE CARD FOR MORE INFORMATION

Sweeping Oscillator Complete Radar Alignment



This alignment instrument, containing a sweeping oscillator, calibrated variable-frequency marker and fixed crystal-controlled markers, is designed for the 10 to 145 mc range. The fundamental-frequency sweeping oscillator is continuously variable in six overlapping bands accurately calibrated on a direct-reading dial. Sweep widths variable to 60 per cent of center frequency below 50 mc, 30 mc, above 50 mc are provided. RF output voltage is 1.0 v rms into 70 ohms, AGC'd for ± 0.5 db flatness over widest sweep and tuning range. The variable marker is a birdie "pip" marker generated by a separate CW oscillator continuously variable from 5 to 170 mc in six overlapping bands and calibrated to ± 1 per cent on a separate direct-reading dial. Eleven individually switched, crystal-controlled pulse type markers at customer specified frequencies over the bandwidth are provided for both separate and simultaneous operation.

Kay Electric Co., Dept. ED, 14 Maple Ave., Pine Brook, N.J.

CIRCLE 98 ON READER-SERVICE CARD FOR MORE INFORMATION



ideal for wear resistant parts CHEMISEAL[†] NYLON

For bearings, gears, cams, bushings, rollers, slides and other mechanical and electro-mechanical parts where wear resistance is essential—and often where no conventional lubricants, or no lubricant at all can be used—select Chemiseal Nylon (Zytel[®] 101). It is not only the best but the least expensive of the standard Nylon compositions.

COMPLETE SERVICE

- Extruded rods, tubing, special shapes.
- Custom-machined parts.
- Injection Molded parts to specification.

And this superior Nylon is backed by a fabrication service which is more complete than is provided by any other organization. It offers (1) an almost infinite variety of extruded rods, tubing and special shapes for your own production of parts, (2) high-speed, low-cost facilities for custom-machining precision parts to your specifications and (3) large volume injection molding of parts for the ultimate in production economy.

Send detailed dimensional drawings of parts and quantities required, or write for Bulletin N-1056.

United States Gasket Company
Camden 1, New Jersey

United States Gasket *Plastics Division*
OF THE GARLOCK PACKING COMPANY

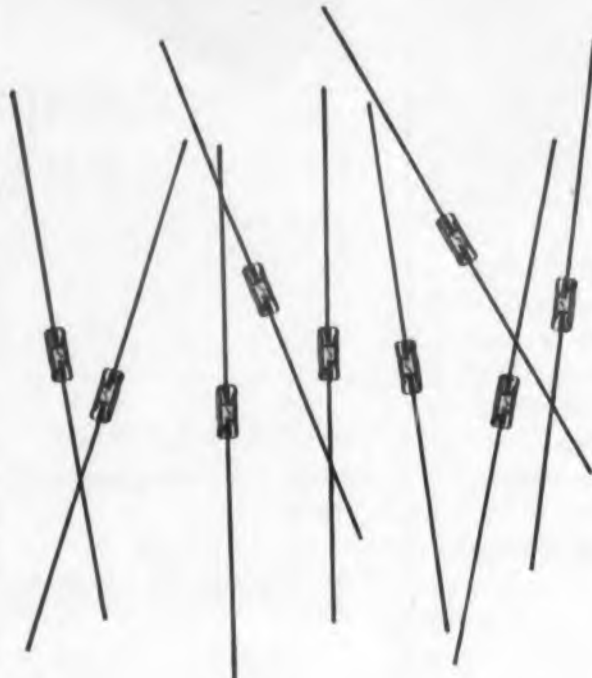
*du Pont trademark
†U.S.G. trademark



CIRCLE 99 ON READER-SERVICE CARD FOR MORE INFORMATION

Now,
at Hughes,
two new
series

HIGH CONDUCTANCE SILICON DIODES



First, a high conductance series designed for operation up to 150°C and featuring forward conductance of at least 200mA at 1 volt, together with excellent reverse characteristics. Like all other Hughes diodes, these are packaged in our famous glass body for complete protection from contamination and moisture penetration. And like all other Hughes diodes, they conform to published specifications under a variety of operating conditions. Here, then, are specifications for representative types in the series.

Second, a related high conductance series in the Hughes glass package with somewhat different characteristics.

* Currently these competitive types are not registered with RETMA; hence their specifications are subject to change. When they are registered, diodes now designated as HD types will be supplied as 1N types according to the registered specifications.

For details, please write: SEMICONDUCTOR DIVISION • HUGHES PRODUCTS
International Airport Station, Los Angeles 45, California

HUGHES PRODUCTS

© 1957. HUGHES AIRCRAFT COMPANY

HUGHES



SEMICONDUCTORS

CIRCLE 100 ON READER-SERVICE CARD FOR MORE INFORMATION

	Max. DC Inverse Operating Voltage (volts)	Maximum Average Forward Current (mA)		Maximum Forward Voltage @200mA @25°C (volts)	Inverse Current At Specified DC Test Voltage (μA)		Test Voltages (volts)
		@25°C	@150°C		25°C	150°C	
HD-6764	70	200	50	1.0	0.025	5	60
HD-6766	130	200	50	1.0	0.025	5	125
HD-6768	180	200	50	1.0	0.025	5	175
HD-6771	225	200	50	1.0	0.05	25	225
HD-6773	300	200	50	1.0	0.1	25	300
HD-6775	380	200	50	1.0	0.1	25	380

Comparable Competitive Types *	Max. DC Inverse Operating Voltage (volts)	Maximum Average Forward Current (mA)		Maximum Forward Voltage @100mA @25°C (volts)	Inverse Current At Specified DC Test Voltage (μA)		Test Voltages (Volts)
		@25°C	@150°C		25°C	150°C	
HD-6132 1N482B	36	200	50	1.0	0.025	5	30
HD-6133 1N483B	70	200	50	1.0	0.025	5	60
HD-6134 1N484B	130	200	50	1.0	0.025	5	125
HD-6135 1N485B	180	200	50	1.0	0.025	5	175
HD-6136 1N486A	225	200	50	1.0	0.05	25	225

New Products



Instrumentation Amplifier

1/2 Cps to 2 Mcps

This amplifier, Type 104, is capable of reproduction of fast transients and provides voltage gain from 1 to 10. High frequency response is flat within ±1 db to 2 mcps with resistive loads, and within ±3 db to 2 mcps with capacitive loads not greater than 300 μfd. The low frequency response is flat within ±1 db to 1/2 cps with loads greater than 100 K; resistive loads below 100 K limit low frequency response owing to 20 μfd output coupling condenser. Gain can be varied between 1 or 10 with an accuracy of ±3 per cent at 1 kcps. Noise level referred to input is less than 50 μ-volts. Five hundred megohms input impedance is available, but in instrumentation use other input impedances, 0.1, 1, 10, and 100 megohms are available by turning a front-panel switch. Power requirements are 250 v regulated dc, 20 ma; and 6.3 v, preferably dc, at 0.7 amp.

Dimensions of the amplifier are 1-3/8 in. w, 4-1/2 in. h and 9-1/2 in. deep. Weight is 15 ounces.

Atlantic Research Corp., Dept. ED, Alexandria, Va.

CIRCLE 101 ON READER-SERVICE CARD FOR MORE INFORMATION



Galvanometer

Measures Weak Currents

This galvanometer is especially suitable for measurement of weak photoelectric and thermoelectric currents. Designated FT-MG-1, it also serves as an indicator when using thermocouples for bridge measurements, and in combination with a dry rectifier, it is suitable for ac measurements. When used with thermic converter elements the galvanometer may be employed in high frequency measurements. The Type FT-MG-1 is a mirror galvanometer employing a parallax-free light spot as the indicator.

Federal Telephone and Radio Co., Dept. ED, 100 Kingsland Rd., Clifton, N.J.

CIRCLE 102 ON READER-SERVICE CARD FOR MORE INFORMATION



**Alpha
Contamination
Counter**
Probe Separately
Available

Providing three ranges of 0-150, 0-1500 and 0-15,000 counts per minute, a new portable survey instrument for alpha surface contamination measurement has been announced. Designated Model 2112-P, it consists of an unsealed air proportional alpha probe connected by means of a cable to a battery-operated count rate meter. The alpha probe, separately designated Model AP4, may be ordered separately if desired and used with standard ac-operated quarter-volt scalars or ratemeters. Its counting chamber has an active area of 75 sq cm, and a window thickness of approximately 0.8 mg/cm². It is light in weight, non-microphonic, easily decontaminated, and very stable in calibration reproducibility. A deposited uranium alpha source is supplied to enable the user to calibrate the instrument quickly. High voltage may be varied from 1500 to 2300 v to accommodate different chambers and different atmospheric pressures. Probe efficiency is approximately 25 per cent for 5.0 mev alphas from RA D + E and from U₃O₈, for pi geometry. Probe AP4, in association with instrument 2112-P, will measure alpha contamination from a minimum of 2 alphas per cm²/minute to 10,000 alphas per cm²/minute.

Nuclear-Chicago Corp., Dept. ED, 229 W. Erie St., Chicago 10, Ill.

CIRCLE 103 ON READER-SERVICE CARD FOR MORE INFORMATION

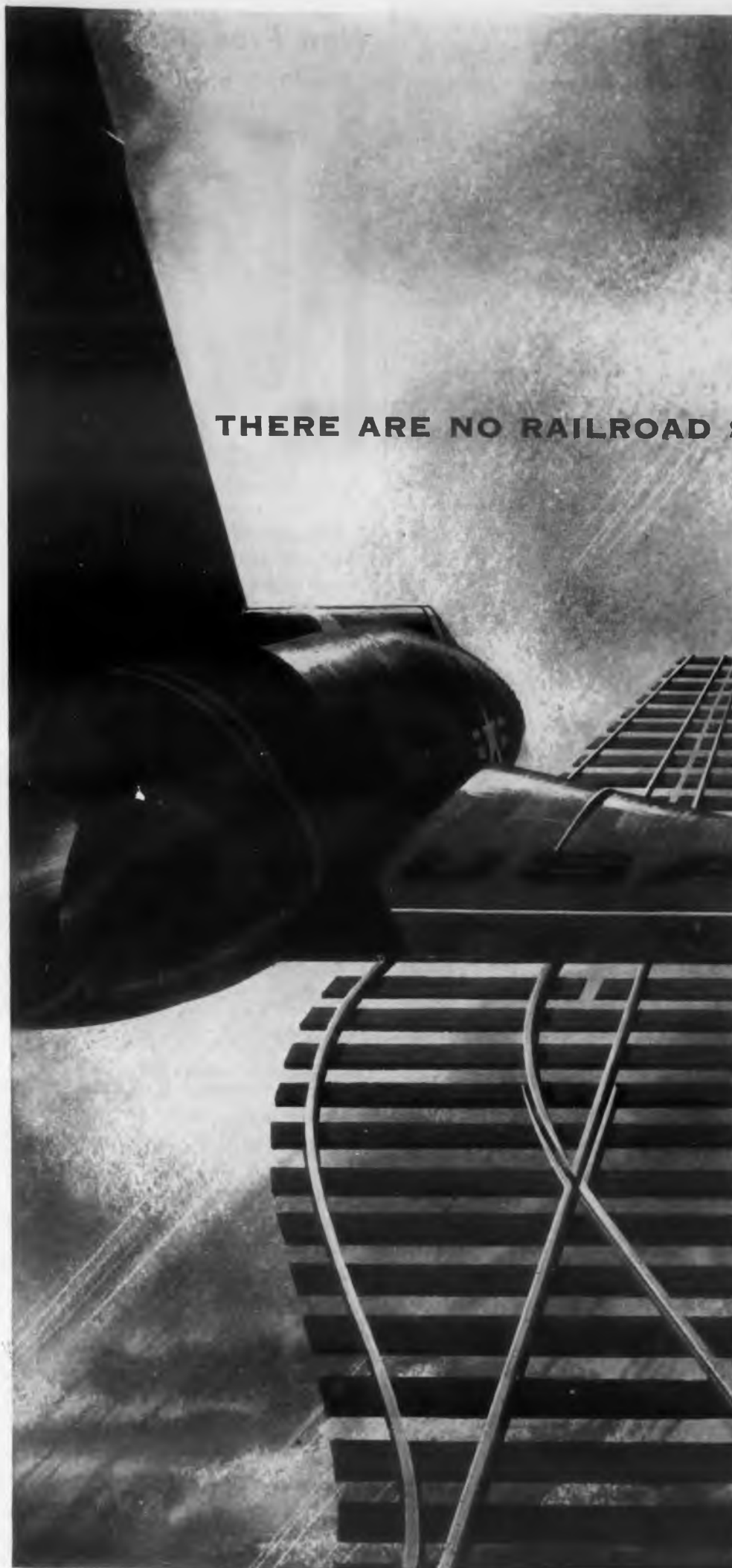


**Low Noise Chopper
External Coil**

This chopper has been designed to eliminate the serious problem of capacitive coupling between contact and coil leads which exists in the operation of miniature choppers in high impedance circuits. The new external coil chopper offers complete electrostatic shielding between contact and coil leads. Resulting peak-to-peak noise levels are less than 100 μv across a 1 meg impedance. Coil excitation leads extend above the top of the envelope or case, at the opposite end from the contact terminals. The chopper is offered with spdt switch action, with nominal contact ratings up to 10 v, 1 ma. It is approximately 1-3/4 in. high and 7/8 in. in diameter.

The Bristol Co., Dept. ED, Waterbury 20, Conn.

CIRCLE 104 ON READER-SERVICE CARD FOR MORE INFORMATION



THERE ARE NO RAILROAD SIDINGS IN THE SKY

When railroad traffic gets too heavy or complex, a train will be switched onto a siding until the tracks are clear. However, high-speed aircraft in busy traffic patterns over metropolitan areas cannot wait...

Hughes, a leader in the development of highly advanced data processing techniques, is doing research on air traffic control systems which can continuously monitor a high volume of air traffic and precisely control each individual airplane. With this system the time delays, inefficiency and inaccuracies present in manual control are practically eliminated.

Air traffic control represents only one of many projects underway. Confidential new projects... many infinitely more complex... promise an unlimited future to scientists and engineers in the Hughes Ground Systems Division.

If your experience is in electronic circuit design, logical design, electronic packaging, and radar systems, we invite you to investigate these outstanding opportunities.

the West's leader in advanced electronics

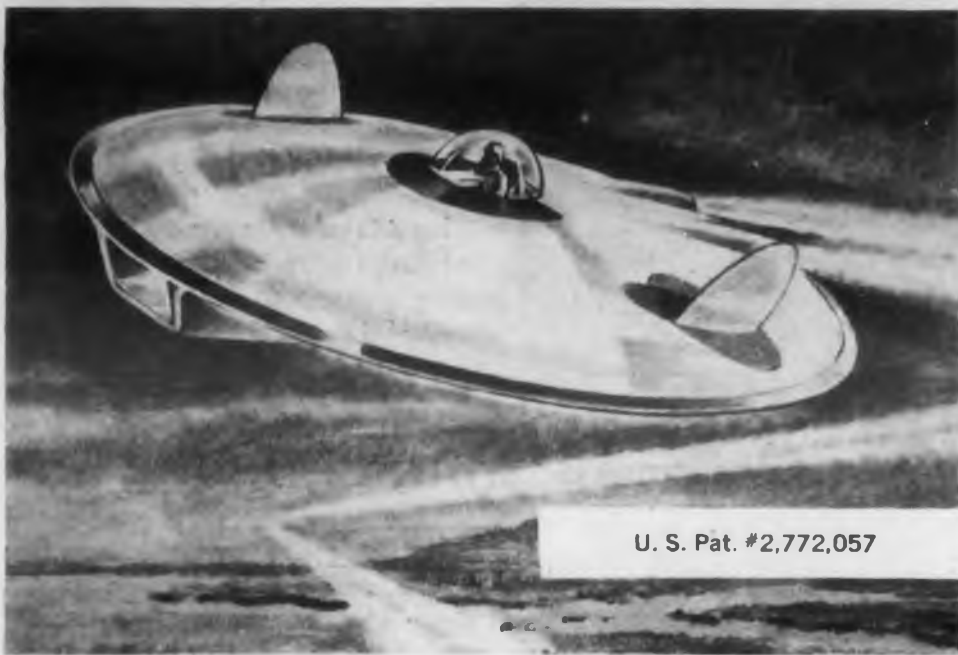
HUGHES

SCIENTIFIC STAFF RELATIONS
RESEARCH AND
DEVELOPMENT LABORATORIES

Hughes Aircraft Co., Culver City, California

CIRCLE 570 ON READER-SERVICE CARD FOR MORE INFORMATION

MARS outstanding design SERIES



U. S. Pat. #2,772,057

saucer secret?

Whose incredible design is the flying saucer?

These flying objects (unidentified, of course) maneuver at high speed, with human-crushing suddenness. Their unearthly behavior poses a perplexing problem to imaginative designers: how might man survive in them?

John C. Fischer, Jr. approached the problem with this circular aircraft and its unique control system, U. S. Pat. #2,772,057.

This "saucer's secret" is a rotatably adjustable shell (upper) and a pilot's compartment which pre-rotates toward the direction to be flown. The functional design "humanizes" saucers because the rotating provisions distribute *g-forces* laterally on the pilot, minimizing blackouts.

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

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

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



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

at all good engineering and drawing material suppliers

CIRCLE 106 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products



Resistance Network
0.01 per cent Tolerance

This precision resistance network splits 600 v into two parts within 0.01 per cent over the temperature range of 0 C to 100 C, and under adverse environmental conditions. The network is completely encapsulated and hermetically sealed. It is capable of taking surges of double rated voltage. The network has specific application on computer power supplies.

General Resistance Inc., Dept. ED, 577 E. 156 St., New York, N.Y.

CIRCLE 107 ON READER-SERVICE CARD FOR MORE INFORMATION



Test Chamber
Simulates Sand and Dust

For environmental testing, this sand and dust chamber stabilizes the composition and density level of sand and dust, according to MIL-F-5272A, by continuously purging a small amount of dust-laden air which is recirculated to exhaust outside of the chamber. Make-up air and sand and dust replace the exhausted air. Relative humidity is automatically maintained. Chemical dehydration is not required.

Available in a wide range of standard velocity levels for applicable MIL specs, all units incorporate mechanical refrigeration and heating systems that supply uniform internal chamber temperatures with operating ranges of 25 and 70 C, tolerance ± 2 C. Relative humidity is maintained below 30 per cent. Other standard features include convenient high capacity sand hopper and 9-point, 35-amp terminal connection.

Tenney Engineering, Inc., Dept. ED, Environmental Div., 1090 Springfield Rd., Union, N.J.

CIRCLE 108 ON READER-SERVICE CARD FOR MORE INFORMATION

complete
calibration
with one
multi-range
instrument



FAST ACCURATE CALIBRATION

Now possible with one completely self-contained AC-DC calibration standard requiring a minimum of operator training and previous instrument calibration experience.

Compact Light Weight
Model 829

**INSTRUMENT
CALIBRATION
STANDARD**

QUICK CONVENIENT TESTING

Portable AC-DC unit contains all power supplies and standards in one single cabinet. Operates without batteries or accessories.

Precise, practically error-proof checking of most types of electrical indicating instruments in daily use is a routine convenience for Model 829 users. Maintenance of quality control by frequent calibration of instruments and allied test equipment can be accomplished within department by available personnel. A mechanical index explains step-by-step test procedure.



WESTON Special Meters

used as standards have 5-inch mirror precision scales, knife edge pointers and are adjusted to better than 0.2% accuracy.

Calibration to full scale accuracy of 0.5% can be accomplished for all instruments measuring d-c voltage (22 ranges) from 0.25 mv to 2000 volts, d-c current (2 ranges) from 2 μ a to 20 amperes, a-c voltage (19 ranges) from 1.5 mv to 1500 volts and a-c current (14 ranges) from 1.5 ma to 20 amperes. Net price \$2650. f.o.b. Boonton, New Jersey.

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**Radio Frequency
LABORATORIES, INC.**
Boonton, New Jersey, U. S. A.

CIRCLE 109 ON READER-SERVICE CARD

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HIGH PERFORMANCE



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& Slip Ring Assemblies

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Wide range of grades available for standard and special applications. Call on our 40 years of design experience to help solve your problems.

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PRODUCTS: Unique (oil-free) self-lubricating Bushings and Bearings (applicable -450° to +700°F; with expansion coefficient half that of steel will not seize shaft at low temperature); Oil-free Piston Rings, Seal Rings, Thrust and Friction Washers, Pump Vanes.



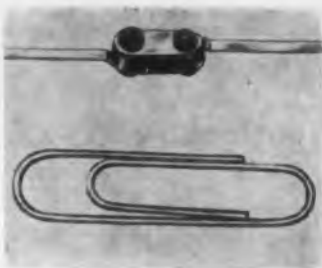
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 Send data on BUSHINGS.

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 CITY _____ ZONE _____ STATE _____

CIRCLE 110 ON READER-SERVICE CARD



**Selenium Rectifier
 Miniature**

This 5 ma d-c half-wave rectifier, about as long as an ordinary paper clip, weighs 0.015 oz., and will handle up to 125 v ac with a resistive load. Assembled in a black plastic body with flat pigtail leads, it is inexpensive and extremely rugged in withstanding vibration and shock. List prices ranges from 51¢ to 60¢, depending on type.

The rectifiers, imported and stocked from Siemens Co., W. Germany, are available only in half-waves, but several units may be connected for other circuits, such as bridge, center tap and doubler. They can be used for test instruments, small power supplies, computers, control circuits, bias supplies, relays and applications like transistor power supplies where a light current is required.

Radio Receptor Co., Inc., Semiconductor Div., Dept. ED, 240 Wythe Ave., Brooklyn 11, N.Y.

CIRCLE 111 ON READER-SERVICE CARD FOR MORE INFORMATION



**Economical Nylon
 Bearings
 Snap-In Installation**

These nylon bearings, inherently low in cost, are installed by snapping them into place. A flange at either end retains the bearing in the hole. A helical split called a compensation gap permits the bearing to be collapsed sufficiently for installation. This gap also provides compensatory space for temperature changes and moisture absorption and thus permits use of exceptionally close fit between bearing and shaft. In many applications the nylon bearing needs no lubrication, is corrosion-proof, non-contaminating; and it can operate in most liquids. Friction is low, and the resiliency of the material helps damp vibrations and resists pound-out. Toughness eliminates abrasion failures. The bearings come in two lengths, one for plate thicknesses of 0.040 in. to 0.075 in. and the other for plate thickness from 0.072 in. to 0.135 in. Each of these lengths come in nine bore sizes for 1/8 in. to 3/4 in.

Thomson Industries, Inc., Dept. ED, Manhasset, Long Island, N.Y.

CIRCLE 112 ON READER-SERVICE CARD FOR MORE INFORMATION



ROTARY JOINTS

These are just a few of the hundreds of rotating joints that have established NRK as the No. 1 source for such assemblies. Whatever your need for radar or microwave components, you will find at NRK complete facilities and matchless experience for designing and manufacture.



Microwave Assemblies, Radar Components and Precision Instruments — manufactured and designed to your specifications.

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4601 W. Addison St.,
Chicago 41, Illinois

Eastern Sales Office
Box 445, Westfield, N. J.

West Coast Representatives
Bray and Carter
2232 W. 11th St., Los Angeles 6, Cal



CIRCLE 113 ON READER-SERVICE CARD FOR MORE INFORMATION



**ELGIN'S
NEW**

MV

Big Relay Performance!

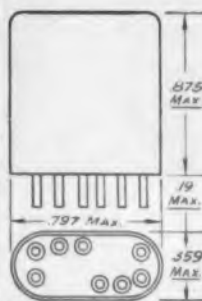
...crystal can size

Elgin's new MV rates superior to other high performance relays, yet is less than an inch long and weighs less than half an ounce. It meets military specifications and is designed for continuous use in the -65°C to 125°C temperature range. The MV has a life

rating of 100,000 operations minimum at rated load. This new relay is in production now and prompt delivery is assured. For computers, control systems and every installation that requires dependable performance AND miniature size... specify MV.

SPECIFICATIONS

VIBRATION	10 to 80 cycles per second at maximum excursions of .06"—80 to 2000 CPS 20G's acceleration
SHOCK	50G for 11 milliseconds
LIFE	100,000 operations minimum at rated current
AMBIENT TEMPERATURE RANGE	-65°C to 125°C
DUTY	Continuous
OPERATING POWER	Nominal 1.2 watts at ambient temperature
CONTACT ARRANGEMENT	DPDT (2 Form C)
CONTACT RATING	2 amps resistive at 32VDC or 115VAC
CONTACT MATERIAL	Silver-Magnesium-Nickel Alloy
CONTACT RESISTANCE05 ohms
OPERATING TIME	5 milliseconds maximum at nominal power
RELEASE TIME	5 milliseconds maximum
ALTITUDE	Voltage breakdown of relay is 1000 Volt AC to 40,000 ft.—550 Volts AC to 70,000 ft.
DIELECTRIC STRENGTH	1000 volts RMS
INSULATION RESISTANCE	100 megohms minimum at 125°C
STANDARD COIL RESISTANCES	30, 120, 600, 1000, 2500, 5000, 10000 ohms, others available
SIZE875 high x .797 wide x .359 thick max.
WEIGHT	0.45 ounces (max.)
MOUNTING ARRANGEMENT	Bracket, side studs, top studs
TERMINAL ARRANGEMENT	Plug-in, solder-hook, 3-inch leads



ELECTRONICS DIVISION

ELGIN NATIONAL WATCH COMPANY

107 National Street, Elgin, Illinois
2435 N. Naomi Street, Burbank, California

CIRCLE 114 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

**Teflon-Silicon Terminals
For Hermetic Seals**



Teflon-silicone hermetic terminals for transformers, capacitors and similar electronic components, this new Series 399 is design to conform to MIL-T-27A. They are rugged and simply constructed. Ratings are 1500 v operating, 4000 v test, 10 amp. Assembly is accomplished either by clinching in a press or by a drive fit of the electrode with a press; or the manufacturer will install the terminals in the user's covers. The hermetic seal is completed at the time the inner leads are attached. The electrodes are available in three styles: solid with single turret, solid with double turret and hollow with lug for minimum clearance.

Lundey Associates, Dept. ED, 694 Main St., Waltham 54, Mass.

CIRCLE 115 ON READER-SERVICE CARD FOR MORE INFORMATION



**Accelerometer
Low G**

Acceleration values down to 0.03 g can be accurately measured with the model 2218 accelerometer. Minimum sensitivity of 40 mv per g is provided by the Piezite I ceramic element. A natural frequency of 20 kc, minimum, gives a response from 2 cps to over 4000 cps with a linearity of ± 5 per cent. Moisture proof construction assures accurate operation under wide environmental conditions. Temperature characteristics are linear (± 10 per cent) from -65 to $+230$ F. The accelerometer weighs 2 oz and is 1 in. hex in size. It is supplied with a noise treated cable.

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

CIRCLE 116 ON READER-SERVICE CARD FOR MORE INFORMATION

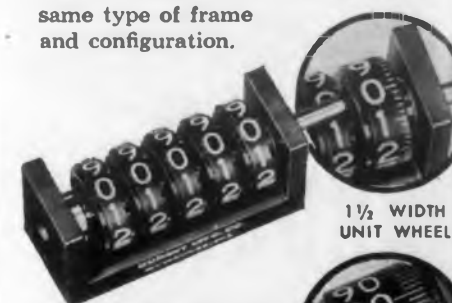
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VARIATIONS**

New Y

**DIGITAL READ-OUT
COUNTERS**

by **DURANT**

Design engineers can now select one or more standard units from a range of 96 Instrument Counters, having the same type of frame and configuration.



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2 to 7 Figures



DOUBLE WIDTH UNIT WHEEL

Here is a family group that provides uniformity in digital recording to satisfy nearly all design requirements... on radar equipment, navigation instruments, computers, missile tracking devices, and gauging instruments.

They are compact, average weight only 2 ounces, have easy to read figures, white on black... speeds to 2500 RPM. Available in single or dual bank style, in 2 to 7 figures capacity... three styles of unit wheel configuration.



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Nylon Bonding Agent

High Bond and Peel Strength

An epoxy-based compound that bonds nylon to itself, to metal, or to other materials has been brought out. Designated Bonding Agent R323, it possesses high bond and peel strength, and may be used with rubber.

Carl H. Biggs Co., Dept. ED, 2255 Harry Ave., West Los Angeles, Calif.

CIRCLE 118 ON READER-SERVICE CARD

Neon Glow Lamp

For Ultra-Miniature Units

Designated NE-2D, a new neon glow lamp for use in sub-miniature indicator and pilot light assemblies has been developed, principally for ultra-miniaturized power supplies, amplifiers and computing devices. Although similar in shape and construction to the NE-2 glow lamp, the NE-2D has a smaller bulb, a maximum overall length of less than one inch, and a flanged base that makes for easy removal and replacement. It operates on 110-125 v circuits in series with a 62,000 ohm resistor. Power consumption is 1/10 watt, life expectancy 1500 burning hours.

General Electric Co., ED, Nela Park, Cleveland 12, Ohio.

CIRCLE 119 ON READER-SERVICE CARD

Time Integrating Instrument

Measures Analog Integral

The Model 270 integrating system obtains the time integral of rapidly varying, short or long term analog signals. It is supplied as a portable or rack-mounted instrument, and gives the user accurate digital display of both the integral and the action time of the phenomenon being measured. Output connectors are provided so that this information can be automatically printed by a typewriter or recorded onto tape. The Model 270 has a counting rate of 10,000 counts per sec which permits the measurement of values over time intervals as short as 1 msec.

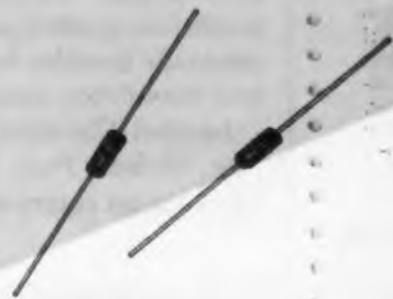
Alleghany Instrument Co., Dept. ED, 1091 Wills Mountain, Cumberland, Md.

CIRCLE 120 ON READER-SERVICE CARD

CIRCLE 121 ON READER-SERVICE CARD

Transitron

MILITARY type silicon diodes



1N457

1N458

1N459

1N251

TRANSITRON'S Military type silicon diodes are designed to meet the requirements of MIL-E-1, and are characterized by reliability under the most severe operating conditions.

Their subminiature size and rigid specifications make them ideal for a wide range of applications. Types 1N457, 1N458, and 1N459 are intended for low and medium frequency uses, requiring voltage ratings up to 175 V. Type 1N251 is a high frequency diode especially designed for detector and high speed pulse units.

In addition to these four military types, silicon diodes meeting many other application requirements are also available. These include high conductance types, as well as fast switching-high voltage diodes.

Type	Minimum Forward Current at + 1 v (ma)	Inverse Current at Specified Voltage (μ a)	Maximum Operating Inverse Voltage (volts)	MIL-E-1 TSS #
1N457	20	.025 @ -60 V	60	1026
1N458	7	.025 @ -125 V	125	1027
1N459	3	.025 @ -175 V	175	1028
1N251*	2	.2 @ -10 V	30	1023

*Inverse recovery time under .15 microseconds

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BULLETIN TE 1350

Transitron

electronic corporation • wakefield, massachusetts



Germanium Diodes



Transistors



Silicon Diodes



Silicon Rectifiers

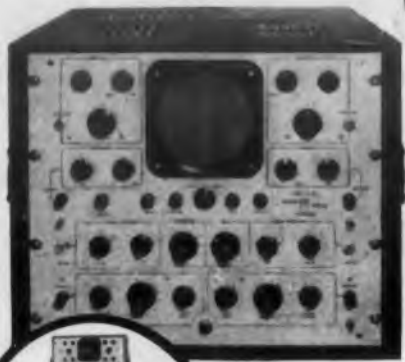


opening new horizons in MULTI-CHANNEL OSCILLOGRAPHY!

2 Channels . . . DC to 15 MEG.

NEW!

Featuring a vertical frequency range from DC to 15 megacycles, this new ETC Model K-215 2-channel oscilloscope paves the way to more accurate studies and recording of simultaneous operational phenomena in the higher frequencies. Accurately calibrated sweep speeds and high vertical deflection sensitivity assure quantitative time and amplitude measurements with accuracy comparing to that of quality indicating meters. Features include 10 kv. acceleration potential; transistorized multi-vibrator producing 1 kc. square wave calibrator; provision for either external or internal triggering and many other features never before incorporated in a moderately-priced instrument of this size. Forced air-ventilated regulated power supply using selenium rectifiers and handy ETC Scopemobile are included.



Showing the K-215 and power supply mounted on ETC Scopemobile.

4-Channel Recording 'Scope and MASTER STRAINALYZER

THE MOST VERSATILE,
FULLY MODERNIZED
INSTRUMENT OF ITS KIND

NEW!

Fully self-contained, entirely automatic and designed for either direct or remote control, this ETC Model H-42B Oscilloscope and Master Strainalyzer triggers events and records resulting operational phenomena at as many as 4 different points concurrently on the face of a single 5" 4-gun ETC cathode ray tube. So broad is its usefulness that its full range of applications can only be hinted by a description of its features. Input data may be either differential or single ended, thus permitting use of associated transducers or strain gauges of practically any type and of any resistance between 50 and 5,000 ohms. Frequency range is DC to 100 kc. Other features include automatic amplitude calibration; self-contained bridge power supply; 4-step sequence timer; crystal-controlled timing pulse; provision for any type of camera and many others. Write for Bulletin H-42B.



ETC produces standard and special multi-beam 'scopes up to 8-channels; DC amplifiers and a complete line of 2- to 10-gun cathode ray tubes. Write for Catalog 4.

ETC electronic tube CORPORATION

1200 E. Mermaid Lane, Philadelphia 18, Pa.

CIRCLE 122 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

Flux Removers

Varying Degrees of Solvency

A line of chemical flux removers has been designed to remove flux residues at the fastest rate consistent with safety to personnel and plant, the circuit itself, plastic parts, color coding, and decals. No flammable or toxic materials, such as xylol, acetone, alcohols, naphthas, carbon tetrachloride or trichloroethylene are present.

Four standard types of removers are offered in varying degrees of solvency. Type LN-10 is rapid and efficient on printed circuits where fast and complete removal by simple dip is essential. Type 1136 is for use on parts which contain decals, silk screening, fungicidal lacquers, etc., yet require fast removal of hot or cold residues. Type HCR removes hot residue by means of a simple dip. Type 65 is a completely neutral remover, nonhydrolyzing and mild in odor, for removal of warm or hot residues immediately after soldering. Special flux removers are made to order for critical printed circuit boards and assemblies, components, inks and plastics.

London Chemical Co., Dept. ED, 1535 N. 31st Ave., Melrose Park, Ill.

CIRCLE 123 ON READER-SERVICE CARD FOR MORE INFORMATION



Vibration Calibrator Non-Contacting Probe

Vibrations from 10 to 20,000 cps, with amplitudes from 20 to 20,000 microinches, can be measured by a non-contacting probe within an accuracy of ± 5 per cent. Vibration amplitudes of non-magnetic metals such as copper, brass and aluminum, of magnetic metals like iron and steel, and of non-metallic surfaces, may be read. A precision attenuator provides ranges of 0.02, 0.06, 0.20, 0.60, 2, 6 and 20 thousandths of an inch. Accuracy is ± 5 per cent in all ranges. Since no surface contact is required, there is no "loading" of the vibrating surface. A unique method compares peak-to-peak displacement of the vibrating surface with a standard displacement, allowing direct reading in thousandths of an inch of the variation in output which the vibration of the surface creates. The instrument is highly portable, weighing only 30 lb, and provided with a handle for carrying. Binding posts permit observation of vibration waveforms on a conventional oscilloscope. Designation is Model 501.

Tel-Instrument Electronics Corp., Dept. ED, 728 Garden St., Carlstadt, N. J.

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Lamtex's new insulating material with ideal properties of:

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Seamless, continuous weave tubing available in almost any cross-section shape—Lengths to 12 feet or more—Any wall thickness from .008"—All diameters from .062 ID.

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*Tuff-Tube with copper, nickel, silver or gold plated or bonded on ID or OD.

Send for descriptive brochure—design features, tech data application notes.



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of **silicone rubber parts**
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Free quotation quickly made from your sample or blueprint

To help you overcome design problems, our engineering staff and experience are at your disposal. To assist you in meeting production deadlines and quality standards, we offer the finest facilities for fast mass production with highest uniformity. Compound selection and molding to meet your exact specifications are also available. Why not write today for your free samples or quotation, no obligation, of course.

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CIRCLE 126 ON READER-SERVICE CARD

Coax Cable Stripper Air-Operated Machine



Any standard-size coaxial cable can be stripped at production speeds by inexperienced and unskilled workers, with the help of this air-operated machine. Both length of strip and exposure of braid can be adjusted. Less than 3 sec are needed in production to make a clean, square-shouldered strip. Constructional design makes cutting the polyvinyl insulation impossible.

The unit is powered by a 1-1/8 in. air cylinder, under 75 lb minimum pressure. Only a standard air connection is required to put the machine in operation. A single air valve actuates the reciprocal braid-cutting motion in its automatic cycle.

The bench model pictured here measures 28 in. x 6-7/8 in. x 10 in. Its cutter is furnished to specification.

Wire Stripper Co., Dept. ED, 1729 Eastham Ave., E. Cleveland, Ohio.

CIRCLE 127 ON READER-SERVICE CARD FOR MORE INFORMATION

Microwave Relay System Portable "Suitcase" Type



Completely packaged in four readily portable "suitcase" aluminum housings, this microwave relay system is intended for common carrier, television and data transmission uses. A feature is two-band operation based on interchangeability of rf components, whereby the relay can operate in the 6-7 kmc band with one watt output or in the 11-13 kmc band with 250 mw output. Designated Type MVT/MVR, the relay incorporates triode if amplification with an AFC circuit and AGC action, tunable direct indication wavemeter, and full NTSC color transmission compatibility.

American Microwave Corp., Dept. ED, 11754 Vose St., No. Hollywood, Calif.

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FOR PROVEN RELIABILITY

Specify

HUSKY RELAYS



Husky Relays are precision-engineered to give peak performance under all conditions. Exhaustive laboratory tests, quality-controlled production and a demanding inspection program insure that each Husky Relay will deliver maximum service on the job.

The complete Husky Line contains relays designed to meet standard needs. If you have a special design problem, send us your specifications for engineering review.

Don't underestimate the importance of the "Right" relay in your design. Remember, you can rely on Husky Relays!



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MINNESOTA

W YORK

CE CARD

1, 1957

UNION

Here's the "HOTTEST" AC Relay on the market—



New High-Temperature UNION AC Relay rated from -65°C . to 125°C ., 115 Volt, 60 to 400 cycles. Suitable for airborne circuits, including jet planes and missiles.

Miniature relay applications are getting hotter all the time—and many of them call for self-contained AC relays.

To meet these needs, UNION has developed AC relays incorporating silicon rectifier assemblies. They'll withstand temperatures from -65°C . to 125°C .. The size is the same as the 85°C . UNION AC Relay.

New Hi-Lo Contacts, too! These contacts permit switching loads of two amperes or dry-circuitry level in the one relay. Or, you can get gold alloy contacts for dry-circuitry use.

OTHER ADVANTAGES

Vibration resistance up to 1,000 cycles at 15 G's and shock in excess of 50 G's.

Life expectancy. Tested through 1,000,000 operations.

Coil resistance. 3,700 ohms.

Small size, lightweight. Measures only $\frac{1}{2}$ " higher than our DC relays and weighs about 5 oz. All other construction features are the same as the DC relay.

Types and Mountings. Available in 6 PDT or 4 PDT models, plug-in or solder-lug connections and all the usual mountings.

Meets or exceeds all requirements of MIL-R-5757-C, MIL-R-25018, and MIL-R-6106B.

Write for complete information. Ask for Bulletin 1012.

GENERAL APPARATUS SALES



UNION SWITCH & SIGNAL

DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY

PITTSBURGH 18, PENNSYLVANIA

CIRCLE 130 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature

Synchronous Timing Motors 132

Synchronous timing motors designed to withstand temperatures up to 165 F are pictured and described in Form No. 150, a data sheet of 2 pages. The text cites all specifications and gives a complete description of special features and uses. Detailed drawings illustrate a variety of standard brass pinions and ratchets applications. The Lux Clock Mfg. Co., Inc., 95 Johnson St., Waterbury 20, Conn.

Steel and Aluminum Fasteners 133

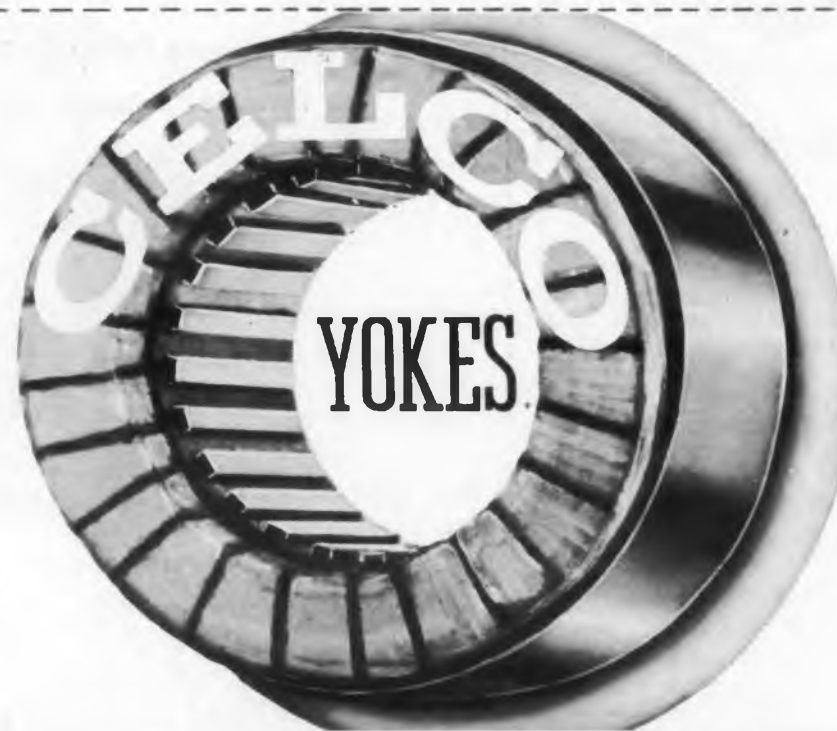
A complete line of high quality fasteners available in stainless steel and aluminum are described and illustrated in a 4-page brochure. Thread cutting screws, sheet

metal screws, machine screws, cap screws, washers, specials, bolts and nuts are among those listed. Fasteners Inc., 2901 Montrose Ave., Chicago 18, Ill.

Tubing and Switches 134

Industrial & Gov't specification hook-up and lead wire, insulated tubing and switches are covered in Industrial Bulletin No. T-257, now available.

The bulletin includes colors, sizes and types for Military specifications covering hook-up and lead wires for high heat, high voltage and miniaturization; tubing which conforms to ASTM, NEMA and U/L Specifications in addition to listing "Teflon" tubing. Birnbach Radio Co. Inc., 145 Hudson St., New York 13, N.Y.



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Celco Constantine Engineering Laboratories Co.
MAHWAH, NEW JERSEY

CIRCLE 131 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Guidance Instruments 135

With photographs, descriptions, general specifications and test data, 21 standard precision guidance and control instruments have been covered in a 24-page booklet. The catalog contains information on free and rate gyros, linear and angular accelerometers, and rectilinear and rotary potentiometers. It shows an outline drawing and connection diagram for each instrument. A section of the booklet is devoted to a description of test procedures. Humphrey Inc., 2805 Canon St., San Diego 6, Calif.

Precision Optical Instruments 137

How low-cost precision optical instruments can simplify and speed manufacturing and inspection operations is the topic of a booklet called "Industrial Optical Aids." The text describes an assortment of instruments and suggests ways to use them for faster, lower cost production. Items discussed include magnifiers, microscopes, wide field tubes, macrosopes and comparators. Bausch & Lomb Optical Co., 635 St. Paul St., Rochester, N.Y.

Widening Uses of Microfilm 136

"New Horizons with Microfilm" a four-color 36-page booklet describes the conception and growth of the system for activating microfilm by mounting it in aperture cards or jackets is now available. It gives details of new equipment, supplies and techniques for handling engineering drawings, personnel and other office records, traffic control material, and provides several pages of case history reports on applications, savings and other benefits. Filmsort Div. of Dexter Folder Co., Pearl River, N.Y.

Servo Motors 138

The characteristics and applications of standard and custom servo motors are detailed in Bulletin 385. Complete electrical and mechanical specifications are given along with data on plate to plate, transistorized servo amplifier, and magnetic servo amplifier applications. The 10-page brochure is liberally illustrated with photographs and circuit and dimensional diagrams. Servomechanism components are illustrated and described. Norden-Ketay Corp., Jericho Turnpike, Commack, N.Y.

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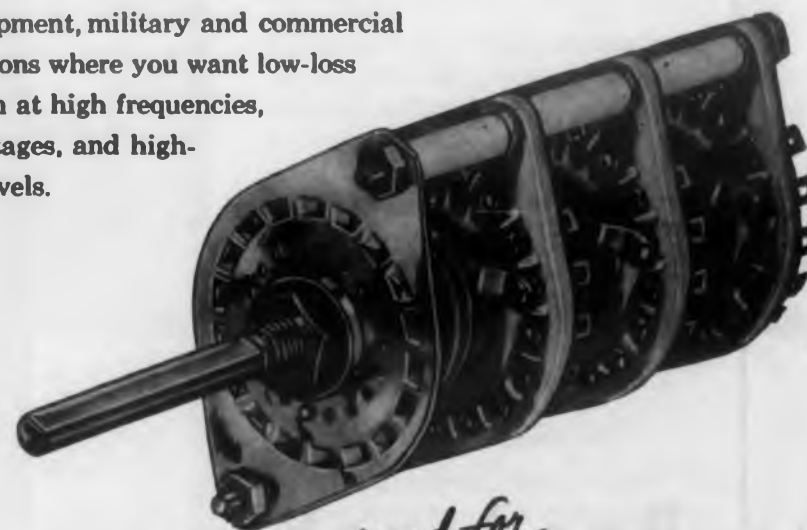
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When you purchase a breadboard, the prime considerations should be flexibility, ease of assembly, precision and price.

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Name

Title

New Literature

Alligator Clips 142

Catalog Sheet No. 176 describing Alligator Clips "70 Series" is now available.

The data sheet gives the functional advantages of cord strain relief ears and new-design meshing teeth. It also includes complete specifications of the three versions of this clip. Mueller Electric Co., 1580H East 31st St., Cleveland 14, Ohio.

Power Resistors 143

Complete line of power resistors to meet requirements of military specifications MIL-R-26C (Fixed Wire-Wound Power Type Resistors) are described in Bulletin No. 12.

Among the features listed are Vitrohm construction, wide range of wattages and resistances, minimum size for ratings offered in characteristics G, V or Y and a complete selection of mountings. Ward Leonard Electric Co., Mt. Vernon, N.Y.

Punched Tape 144

A colorful 24-page booklet entitled "The Punched Tape Story" presenting simplified cartoon-type illustrations for quick and complete interpretation of an automatic writing machine is now available.

The booklet shows how common language punched paper tape can be created for integrating other business equipment or used to actuate the same or other writers to produce documents, completely automatically, at 100 words per minute. Commercial Controls Corp., Sub. Friden Calculating Machine Co. Inc., 1 Leighton Ave., Rochester 2, N.Y.

Control Guide 145

Pocket Control Guide No. 5, a handy control cross reference guide released semi-annually giving latest replacement control information is now available. Hundreds of new listings are included in this 3-3/4 in. x 8-1/2 in., 106 page guide. Centralab, Div. Globe Union Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.

Carbon Film Resistors 146

Low cost, precision carbon film resistors are described in a bulletin just released. It features construction layer of pure carbon particles deposited on a ceramic rod. The bulletin includes the mechanical and electrical characteristics and states that the resistors conform to MIL-R-10509B specifications. The resistors are available in five types ranging from 1/4 to 2 w sizes, and are used in test equipment, meters and hi-frequency circuits. Continental Carbon, Div. Wirt Co., 5221 Greene St., Philadelphia 44, Pa.



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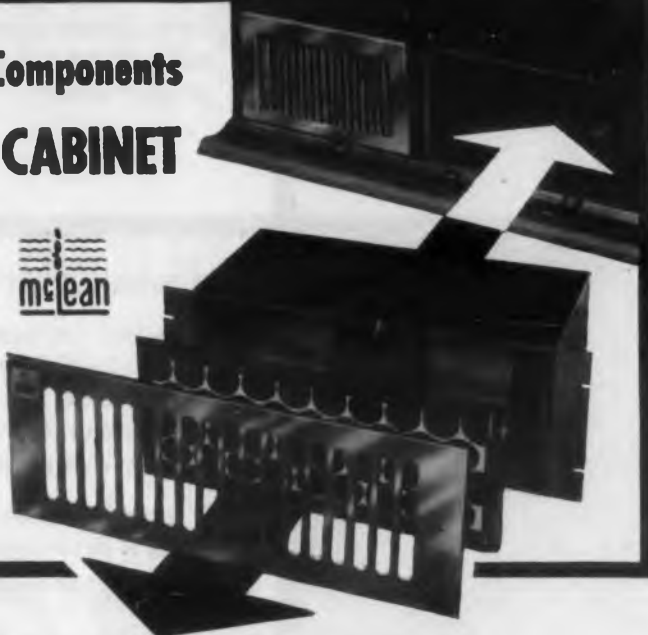
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New Literature

Encapsulation Shells

150

Molded epoxy shells for the encapsulation of resistors, coils, capacitors and other electronic components are the subject of a 2-page data sheet. The leaflet is illustrated and contains a list of electrical and physical properties. Epoxy Products, Inc., 137 Coit St., Irvington, N.J.

Molecular Bonding Process

151

A patented casting process for the molecular bonding of aluminum and magnesium casting alloys to steel, iron and other metals is discussed in a booklet of 18 pages. The process permits the production of bimetallic units combining selected physical properties of both metals. The bulletin describes and illustrates a diversity of products in which the process is used, among them cylinders, gears, brake drums, bearings and hydraulic components. A 2-page section is devoted to a discussion of design factors. Fairchild Engine and Airplane Corp., Al-Fin Div., Deer Park, N.Y.

Right Angle Bevel Gear Units

152

Standardized right angle bevel gears for industrial applications are illustrated and described in Bulletin No. 57 just published.

Line drawings give the dimensions of the three standard sizes: 5, 1 and 1/3 horsepower, which are available as 2-way or 3-way types and with 2:1 or 1:1 shaft ratios. The bulletin also includes table of basic data listing rated horsepower and speed for all standard models and gives the static torque from the output shaft, the shaft diameter and weight of each. One of the features of the unit is the long service life (1000 hours continuous duty for the two smaller sizes; 2000 hours for the 5 hp size). Airborne Accessories Corp., 1414 Chestnut Ave., Hillside, N.J.

Compact Spring Washers

153

Pre-assembled stacks of multiple spring washers held together by pins or rivets passing through the washers near the neutral axis is described in 6-page bulletin just released.

The well illustrated bulletin shows exploded views of how washers are assembled, and schematic drawings showing several typical applications for the "cartridge." One of the features of the "cartridge" is as a one-piece component in the final machine it is easier to handle and install than loose washers. Associated Spring Corp., Bristol, Conn.

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VERSATILITY teams up with high input impedance in this new, improved broad-band amplifier. Used as a general purpose preamplifier or as an isolation amplifier, it fits neatly in scores of tests at both audio and ultrasonic frequencies.



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TYPICAL applications are: vibration and noise studies, work with accelerometers and hearing aids, and pulse amplification. A 5-volt 50-ohm output is provided for driving oscilloscopes, sound level meters, and pen recorder power amplifiers.

FEATURES of the Model 102B are: accurate decade gains of 0.1 to 1000; selectable bandwidths of 2 cps to 150 kc or to 1.7 mc; noise below 10 microvolts with 150 kc response, and below 20 microvolts with 1.7 mc response.

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NEW CATALOG B gives detailed data on the Model 102B and all other Keithley Instruments and accessories. Your copy will be sent promptly upon request on your company letterhead.

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Illustrated listings of components and accessories for oscilloscopes including specifications on such items as knobs, pulse transformers, probes, magnetic shields, photographic recording equipment, racks and carrying tables. Many more miscellaneous items listed in easy to read form.

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Absorption Analyzer

156

"Puts Money in the Pockets of TV Servicemen" is the title of a 4-page brochure which gives details on the operation of a portable absorption analyzer. The illustrated folder presents comparative examples of the steps involved in isolating trouble both with and without the instrument. Kingston Electronic Corp., 17 Tudor St., Cambridge 39, Mass.

Electronic Tracking Systems

157

Brochure B571 describing the tracking systems designed for the US Air Force is now available. The basic systems of AME and DME are discussed in detail as well as the applications involved. Cubic Corp., 5575 Kearny Villa Rd., San Diego 11, Calif.

Extruded Tubing

158

A combined specification and price sheet on Flexite Teflon Extruded Tubing is now available. This is a Class C insulation and capable of continuous service at temperatures up to 250 degrees C. L. Frank Markel & Sons, Norristown, Pa.

Oscilloscope

159

Four-page brochure describing Model 411A oscilloscope is now available. The instrument described in leaflet is a wide-band, precision, general purpose laboratory oscilloscope with six-plug-in units. Laboratory for Electronics, Inc., 75 Pitts St., Boston 14, Mass.

Transistorized Counting Circuits

160

Two basic types of transistorized circuit packages, both plug-in configurations, are featured in a folder of 4 pages. Design and construction details are pointed out along with typical circuit applications for both series. The bulletin, Catalog No. 11447, also contains full specification charts with input and output. Photographs, hook-up diagrams and schematics are provided for illustration. The Walkirt Co., 141 W. Hazel St., Inglewood, Calif.

Phase Shift Correction

161

Technical Paper 552 is a 30-page article entitled "Measurement and Correction of Phase Shift in Copper-Mandrel Precision Potentiometers." Authors Stanley Schneider, Fred Hiraoka and Clarence Gauldin discuss a practical approach to predicting, measuring and compensating for quadrature voltage and phase shift in copper-mandrel potentiometers used in ac circuits. The text of the booklet is thoroughly supported by schematics, tables, graphs and detailed equations. Helipot Corp., Newport Beach, Calif.

WHAT'S BEHIND THE SIGMA SERIES 72 TELEGRAPH RELAY



The "72", as a polarized relay particularly suited to telegraph use, offers a combination of extremely worthwhile operating features. Among them are 500 pulse-per-second speed, freedom from maintenance for at least a half a billion operations (60 ma. 120 VDC inductive load), adjustable bias and sensitivity.

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STANDARD REPAIR KIT for the 72 contains normally (and easily) replaceable parts: two contact screws and one ferro-nickel armature.

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MANUAL for the 72 describes in detail all service operations likely to be needed in the field. What and what not to do, and the appropriate methods, are comprehensively set forth and illustrated in 18 pages. Available to 72 users.



MODEL 4501 TEST SET permits thorough operational checking and adjustment, using either or both coils, of the relay under test.* Measures operating ("trip") values (either manually or automatically), bias, percent-break, and insulation. Provision is also made for connecting an external drive directly on relay coils, and scope connection for observing contact performance in bias and percent-break tests. Standard relay rack panel mounting, 5 1/4" high, less than 6" deep. Case, socket adapters and instruction manual included.

*The Test Set is simply a useful —but not vital— accessory to telegraph relay use. It performs the described tests on not only the Sigma Series 72 relay, but on our Series 7, the WE 255A (which our 72AOZ-160 TS can replace), the WE 215, and similar relays.

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Harold H. Powell Company
Texas, Beaumont
Montague Radio Supply
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New Literature

Electronic Testing Equipment 165

Specialized electronic testing equipment for guided missiles, radar and fire control is featured in an 18-page brochure. The illustrated booklet also contains information on engineering, designing and planning personnel, sales companies representing the firm, and a complete service in printed circuitry which includes artwork, engineering and design. Cal-Tronics Corp., 11307 Hindry Ave., Los Angeles 45, Calif.

Hand Coil Winders 166

Four high speed direct drive hand coil winders are described in an illustrated catalog page. Technical details are given on types of windings, maximum coil OD, maximum loading distance between winding centers, wire sizes wound, tension equipment, winding speeds, motor equipment, dial and automatic counters, magnetic brake, mounting, output end of spindle and other features. Geo. Stevens Mfg. Co., Inc., Pulaski Rd. at Peterson, Chicago 30, Ill.

D-c Power Rectifiers 167

Separate bulletins have been issued to cover each of three lines of d-c power rectifiers. Bulletin AC-57-A contains a complete cataloging of selenium and silicon power rectifiers with up to 1500 amp continuous capacity.

Bulletin AC-57-R covers a manually controlled rectifier for applications requiring moderately stabilized d-c voltage.

Bulletin BC-A-57-1 describes an automatic battery charger. Christie Electric Corp., 3410 W. 67th St., Los Angeles 43, Calif.

Instrument Transformer Guide 168

The 1957 Instrument Transformer Buyer's Guide, GEC-1028B, contains 90 pages of price and product information on a complete instrument transformer line. It lists prices, ratings, ASA accuracy classifications, weights and dimensions, and catalog numbers. Covered are indoor and outdoor type current and potential transformers and Thyrite protectors. Additional information is given on tests, mechanical and thermal limits of current transformers, and previous types of transformers and their replacements. The photo-caption style permits quick reference to voltage ranges, nomenclatures, basic construction features, maximum and minimum primary voltage ratings, current ratings, ASA insulation classes, impulse levels, and cycles. General Electric Co., Instrument Dept., Schenectady 5, N.Y.

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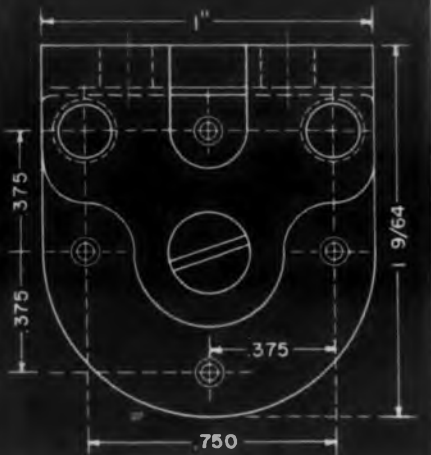
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Stromberg-Carlson's new type "E" relay combines the time-proven characteristics of the type "A" relay with a mounting arrangement common to many other makes.

As the sketch above shows, our new frame mounting holes and coil terminal spacing allow you to specify these relays—of "telephone quality"—interchangeably with brands you have been using. Costs are competitive and expanded production means prompt delivery.

Welcome engineering features of the new "E" relay are—

Contact spring assembly: maximum of 20 Form A, 18 B, 10 C per relay.

Coil: single or double wound, with taper tab or solder type terminals at back of relay.

Operating voltage: 200 volts DC maximum.

You may order individual can covers in a choice of 3 sizes for the new relay, as well as for our type "A" and "C" relays.

For complete details and specifications on the "E" relay and other Stromberg-Carlson relays, send for your free copy of Catalog T-5000R.

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CIRCLE 170 ON READER-SERVICE CARD

Stop-Off Lacquer 171

R 5018 blue silk-screen acid-resist stop-off lacquer is introduced in a data sheet. The page details properties, application methods and production performance. Chemical Products Corp., King Philip Rd., East Providence, R.I.

Electronic Control Assemblies 172

The activities, facilities and products of a division making electronic control assemblies and complex electronic gear are described in E. S. D. Brochure No. 1-57. The 22-page booklet contains illustrations of a telemetering system for balloons, automatic pilot controls, tape recorders, radar instruments and other equipment. Cook Electric Co., 2700 N. Southport Ave., Chicago 14, Ill.

Unusual Plastics Applications 173

A 6-page file folder describes unusual uses and applications of plastics and the facilities for producing them. Completely illustrated with diagrams and case histories, the leaflet describes plastic prototype working models, vacuum forming, fiber glass molding, and fabrication. Amston Plastic Engineering Co., Amston, Conn.

Airborne Electronic Equipment 174

High temperature, high shock, and contamination free airborne power and electronic circuit relays are among the diverse products described in a recent catalog. Full lines of electronic flashers, time delay relays, sequence timers, over and under voltage and frequency sensors and voltage regulators are covered in the same catalog. Also presented are a complete antenna pattern measurement range and rf systems and components. The Electronic Specialty Co., 5121 San Fernando Rd., Los Angeles 39, Calif.

Radiactivity Measuring Instruments 175

Catalog Q illustrates and describes radioactivity measuring instruments in 64 pages. Over thirty units are new with this edition. Sections in the catalog are devoted to nuclear scaling units, rate-meters, gamma-ray spectrometer systems. Geiger and scintillation detectors, portable survey instruments for alpha-beta-gamma and neutron measurements, lead shields, personnel protection devices, counting systems, high intensity gamma and beta sources, and nuclear accessories. A four-color insert describes and illustrates typical instrumentation for a nuclear biochemical laboratory, an industrial nuclear research laboratory, and four typical medical radioisotope laboratories. Nuclear-Chicago Corp., 229 W. Erie St., Chicago 10, Ill.

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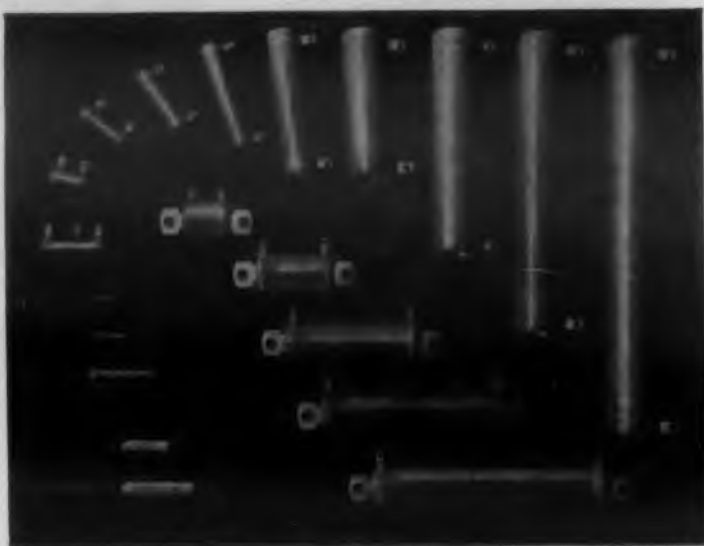
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NOW!

Vitrohm MIL-R-26C Resistors in all styles!



Famous Ward Leonard Vitrohm® vitreous-enameled resistors are now available in every style to meet all requirements of Military Specification MIL-R-26C.

What's more, this line offers you *all* characteristics—G, V, and the exacting Y—and *all* specification sizes and resistance values—even the highest values using the finest wire (0.00175").

Tab-terminal, axial-lead and stack-mounting types are available in styles and characteristics shown in table below.

For complete data on these MIL-R-26C resistors, write us for Bulletin 12. (And incidentally, for Vitrohm resistors to *highest commercial and industrial standards*, get W/L Catalog 15.) Ward Leonard Electric Co., 77 South Street, Mount Vernon, N. Y. In Canada: Ward Leonard of Canada Ltd., Toronto. 7.10

ENGINEERING DATA

TYPE	STYLE	AVAILABLE IN CHARACTERISTICS	RESISTANCE RANGE
Stack Mtg.—Tab	RW20 thru 24	G	All values in Spec.
Tab terminal	RW29 thru 47	V, Y* and G	All values in Spec.
Axial lead	RW55 thru 59	V and G	All values in Spec.†

*Characteristic Y applies to styles RW30, 33, 37 and 47 only. Characteristic Y is similar to V but requires high insulation resistance at end of moisture-resistance tests.

†Maximum values for single-layer-wound resistors with 0.00175" diameter wire.

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Ideas for Design

Get \$10.00 plus a by-line for the time it takes to jot down your clever design idea. Payment made when the idea is accepted for publication. Use the "entry blank" on p 81 to submit your idea.

Hybrid Hi-Fi Amplifier

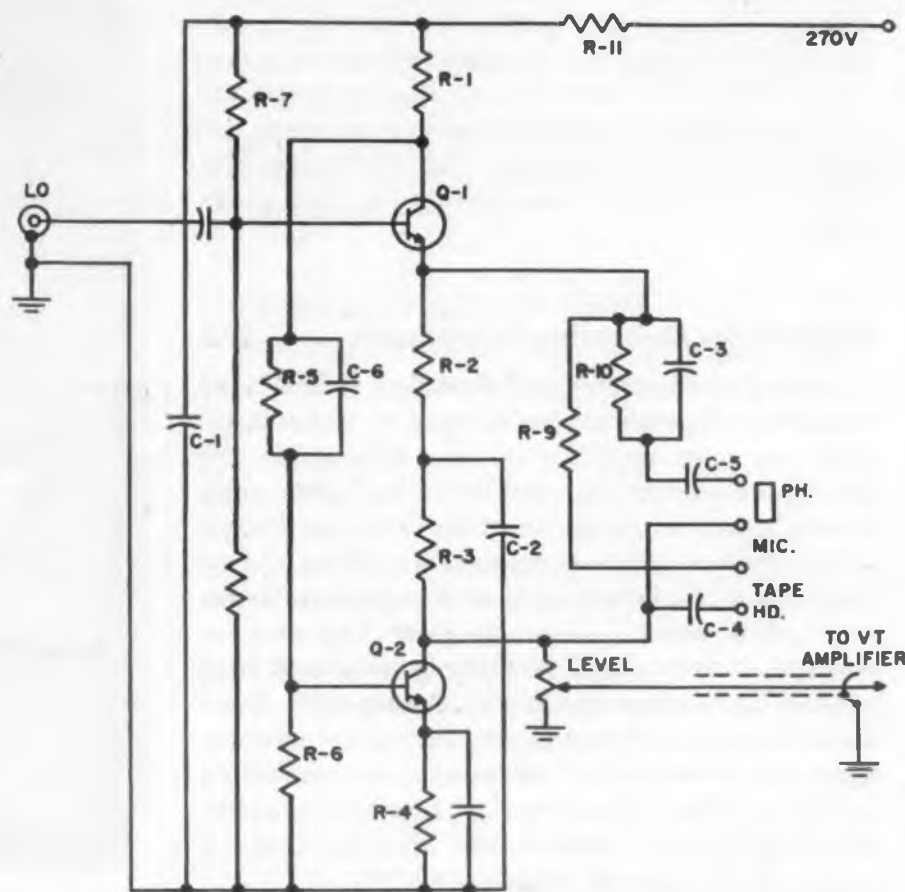
Leonard Feldman
Stephen A. Lipsky

Madison Fielding Corp.
Brooklyn, N. Y.

THE DEVELOPMENT of a highly stable transistorized preamplifier has yielded a hum, noise, and microphonic-free "front end" for a standard vacuum tube audio amplifier. As even the best vacuum tube preamplifiers have not been able to yield hum figures much in excess of 60 db below full output, a transistorized unit is a considerable design improvement.

The transistorized preamplifier is part of the A-15 amplifier designed by the Madison-Fielding Corp., Brooklyn 21, N.Y. The circuit of the preamplifier section, shown in Fig. 1, used two npn transistors in

the common emitter configuration. From the diagram it can be seen that transistors Q_1 and Q_2 are connected in series with R_1 , R_2 , R_3 and R_4 . This series string of transistors and their respective emitter and collector resistors is placed directly across the supply voltage. The collector currents of both stages are therefore practically the same. Resistors R_5 and R_6 set the bias potential on Q_2 . Since both transistors are series connected, Q_1 will see an apparent increase in its emitter resistance as the frequency moves toward cutoff and will itself be stabilized. Additional circuit stability is provided by the emitter



Circuit diagram of the transistorized preamplifier, used in conjunction with a standard vacuum-tube amplifier. The unit has no intrinsic hum, and a metal housing prevents external hum pickup.

resistors R_7 and R_8 , and by the bleeder line resistors R_7 and R_8 . However, because of the requisite high input impedance the value of R_8 is necessarily high, limiting its bleeder effect. The circuit as described is thermally stable for all temperatures likely to be encountered in any application for which this unit was designed.

The input stage Q_1 is a standard grounded emitter configuration with the emitter resistor R_9 bypassed to avoid a high input impedance (10,000 ohms) by means of emitter degeneration. The junction R_9 and R_8 is bypassed to ground by Q_2 , operates as a high-gain amplifier. The output of Q_1 is fed to the base of Q_2 through C_6 . An overall negative inverse feedback loop operates between the emitter of Q_1 and the collector of Q_2 to stabilize the gain, reduce distortion and provide equalization as described below.

The choice of npn transistors for this circuit makes it possible to operate the preamplifier unit from the one amplifier supply. Because of the very small current requirements for the transistor stage, the series resistor R_{11} is of very high value, and Q_2 , together with the decoupling capacitor C_7 and decoupling is more than adequate.

The overall gain of the preamplifier is better than 20 db. An input of 10 mv will give 0.5 v output at 100 cps in the phono position. This gain includes 10 db of feedback used for equalization.

The overall gain of the preamplifier is better than 20 db. An input of 10 mv will give 0.5 v output at 100 cps in the phono position. This gain includes 10 db of feedback used for equalization.

Equalization

The transistor circuit is called upon to amplify and equalize all low level sources such as microphone (which requires a flat response), phono (which requires the RIAA playback characteristic) and tape-head (which requires the 7-1/2 in. per second IRTB playback curve). All equalization is accomplished by feedback for improved distortion by a three-position slide switch. The basic amount of feedback is about 22 db, leaving enough bass boost for the tape-head playback curve down to 40 cps. In the circuit diagram the switch is shown in the phono position where C_1 determines the bass crossover frequency, R_{10} determines the amount of mid-frequency feedback, and C_2 determines high frequency de-emphasis. In the microphone position, resistive feedback is employed (flat response) and in the tape-head playback position, the crossover feedback is altered and de-emphasis is removed. The RIAA curve is used for phono equalization, with other curves compensated for by tone controls further on in the system. This is made possible by the excellent signal-to-hum and noise characteristics of the transistorized preamp, so that the addition of treble and bass boost so late in the circuit does not result in amplified hum and noise. The entire preamplifier unit is housed in a metal case to shield the high-impedance input stage from pickup, and the circuit itself is printed on a 1/16 in. phenolic board.



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A small, low cost, highly efficient general purpose relay with 5 amp. silver contacts. Can be insulated to meet UL requirements. Size: 1 1/2" x 1 1/2" x 1 1/2". Mounting: One No. 6/32 stud and locating tab.

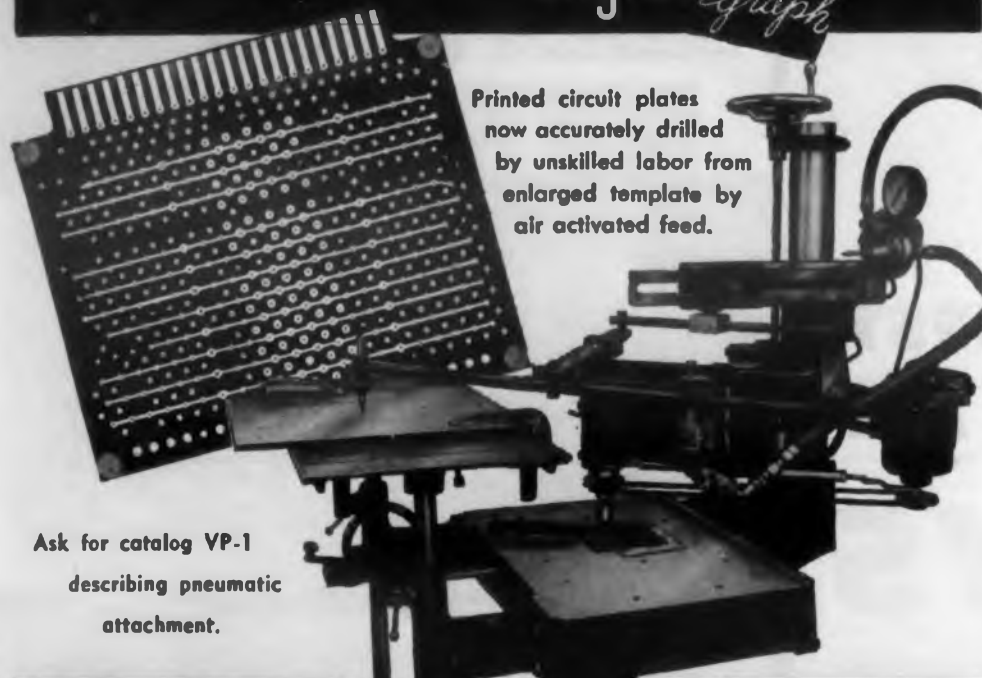


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measured in decibels, in percent of total signal or both. Results are indicated on a calibrated attenuator and on a meter. For permanent, detailed analysis, high and low impedance output are provided to drive a recorder. When equipped with its accessory servo system, the TP-625 will follow RPM, or multiples of RPM, in engines throughout an operating range.

For specifications and further information, write for bulletin 625-1-956.

Technical Products Co.
INSTRUMENT DIVISION
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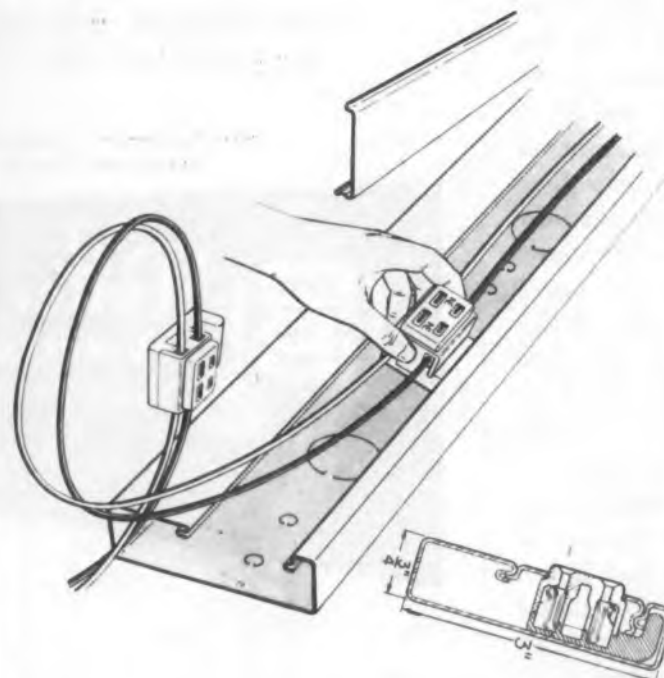
Ideas for Design

Convenient AC Outlets

Featuring feed-through wiring, this baseboard wiring system could find wide use in many design laboratories. It is installed directly on the floor and requires no footers, trim, nor capping. Outlets can be conveniently located wherever desired. To effect reduced installation time and expense, only three fittings are required for mounting—an end blank, a combination internal and external elbow for corner areas, and a standard coupling.

Baseduct, manufactured by National Electric Products Corp., Gateway Center, Pittsburgh, Pa., is available in five-foot lengths, with duplex receptacles on 30 or 60 in. centers. Over-all dimensions are 3 in. high and 3/4 in. wide. Receptacles used within the system are preassembled to the wiring harness at the factory and are held in place within the duct without recourse to any additional support. Mounting holes in the base provide for easy installation. Knockouts in the base of the duct facilitate wiring operations.

The raceway in the lower area of *Baseduct* is sufficiently roomy to house a number of branch-circuit wires. These are contained within the body of the duct without retaining clips or similar accessories. Retention of the receptacle harness within the duct is not dependent on the cover. Capping may be installed and removed without disturbing the receptacle wiring harness or other conductors. The patented receptacles feature "straight-through" passage of wire and permits installation of the multi-outlet assembly without either screws or weld points.



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IDEAS FOR DESIGN — ENTRY BLANK

To the *Ideas-For-Design* Editor of **ELECTRONIC DESIGN** —
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Here is my design idea for possible publication in your *Ideas For Design* department. I can expect \$10 for this idea if accepted for publication.

(Ideas suitable include: 1. new circuits or circuit modifications, 2. new design techniques, 3. designs for new production methods, 4. clever use of new materials or new components in design, 5. design or drafting aids, 6. new methods of packaging, 7. design short cuts, or 8. cost saving tips)

STATEMENT OF THE PROBLEM—

MY SOLUTION, AND WHY — (Please be explicit. Include sketches or photos that will help get the idea across)



Quick Hole Seal

A design, which won for William Gould of Key-one Plastics, Inc., Union, N.J., a \$1000 first prize from Cadillac Plastic and Chemical Co., is a nylon sleeve designed so as to cold flow into a seal between work, bolt, and nut, as shown. This design turns to an advantage one of nylon's less desirable properties—its cold flow characteristic.

Appearance Design

Attractive appearance is achieved in plastics for part of the new Rockola 200-selection juke box. The turntable for the 45 rpm player rests in the center of the piece shown. Injection molded from high acrylic plastic by G. Felsenthal & Sons, Inc., a Chicago plastics molding and fabricating firm. The part is then sprayed with silver-colored metallic paint. A vacuum-plating process covers each star with a coating of gold. Finally, the gold is covered with an additional coat of paint to prevent it from oxidizing. Since all of the silver and gold paint is on the underside of the part, and is seen through the clear plastic, it cannot be scratched or damaged.

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Report Briefs

Price List of AEC Reports

A new free price list of Atomic Energy Commission unclassified research reports for sale by the Office of Technical Services, U. S. Department of Commerce, is now available from OTS on request. To obtain the new list, request *AEC Research Reports Price List No. 27 from OTS, U. S. Dept. of Commerce, Washington 25, D.C.*

Ferroelectric Ceramics

Facilities and methods devised by the Navy for the ceramic forming of transducers of barium titanate are described. Production relies on a new technique of slip casting which produces yields of above 80 per cent of pieces with densities greater than 5.50. Laboratory facilities are described by text and photographs in the report, along with methods of evaluating the transducers. *PB 121418 Development of Ferroelectric Ceramics, J. D. Wallace and M F. Pressler, U.S. Naval Air Development Center, OTS, U.S. Dept. of Commerce, Washington 25, D.C., Feb. 1953, 59 pp, \$1.50.*

Receivers for White Noise

Two K_A -band versions of the comparison receiver, together with facilities for calibration and measurement of received signal power, are described. The derivation of the output response characteristic is traced in analytical form, and it is shown to be parabolic for linear i-f detection. Optimum receiver gain stability is shown to be obtained with linear detection. Techniques used to suppress troublesome spurious emissions from the receiver input are discussed. Two methods of determining receiver noise figure are considered; the noise figure obtained with selected mixer crystals is 12 to 13 db. Expressions are derived for the absolute sensitivity of the single-detection and the comparison (double-detection) receivers, and the observed sensitivity of the subject type of receiver is found to be in reasonable agreement. *PB 121571 Comparison-Type Receivers for White Noise Radiation at 0.86 cm Wavelength, J. E. Gibson, U. S. Naval Research Lab., OTS, U. S. Dept. of Congress, Washington 25, D. C., Dec. 1956, 32 pp, \$1.00.*

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Contact Current Capacity: 5 ma (higher current capacities available on special order); Models 104 and 104A, 100 ma.

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Hydrodynamic Oscillators

This report is concerned with the conversion of liquid-flow energy to acoustic energy, as achieved through a self-excited, flow-interruption process. Certain conditions exist for which flow variations through a variable-area orifice act quasistatically, or as a succession of slowly changing equilibrium states. In this case, the acoustic circuit representation of a pressure-actuated orifice assembly closely resembles the equivalent circuit of a vacuum tube, or electron valve. The similarities and differences between these analogous structures are investigated. *PB 122969 Self-Excited Hydrodynamic Oscillators, John V. Bouyoucos, Harvard Univ., Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D. C., July 1955, 326 pp, Microfilm \$11.10, Photocopy \$49.85.*

Multipole Data Control

This report gives a detailed discussion of a method for eliminating the coupling inherent in complex control systems in order to permit application of well-known single-input, single-output system techniques. The treatment is from the sampled-data point of view because of the ease with which complicated transfer functions may be realized with a digital computer. The method may, however, be readily extended to continuous-data systems. Limitations of the method are discussed, and an example is given of the design of a controller for a system having three inputs and two outputs. *PB 122228 Multipole Sampled-Data Control Systems, Herbert Freeman, Columbia Univ., Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D. C., Sept. 1955, 45 pp, Microfilm \$3.30, Photocopy \$7.80.*

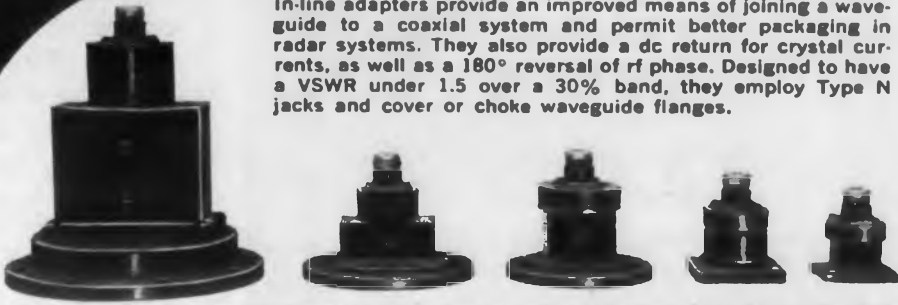
Forward Scattering By a Sphere

An expression for the scattered wave as an expansion in terms of radial eigenfunctions is obtained. The total wave may be expressed in terms of radial eigenfunctions directly but the incident wave cannot. Instead, the incident wave is first expressed by a contour integral. Then a change of variable is introduced and the resulting integral is approximated by the Euler-Maclaurin sum rule. This results in a series for the incident wave in terms of radial functions plus an integral and correction terms. When this is subtracted from the total wave a finite series in terms of radial functions is obtained, and the integral and correction terms are easily evaluated. *PB 122223 Forward Scattering of High-Frequency Plane Waves By a Sphere, George Kear, N.Y.U., Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D. C., Nov. 1955, 31 pp, Microfilm \$3.00, Photocopy \$6.30.*

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Report Briefs

Digital Computers

Part 7 of this report shows that mathematical simulation studies may be planned around the use of digital or analog computers. In this case digital computation can be used in problem preparation for and placement on an analog computer, and provides the only reliable method of checking analog accuracy in early stages of design work. To aid in estimating computing time and code complexity, a practical problem, which had been solved previously, was coded for OARAC. *PB 121598 Dynamic System Studies—Part 7: Digital Computers*, Roger H. Farrell, Chicago Univ., OTS, U. S. Dept. of Commerce, Washington 25, D. C., Sept. 1956, 130 pp, \$3.25.

H-Strictive Vibration Generator

Tests of a high frequency vibration exciter consisting of a magnetostrictive stack and Mason probe are described. It is shown that simulated gas turbine blades having a cross sectional area of one quarter square inch can be failed near the resonant frequency of the exciter. Failure of an actual gas turbine blade having a resonant frequency 1500 cy above that of the exciter is described. Theory of a magneto-magnetostrictive force-velocity pickup is described and results of experimental sensitivity measurements are presented. *PB 121252 Tests of a High-Frequency Large Amplitude Magnetostrictive Vibration Generator and Theoretical and Experimental Investigation of the Feasibility of Mode Shape Analysis from Driving Point Impedance Measurements*, R. W. Gretter, MIT, OTS, U. S. Dept. of Commerce, Washington 25, D. C., Mar. 1956, 49 pp, \$1.25.

Thermocouple Probes

Radiation and recovery corrections and time constants were experimentally determined for several designs of shielded and unshielded thermocouple probes using chromel-alumel wire. A review of the theory of gas temperature measurements and an analysis of the data show that simple empirical formulas may be used to correlate corrections for various gas-stream conditions. *PB 123699 Radiation and Recovery Corrections and Time Constants of Several Chromel-Alumel Thermocouple Probes in High-Temperature, High Velocity Gas Streams*, George E. Glawe, Frederick S. Simmons and Truman M. Stickney, U. S. National Advisory Committee for Aeronautics, Order as NACA TN 3766 from National Advisory Committee for Aeronautics, 1512 "H" St., N.W., Washington 25, D. C., Oct. 1956, 25 pp.

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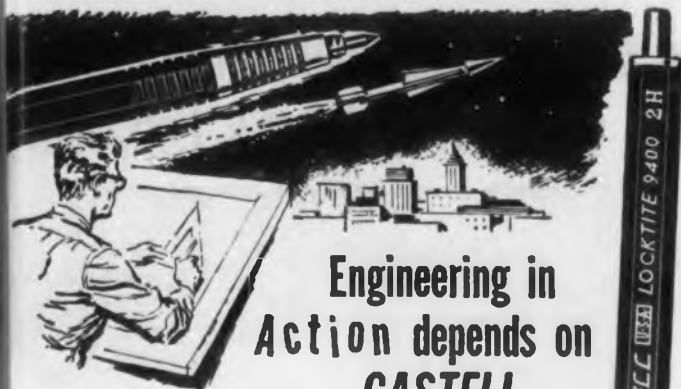
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Electronic Design Guide

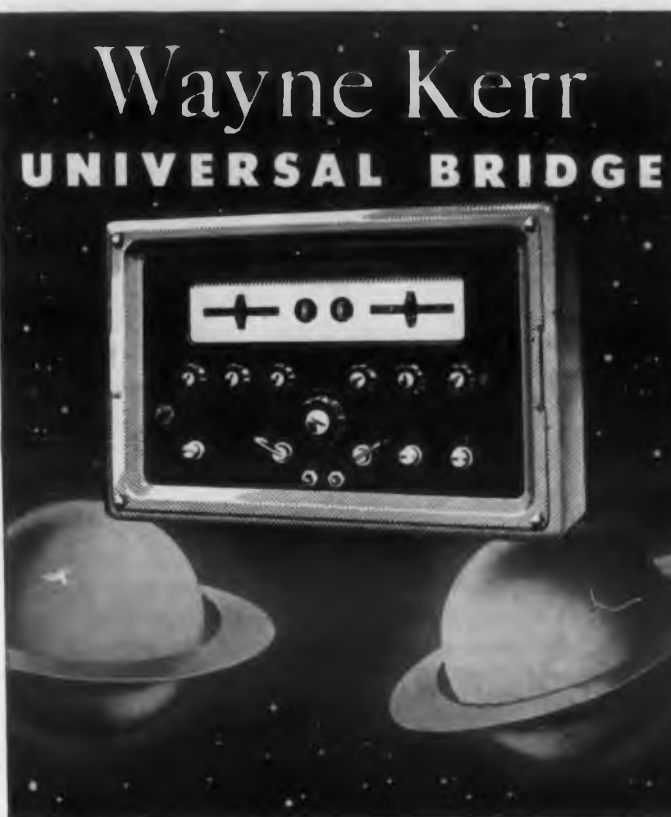
This handbook presents information intended to forestall costly, time-consuming maintenance of operational electronic systems by "building in" provisions for effective maintenance during development of the equipment. Features of design which will afford preventive and corrective maintenance of both ground and airborne electronic systems are presented. Sections of the illustrated volume cover factors in planning for maintainability, steps for designing a maintainable system, and specific characteristics for equipment and maintenance procedures. *PB 121439 Guide to Design of Electronic Equipment for Maintainability, J. D. Folley, Jr. and J. W. Altman, Amer. Institute for Research for Wright Air Development Center, OTS, U. S. Dept. of Commerce, Washington, D.C. April 1956 180 pp, \$4.50.*

Design of Equipment

A major problem faced by the military services is effective maintenance of complex electronic equipments despite shortages of highly skilled maintenance technicians. This guide is intended to help alleviate this problem by recommending design practices which will maximize the ease with which electronic equipments can be maintained. Factors to be considered in planning for maintainability are briefly reviewed. A schedule of steps to be taken in designing a maintainable system is presented. Specific characteristics are recommended for equipment and maintenance procedures. *PB 121439 Guide to Design of Electronic Equipment for Maintainability, John D. Folley, Jr. and James W. Altman, American Inst. for Research, OTS, U. S. Dept. of Commerce, Washington 25, D. C., Apr. 1956, 180 pp, \$4.50.*

Paralleled Cavity Filters

The possible use of degenerate modes in a single cavity for the production of a paralleled-cavity filter as contrasted to the ladder type was studied. A qualitative design with single iris coupling at input and output to three degenerate modes, in a particular cylindrical cavity was obtained and such a cavity built. Arrangements were provided for individually tuning the two TE modes, and for rotation of input and output cavities to vary the coupling to the individual modes. Best operation of this cavity yielded a filter with a pass band of approximately 40 mc at 8970 mc with insertion loss of about 3 db in the pass band. *PB 123427 Paralleled Multimode Cavity Filters, Irving C. Tang, Calif. Univ., Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D. C., Oct. 1955, 28 pp, Microfilm \$2.70, Photocopy \$4.80.*



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Report Briefs

Oscillation Criteria

This paper is concerned with the differential equation $y'' + p(x)y = 0$, where $p(x)$ is a continuous non-negative function for $0 < x < \infty$. PB 123079 *Oscillation Criteria for Second-Order Linear Differential Equations*, Zeev Nehari, Carnegie Inst. of Tech., Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D.C., July 1956, 27 pp, Microfilm \$2.70, Photocopy \$4.80.

Ni-Cd Sintered Plate Cell

A commercially available sintered-plate secondary cell has shown considerable improvement in high-rate and low-temperature performance over the conventional cell used in the nickel-cadmium alkaline battery. This report presents an evaluation made over 700 cy under varied conditions of temperature, charge and discharge rates. The cell was relatively unaffected by operation at 0 F, could be fully charged in less than one hour, and discharged in a few minutes without excessive capacity loss. The cell appeared physically and electrically rugged. PB 121533 *A Sintered-Plate Nickel-Cadmium Cell*, G. W. Work, Naval Research Lab, OTS, U.S. Dept. of Commerce, Washington 25, D.C., Oct. 1956, 15 pp, \$0.50.

Vibration Prevention Design

Previous investigations have shown that mechanical damage will occur to an electronics chassis subjected to a sustained vibration of the same frequency as the natural frequency of the chassis. For maximum protection against resonant vibration, the natural frequency of the chassis must ordinarily be somewhat higher than that of the chassis-isolator assembly. By the method of frequency determination described in this manual, the designer may identify the lowest natural frequency of a chassis. The setting up and solution of the determinant for the frequency equation is discussed, along with the necessary eigenvalues. Included are values for different sizes and kinds of chassis, with curves and equations for finding eigenvalues of other chassis of similar construction. The effect of stiffeners on chassis and on their natural frequencies are described. PB 121564 *Prevention of Mechanical Vibrations in Electronic Chassis—Design Manual* W. F. Stokey, C. F. Zorowski, and F. C. Appl, Carnegie Institute of Technology for Rome Air Development Center, OTS U.S. Dept. of Commerce, Washington 25, D.C. Sept. 1955 96 pp, \$2.50.

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RDF Measurements

Direction finders function on two generally different principles which may be divided into those employing amplitude comparison and those employing phase comparison, or a combination of both principles. The investigation of the effectiveness of the different processes involved in reducing any of these comparative methods to practice is the subject of these measurements. *PB 123718 Standard Direction Finder Measurements. U. S. Office Scientific Research and Development. May 1945. 51 pp. Microfilm \$2.70, photostat \$4.80.*

Tube Capacitance Measurement

This report contains a detailed analysis of the problem, develops a theory to account for the causes of disagreement, and presents data showing excellent agreement between theory and experiment. Finally, what is considered to be the proper method of measurement, which this report proves and advocates, is recommended for adoption. *PB 120460 Report of Correct Capacitance Measurement Procedure On Metal Base Shell Vacuum Tubes, K. M. Soukaras, U.S. Naval Research Laboratory. Aug. 1938. 26 pp, Microfilm \$2.70, photostat \$4.80.*

Design to Resist Mold

A method is presented for evaluating the dc surface resistance of hook-up wire insulations with respect to the effect of moisture and mold growth. Recommendations are made concerning selection of materials for use in the construction of electronic equipment. The principles established in respect to the effects of moisture plus mold growth on the electrical characteristics of insulation surfaces are applied to the design of electronic equipment. *PB 122827 Considerations in the Design of Electronic Equipment as Influenced by the Effect of Moisture and Mold Growth on Hook-Up Wire, R. H. Luce and K. N. Mathes. Rensselaer Polytechnic Institute, Troy, N.Y. 1952, 83 pp, diags, graphs, tables. \$13.80.*

Scatulator

The purpose of this report is to bring together information necessary to determine tropospheric scatter circuit performance, and to present a simple method of applying this information to obtain rapid solutions to the equations involved. The formulae for determining the performance of tropospheric scatter systems are presented. A method of applying these formulae using a circular slide rule is presented and explained. *PB 123075 Scatulator, James E. Bartow, SCEL, Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D. C., Feb. 1956, 15 pp, Microfilm \$2.40, Photocopy \$3.30.*



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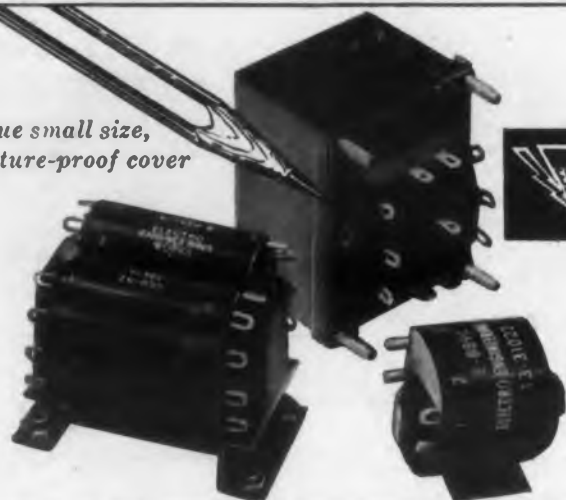
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Patents

Improved Electronic Trigger Circuit
Patent No. 2,744,957. L. M. Carver. (Assigned to C. G. S. Laboratories, Inc.)

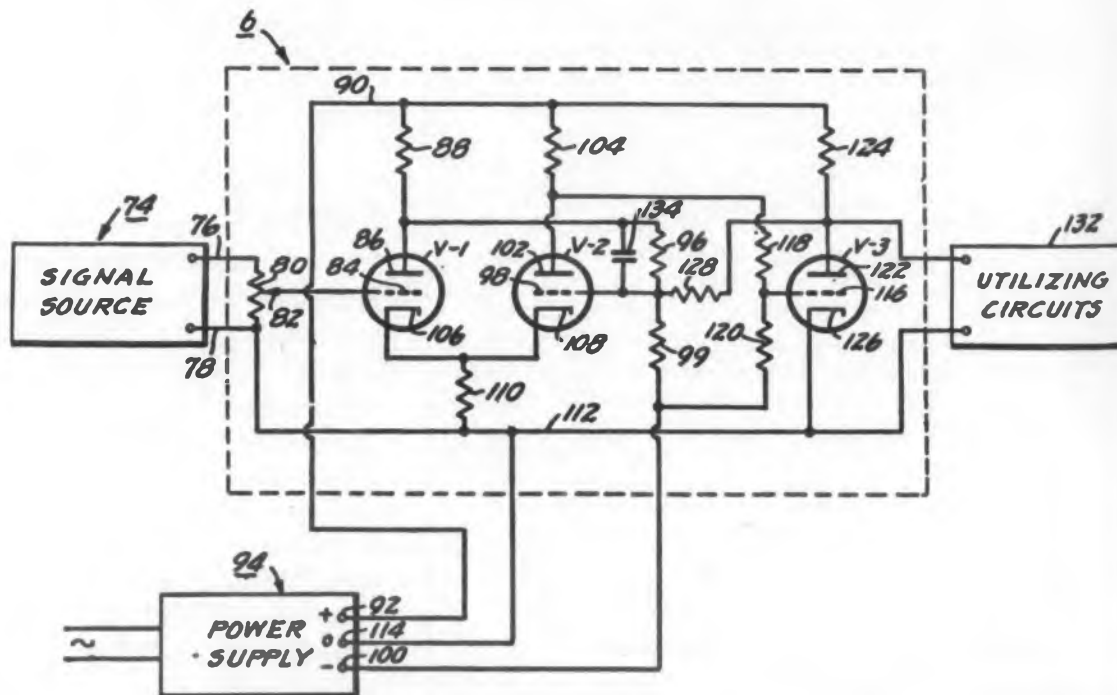
It is important that a trigger circuit, particularly as used in teletypewriter systems, generate pulses having the same duration as the incoming pulses. In the trigger circuits heretofore used, the incoming pulses are of one polarity so that pulses of lesser amplitude would have relatively slower rise and decline time than incoming pulses of greater amplitude. As a consequence, the generated pulse derived from a lower amplitude incoming pulse would have a shorter duration than that derived from an incoming pulse of greater amplitude and in addition would not correspond in duration with the incoming pulses. Automatic compression circuits have been used to reduce the variation in amplitude of the incoming trigger pulses, however, some variation exists.

In order to overcome this difference in duration between the generated pulse and the incoming trigger pulse, the circuit shown in the figure was devised. It differs primarily from prior trigger circuits in being responsive to polar trigger pulses which rise rapidly to a positive value, remains at this value for a moment and then decreases through zero potential to a negative value. The first tube of the trigger circuit is triggered to conducting condition by the positive polarity of the incoming

pulse and triggered to non-conducting condition by the negative polarity of the incoming pulse.

The trigger signal source 74 applies the incoming pulse to the control grid 84 of the first tube V-1 the positive polarity of which renders this tube conducting. A second tube V-2 has its control grid 98 connected with the anode 86 of the first tube so that when tube V-1 becomes conducting, tube V-2 becomes negatively biased to non-conduction firstly, because the drop in potential on the anode of the first tube reduces the potential on the control grid 98 of the second tube and, secondly, because of an increase in potential across the common cathode resistor 110. The negative potential of the signal pulse triggers the tube V-1 to non-conducting condition whereupon the tube V-2 again becomes conducting.

It is necessary for proper operation of the pulse generating circuit that the tube V-1 be prevented from becoming conducting upon termination of trigger pulse which would restore zero potential on the control grid of this tube. This is accomplished by a separate biasing circuit provided by a third tube V-3 and its circuitry operative such that when the tube V-2 is conducting, tube V-3 is non-conductive and when tube V-2 is non-conducting tube V-3 is conductive. The potential on control grid 116 of tube V-3 is controlled by the potential between resistors 118 and 120.



connected as a voltage divider between the anode of the second tube and the negative terminal 100 of the power source 94. As long as the second tube V-2 is conducting, the potential on the anode of this second tube is of relatively low value which maintains the potential on the control grid of the third tube biased below cut-off and it is maintained non-conductive. As long as the tube V-3 is non-conductive its anode potential is relatively high and increases the positive potential on the control grid of the second tube through resistors 128 and 99. The second tube, therefore, continues to remain conductive whenever the potential on the control grid of the first tube becomes zero. An incoming pulse triggers tube V-1 so that it becomes conductive, whereupon the second tube V-2 becomes non-conductive so that its anode potential increases which drives the control grid of the third tube in a positive direction and it becomes conductive. The resistors 128 and 99 are selected to have a value to maintain the second tube non-conductive.

With this trigger circuit the generated pulses have a time duration substantially corresponding with that of the signal pulse respective of variations in the amplitude

of the input signals. There may be a slight delay in the time position of the generated pulse from an incoming trigger pulse of low amplitude as compared to a trigger pulse of greater amplitude.

Time Modulators

Patent No. 2,774,942. Irving F. Barditch. (Assigned to Aircraft Armaments, Inc.)

A time modulator circuit using two tubes is described having their cathodes connected together for maintaining a common voltage thereon which is proportional to the modulating signal. The modulating signal is applied to the grid of the first tube. A sawtooth wave generator applies a linear sawtooth wave at a frequency greater than the frequency of the modulating signal to the grid of the second tube and triggers current flow through the second tube when the sawtooth wave rises sufficiently with respect to the modulating signal. The plate to cathode circuit of the second tube is inductively and regeneratively coupled with the plate to cathode circuit of the first tube and with the grid circuits of both of the tubes. This augments the current through one of the tubes and simultaneously drives the other tube beyond cut-off.

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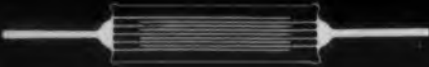
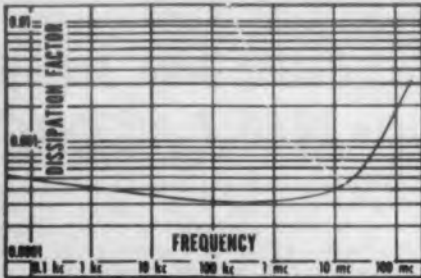
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Books

Research and Development of New Design Method for Power Transformers

Armour Research Foundation of Ill. Inst. of Tech., Technology Center, Chicago 16, Ill.

Published in this final report are the results of a research program directed toward the development of design procedures for transformers with special requirements. The types investigated were transformers with unbalanced magnetization for use with rectifier supplies or combined rectifier and filament supplies; current-limiting transformers for either rectifier or filament supplies; current-limiting transformers with unbalanced magnetization for rectifier supplies; vibrator-supply transformers; low-capacitance filament transformers; and instrument transformers. The ranges of electrical characteristics and operating conditions given major consideration are power output up to 5 kv amp; operating voltages to 50 kv; frequencies from 25 to 2500 cps; pressures as low as 1.32 in. of mercury;

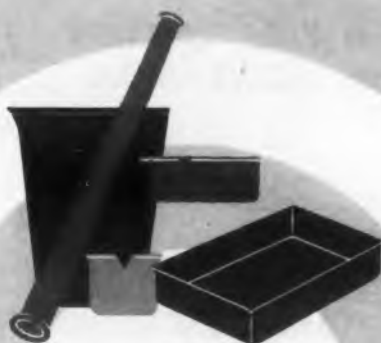
operating temperatures to 200 C; and ambient temperatures from -55 to 200 C.

The report has been divided into two parts. The first part contains the essentials of the basic design procedure developed and presents the theoretical considerations, experimental work, and derivation of the design procedure for each of the special transformer types studied. Here also is a study of optimum transformer proportions as they are affected by changes in the stack ratio of cores assembled from scrapless laminations. A chapter of this part has been devoted to a consideration of winding current densities and how they influence transformer losses and heating.

In the second part are a step-by-step design procedure and an example design for each of the special transformer types. Also presented are design procedures for ordinary filament transformers, autotransformers and rectifier-supply transformers which are the result of earlier investigations.



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Introduction to Operations Research

West Churchman, Russell L. Ackoff and Leonard Arnoff. John Wiley and Sons, Inc., 440 Fourth Ave., New York 16, N.Y., 255 pages, \$12.00.

The essential background for evaluating a growing field and for understanding its potentialities and procedures is supplied in this introductory treatment. For prospective consumers and practitioners of operations research the book offers a survey which can form the basis of further education. The authors present a general coverage of such topics as inventory, linear programming, waiting line, replacement, competitive and other mathematical methods useful in operations research. A case example has been presented to illustrate each method and model. The book emphasizes the importance of administration and defining management problems in terms of objectives.

American Institute of Physics Handbook

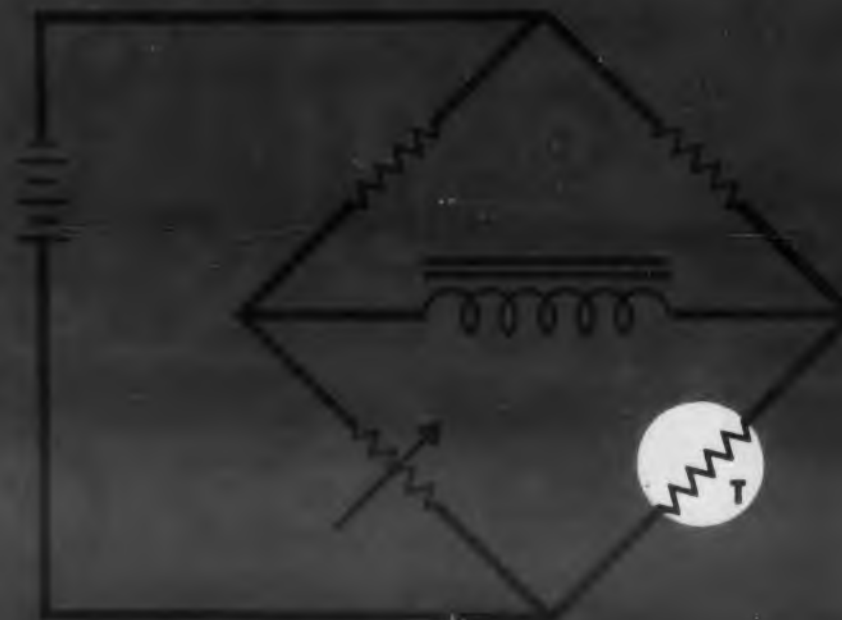
Dwight E. Gray, Coordinating Editor. McGraw-Hill Book Co., 330 W. 42nd St., New York, N.Y., 1524 pages, \$15.00.

Divided in eight sections on mathematics,

mechanics, heat, sound, electricity and magnetism, optics, atomic and molecular physics, and nuclear physics, this reference reaches into more than a hundred subject areas. Following are some of the topics that fall within its scope: geophysical data, including sections on geodesy, seismology, oceanography and meteorology; rheological data such as material on gels, tensile strength of liquids, fluid flow through porous materials, viscosity of suspensions, cavitation and diffusion in liquids; flow of gases, taking account of important developments in aerodynamics; shock waves; cross sections, fission products, health physics, and mesons; properties of paramagnetic salts, with very low temperature data; high pressure effects; values of the electronic constant in the low temperature heat capacity of metals, including superconductors; constants in the Gruneisen equation for the thermal expansion of metals; thermal conductivity at very low temperatures; and material and concepts on analogies (acoustics section).

A joint effort of more than 90 specialists, this book is the first to be sponsored by the American Institute of Physics.

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What the Russians Are Writing

J. George Adashko

Contents of Avtomatika i Telemekhanika No. 9, 1956

Components

Polarized Relay with Ball Armature, A. Svoboda (Prague); (1 pp, 2 figs).

A new approach to the design of polarized relays comes from Czechoslovakia via the Russian journals and is shown in Fig. 1. It is claimed to be cheap to manufacture and to have a fast operating time, less than one millisecond.

The relay comprises a cartridge of soft magnetic material closed by two caps *B* and *C*, to which polepieces *E* and *F* are attached. Sector-shaped permanent magnet *A* is located inside the cartridge. Coils *D* are connected in series so that the fields in polepieces *E* and *F* are additive. Steel ball *G*, located between the parallel end planes of the polepieces, has a diameter somewhat smaller than the width of the interpole gap.

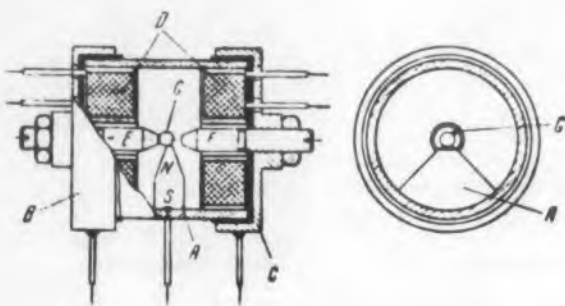


Fig. 1: Ball *G* is the only moving part of this polarized relay.

The ball is attracted to the magnet and to one of the polepieces. This occurs even if the ball is placed in dead center, for its equilibrium there is unstable. The only two stable positions are when the ball touches any one of the polepieces; the ball can move from one

stable position to the other only under the influence of an external force (produced by the coil). If coil *D* is energized and the polarity of the current is such as to reduce the flux in the polepiece (*E* in the figure), the magnetic field in the airgap between the ball and the other pole increases, and the ball shifts positions. Reversing the current returns the ball to its previous position.

Magnet *A* and polepieces *E* and *F* are made of a conducting material and are insulated from each other. Ball *G* serves both as a contact and as an armature.

Circuits and Circuit Elements

Synthesis of Parallel Correcting Networks for Servomechanisms using the Logarithmic Frequency-Characteristic Method, S. M. Fedorov (6 pp, 4 figs).

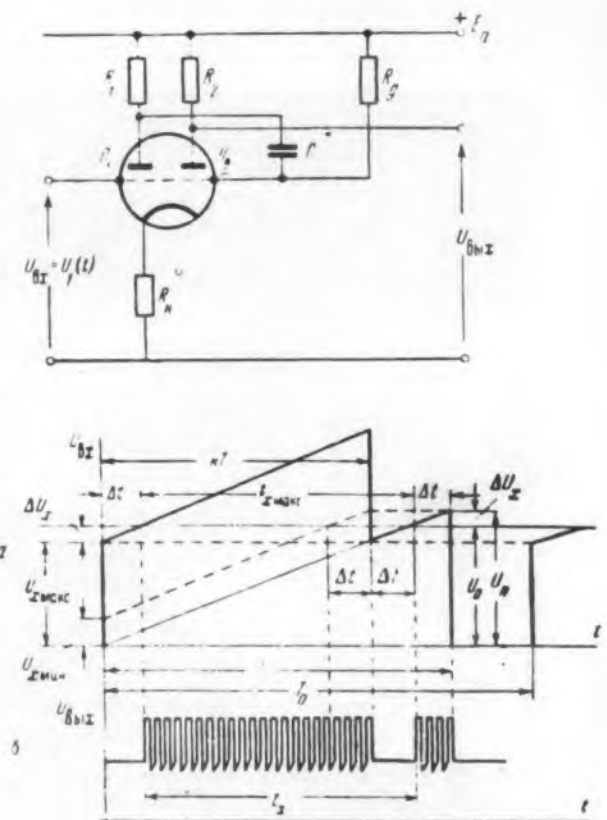
A method is shown for converting the logarithmic amplitude characteristic, in the form $20 \log [1 + K_{oc}(j\omega)K_x(j\omega)]$, into a logarithmic characteristic of the form $20 \log [K_{oc}(j\omega)K_x(j\omega)]$, thereby facilitating considerably the synthesis of parallel correcting networks (K_{oc} is the transfer function of the additional feedback [parallel correcting] network, and K_x is the transfer function of the portion of the system included in the feedback loop).

Topics in the General Theory of Circuits with Non-Linear Magnetic Elements, S. A. Ginzburg, (12 pp, 10 figs).

A circuit-theoretical examination of several general properties of non-linear a-c circuits, particularly circuits containing non-linear magnetic elements, and the relationships between the static and dynamic parameters of a non-linear circuit. The articles contains also a general procedure for plotting characteristics of any circuit containing non-linear saturated-core reactor, and derives the conditions under which stable voltage and relay effects are obtained in a non-linear a-c circuit. Some experimental data are cited.

One Method of Time-Pulse Conversion, I. A. Zakharii, V. N. Mikhailovskii, (11 pp, 6 figs, 1 table).

Analysis and experimental verification of the circuit shown in Figs. 2 and 3, which transforms a rectangular pulse U_x into a time interval t_x between the leading fronts of two hf pulse trains.



Figs. 2 and 3: The input U_{BX} to the first grid of this multi-vibrator is a rectangular pulse (upper half of voltage diagram). The output (lower part) is a pulse train. The time t_x between the starts of the pulse trains is proportional to the input voltage.

Use of
Analytical
lv. A.

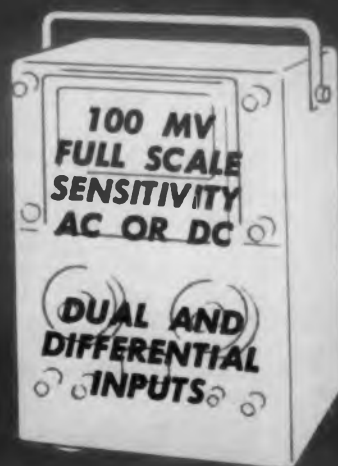
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Servomechanism Theory

Use of "D-Expansion" to Plot the Root Loci and to Analyze the Response of Automatic Control Systems, Iv. A. Gopp, (20 pp, 5 figs).

Stability analysis of an automatic-regulation system determines the permissible range of variation of the system parameters, but gives no indication of the character of and response to the transient process. The "D-expansion" method is essentially an extension of the locus-of-roots method and involves plotting the lines along which the real part of one of the roots maintains a fixed value. A family of curves of this type makes it possible to define the optimum parameters which provide the desired response to the transient process. Numerical examples are used to illustrate the argument.

Apparatus Design

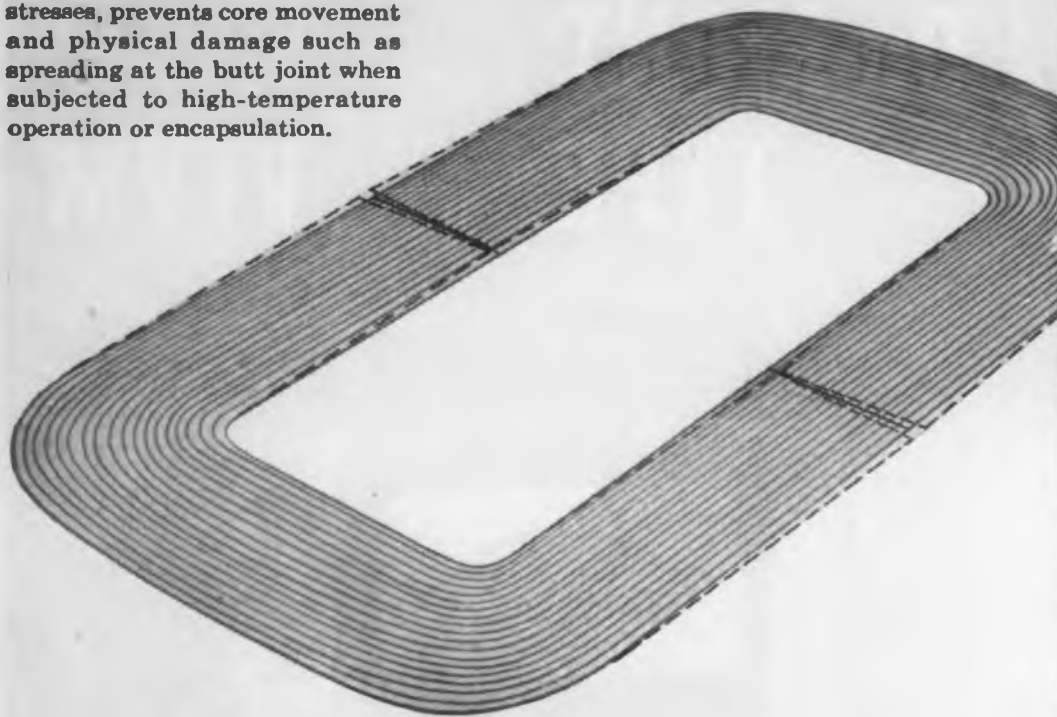
Calculation of Operating Characteristics of Two-Phase Servomotors and Tachometer Generators, G. M. Kasprzhak, I. I. Slepshkin, (17 pp 6 figs, 4 tables).

Symmetrical components are used to analyze the mechanical characteristics and the electrical parameters of two-phase machines. Equations are derived for the variation of the output voltage and phase angle with motor speed. One can plot from design equations of this type regulation characteristics in which all the parameters of the machine and of the supply system are taken into account.

The calculation procedure given in this article can be used for the analysis of unbalanced operation of the two-phase induction machine and explains the many known properties of this equipment: linearity of the mechanical characteristics at high critical slip and small signals, linearity of the tach-generator characteristics in single-phase operation under the same conditions, and the independence of the electric characteristics of the machine windings from each other under starting conditions.

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Un-"normalized" core, with the same applied voltage, records considerably higher exciting current after encapsulation.

Contents of *Avtomatika i Telemekhanika* No. 9, 1956 (continued)

The calculations also disclose important phenomena, which have not yet been thoroughly investigated, such as the dependence of the stator current on the phase rotation under any unbalanced condition, and the dependence of all the electrical and mechanical variables on the same factor with different resistances inserted in series with the phase windings. Extensive equations are given for various operating conditions.

Other Articles in This Issue

"Directional Relay-Type Radioactive Indicator," A. N. Svenson, B. P. Sigorski, (8 pp, 4 figs); "Determination of Optimum Parameters of a Regulator Used to Control an Object with Time Delay," S. A. Levitan, (4 pp, 6 figs); "Bibliography on Magnetic Amplifiers, 1955," (Very extensive, listing some 150 Russian, European, and American papers and books).

Contents of *Acoustic Journal* No 3, 1956

Correlation Method of Measuring Transmission Distortion Coefficient; M. A. Sapozhnikov, (6 pgs, 1 fig).

Describes an experimental set-up for the use of the mutual correlation between the input and output signals in an operating sound channel. This method is contrasted with the conventional methods, which are only indirect and which can not be performed during normal operation of the channel. The experimental set-up (Fig. 4) consists of a multiplier, two stabilizers for the mean squared values, and a compensator (in this circuit the instrumented output of the multiplier will give indications that are proportional to the correlation coefficient).

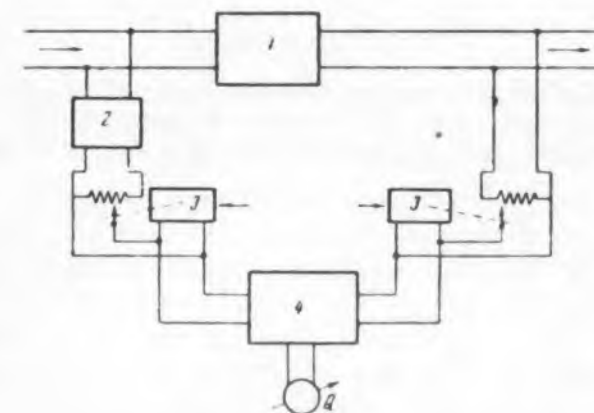


Fig. 4: 1. Channel, 2. phase compensator, 3. automatic stabilizers, 4. multiplier, Q. correlation coefficient meter.

Modulation Method of Measuring Small Electric Voltages at Audio Frequencies; D. K. Balabukha, L. L. Miesnikov, E. N. Platnikova (7 pgs., 6 figs, 1 table).

One of the important problems in modern acoustics and radio physics is the measurement of weak signals at sonic and ultrasonic frequencies when the internal

noise of the amplifying equipment produces a background that is stronger than the signal itself. At ultra high frequencies this problem is measured by using the modulation method, which is applied, in this investigation, to low frequency.

This article describes modulation by means of periodic variation of a capacity in the circuit and indicates an approximate method for calculating the input circuit of the circuit and the parameters of the modulators. It is claimed that this method increases the sensitivity of measurement by one order of magnitude compared to the methods usually employed at this time.

On the Calculation of the Radiation Resistance of Several Distributed Radiator Systems; M. I. Karnovski (12 pgs, 9 figs).

In the calculation of distributed systems of sound equipment (such as in large holes where many speakers are used) one usually does not take into account the interactions between speakers, which result in changes in the radiation resistance of the individual speaker; the radiation resistance of each source in the group is assumed to be the same as if it were insulated. However, if the sources are located at distances that are small compared with the wavelength, the radiation resistance of the speaker in a group may differ considerably from the resistance of the isolated speaker.

This article defines the active component of the mechanical radiation resistance of various groups of spherical radiators, operating under conditions of constant oscillation velocity and radiating in phase and out of phase harmonic waves; the effect of coherent noise is also investigated. The radius of the spherical radiators is assumed to be small compared with the wavelength.

On the Theory of the Ultrasonic Interferometer; V. A. Solov'ev, (6 pp, 2 figs).

The ultrasonic interferometer is one of the most widely-used instruments for the measurement of the velocity of sound in gases and in liquids. The article gives new equations for the absorption coefficient of ultrasonic waves by means of interferometric measurements. Refers to several American works.

Other articles in this issue:

"Propagation of Sound in Inhomogeneous Media," a review, L. M. Brekhovskikh, (9 pp, 7 figs); "Instrument for Measuring the Elastic Moduli of Crystals," K. S. Aleksandrov, O. V. Nosikov, (4 pp, 1 fig, 1 table); "Concerning the Problem of New Coefficients for Qualitative Estimate of Room Acoustics," E. E. Golikov, (12 pp, 16 figs, 2 tables); "Propagation of Elastic Waves in Medium containing Cylindrical Channels," V. V. Tiutekin, (11 pp, 4 figs); "Effect of Velocity of Subsonic Stream on Radiation Resistance of Piston with Infinite Flange," D. N. Chetaev, (8 pp, 2 tables); "Values of Time Factors for Perception of Complicated Sounds," L. A. Chistovich, (7 pp, 7 figs).



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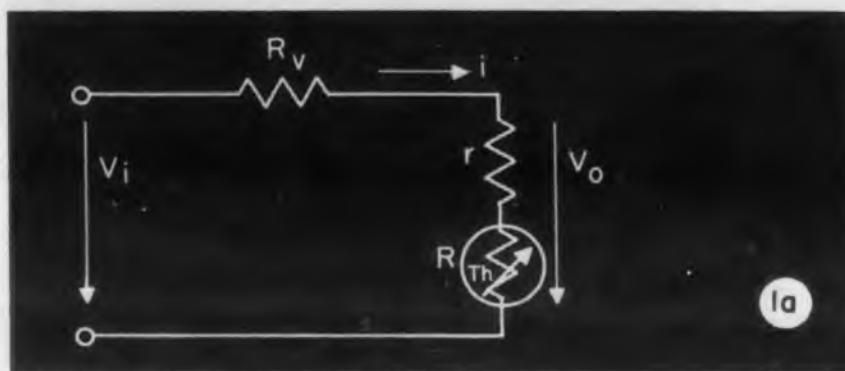
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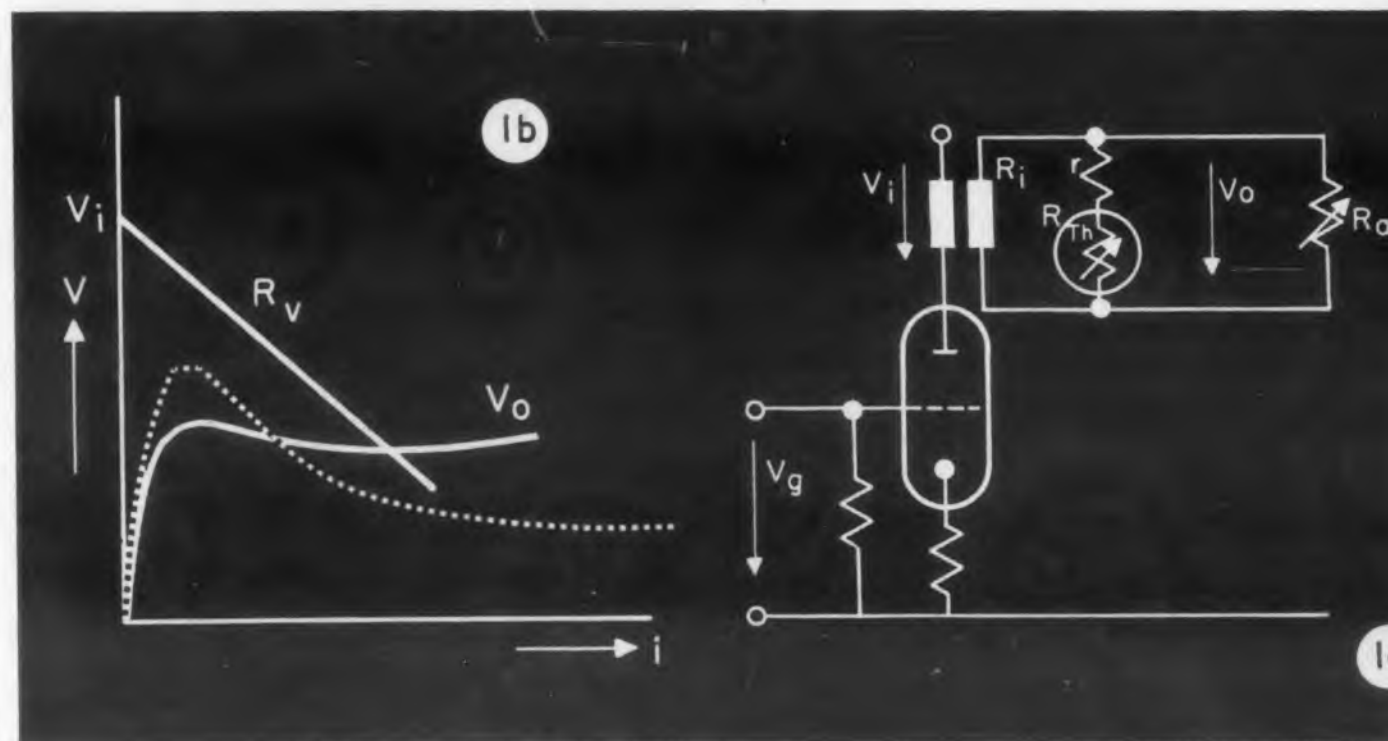
Abstract—German



Basic stabilization circuit for a wide range of currents.

ABOVE frequencies of about 10 cps a thermistor acts as a constant resistance, while for slowly varying signals the thermistor has zero (or negative) differential resistance. Because of this sluggishness it is an element which is ideally suited for stabilization purposes. The high sensitivity allows compensation in the ratio of 500 to 1 while the power consumption is only of the order of 40 mw.

A basic circuit for stabilization over a wide range of currents is shown in Fig. 1a. In this circuit the output voltage v_o is, over a wide range, independent of the input voltage v_i . The addition of the linear resistance r to the thermistor R_{Th} in Fig. 1a results in the composite characteristics shown in Fig. 1b. (This curve is flatter than the thermistor characteristics shown dotted.) An operating point is located by drawing the load line R_r . In the circuit of Fig 1c this characteristic is used to obtain



Characteristic curves of basic circuit on which a schematic (fig. 1c) can be based or . . .

Stabilization With

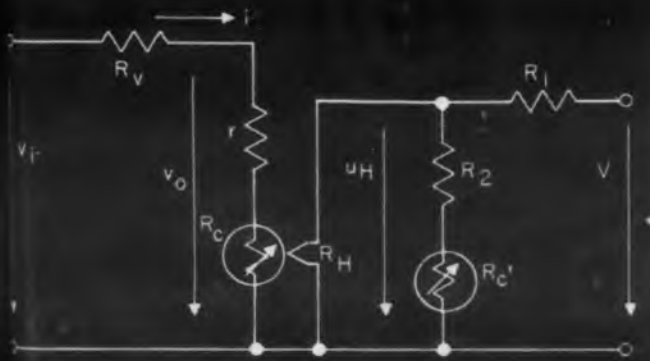
an output voltage, v_o , which is independent of the input, v_i . The operation of the circuit is independent of changes of tube parameters and supply voltage. The load resistance R_o in Fig. 1a corresponds to the parallel combination of R_a and R_i in Fig. 1c.

A more detailed schematic in which this scheme is utilized is shown in Fig. 1d. A control thermistor, R_c , is heated from a separate source, V , so that its characteristics are independent of the ambient temperature and dependent only on the current, i . This (temperature-independent) preheating controls the compensating thermistor R_{Th} , so that resistance is maximum at the ambient temperature (20 C) because then its resistance decreases with decreasing voltage on the heater, R_H . By correct choice of values, the control thermistor is cooled just sufficiently (with increasing ambient temperature) so that its decreased resistance compensates for the

With Temperature Compensated Thermistors

E. Brenner

of the increase in ambient temperature. The design can be executed for increase of ambient temperature up to about 60 C. The control thermistor, R_c , is a power-sensitive type while the compensating thermistor R_c' is a temperature-sensitive type (disc construction). Although for all thermistors the characteristics approach an exponential curve, there is, for temperature-sensitive types, a small region in which the desired temperature dependence is achieved (if the thermistor is supplied from a low voltage, low impedance source). The article also treats limiting action without load current, stabilization under conditions of slightly varying load and stabilization of oscillators. Experimental data are included. *Abstracted from article by W. Dietrich Electronische Rundschau Vol. 10, No. 11, Nov. 1956, p 302.*



ld

A circuit for temperature compensation of an indirectly heated thermistor.

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875003	15	1.5	.008	15

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Abstracts

Analog Correlation System

A SYSTEM designed to measure the degree of correspondence between two wave train data pairs has been developed by the Naval Research Laboratories. An analog type system, it is used to compute correlation coefficients between initiating functions and the corresponding received functions after propagation and reception experience.

The computer system consists of a record and playback mechanism as shown in the block diagram of Fig. 1. The record section contains a dual-channel data transcriber and a dual-channel Ampex magnetic recorder.

The playback section is composed of the recorder feeding two amplifiers in playback from dual-channel tape, which in turn drive the correlator. A General Radio 1800A VTVM is used as an indicating unit. The Sanborn recorders are shown as a monitoring means on the two correlator inputs. Fig. 2 shows sample monitoring records.

In the data transcriber, film data on 35 mm strips are projected on a large ground-glass table top. A carriage assembly is situated above the ground-glass screen. It is fitted with two cross-line indicators, the vertical position of which is controlled by cranks. They are driven horizontally by a constant speed motor across the ground-glass surface at 1/16 in. per sec. Two operators follow the optically projected data with the cross-line indicators by means of the cranks.

The position of the indicators determines the settings of two potentiometers, which are excited by a 100 cps sine wave. As a result the potentiometer outputs are 100 cps signals modulated by the cross-line position rate—the desired function.

The transcriber output is fed into the 2-channel recorder. Spacing between heads of the dual-channel head assembly can be varied to change the time delay between the samples. After a group of data pairs has been recorded on tape, it is cut into appropriate lengths and formed into data pair loops.

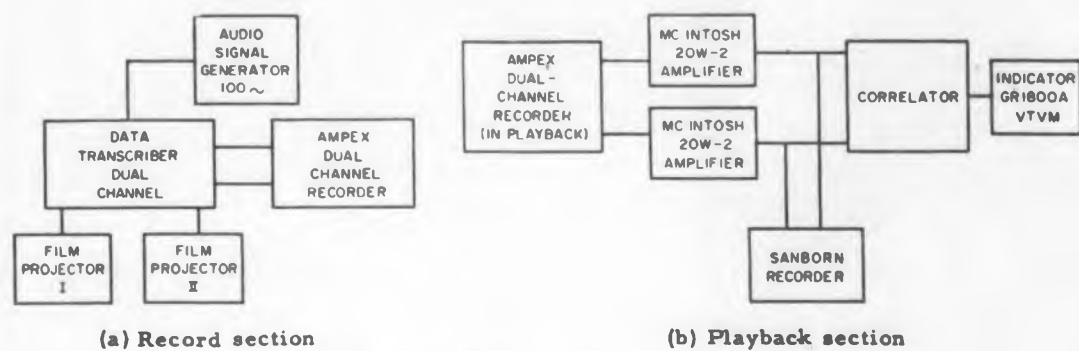


Fig. 1. Block diagram of computer system.

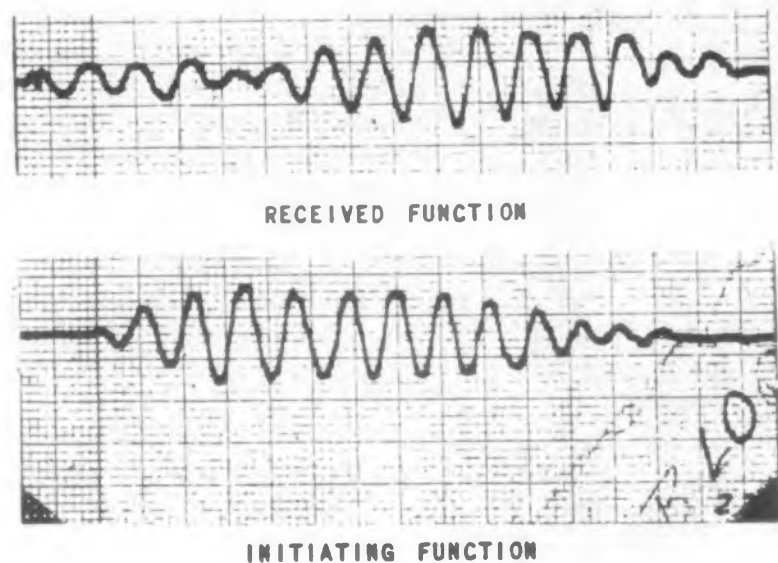


Fig. 2. Typical correlation input waveforms as would be displayed on Sanborn recorders.

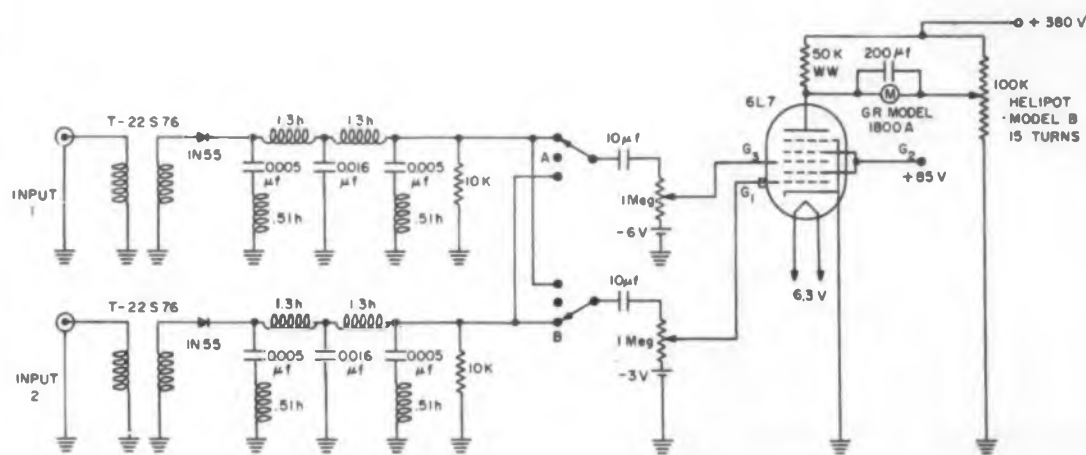


Fig. 3. Correlator unit schematic.



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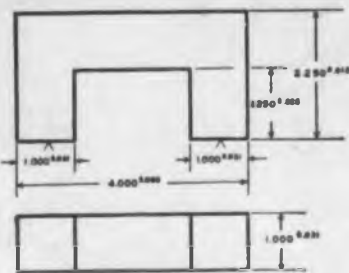


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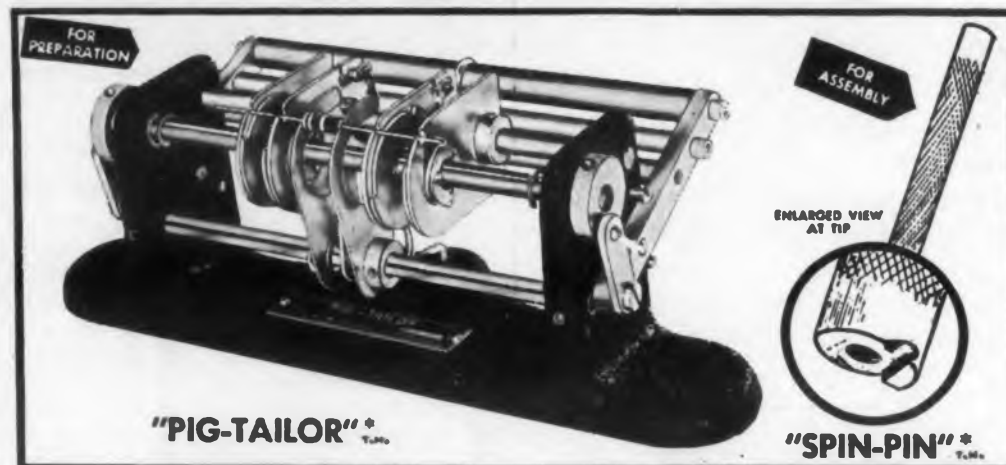
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Abstracts, cont.

Fig. 4. Correlator calibration curve. Circled points indicate experimental values of R obtained by using correlator.

Each loop is played back continuously at 30 in. per sec. Since the original 100 cps is recorded at 0.416 in. per sec tape speed, the initial 100 cps appears as 7200 cps at the correlator input.

The two loop outputs are fed through matching transformers to crystal rectifiers and low pass filters to attenuate the 7200 cps component and extract the original modulation data, which are now transposed to a higher frequency. The correlation tube shown in Fig. 3, is operated so that one grid has linear control of the plate current (grid 1) and the other grid has linear control of the transconductance (grid 3). The tube takes the instantaneous product of the two data samples. In the plate circuit of this tube, an RC filter is used to average the product. A stable reference voltage is used to balance out the quiescent dc plate voltage. The GR 1800A VTVM on open grid connection measures the change in average level of the tube's plate voltage. This change is proportional to

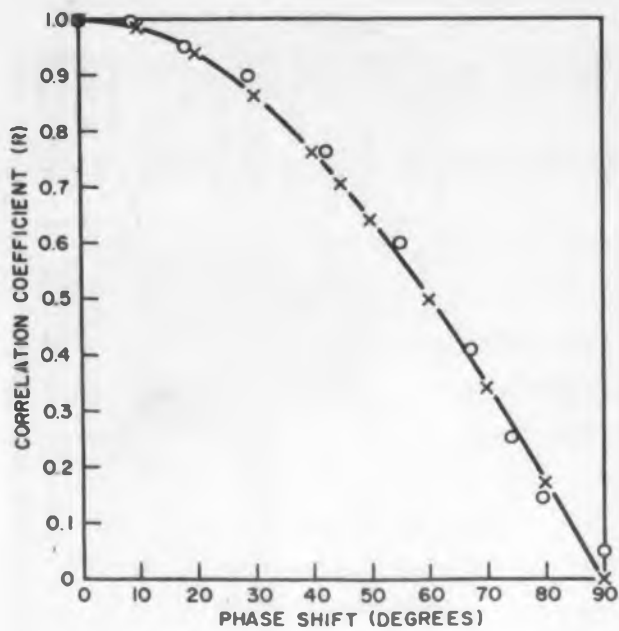
$$\{f_1(t) f_2(t + \tau)\}_T$$

where t is the running variable time, T is a fixed period over which the expression is averaged, τ is a time delay, and f_1 and f_2 are the tape-recorded signals fed to the 6L7 tube grids. With the RC filter constants actually used, a small part of the averaging is done by eye with negligible error since the process is repetitive.

The desired correlation coefficient is

$$R = \frac{\{f_1(t) f_2(t + \tau)\}_T}{[\{f_1^2(t)\}_T \{f_2^2(t + \tau)\}_T]^{1/2}}$$

where T is sufficiently long to include both f_1 and f_2 , and τ is adjusted to maximize R . The procedure employed is as follows:



1. Apply f_1 to both grids of the correlator tube and call the output meter reading G_{11} .

2. Apply f_2 to both grids and call this output meter reading G_{22} . Adjust input level to the correlator so that

$$G_{22} = G_{11}.$$

Note: Steps 1 and 2 must be accomplished so that the tube remains in its linear range.

3. Apply f_1 to grid 1 and f_2 to grid 3; adjust delay for maximum meter reading. Call this output meter reading G_{12} .

4. Reverse the grid connections of step 3 and call output meter reading G_{21} . For perfect multiplication by the vacuum tube,

$$G_{12} = G_{21},$$

and the coefficient

$$R = \frac{G_{12}}{G_{11}} = \frac{G_{21}}{G_{11}} = \frac{G_{12}}{G_{22}} = \frac{G_{21}}{G_{22}}.$$

In practice, tube multiplication is never quite perfect, especially where power levels vary widely over a data sample; under these circumstances, the correlation coefficient may be approximated closely by:

$$R = \frac{G_{12} + G_{21}}{G_{11} + G_{22}},$$

If G_{11} and G_{22} are approximately equal.

The theoretical correlation coefficient is given as smooth curve in Fig. 4. Empirical measured values are shown as circled points for two continuous waves of the same frequency, with phase shift as the variable. Abstracted from An Analogue System for Computing Correlation Coefficients, by J. M. Headrick and J. L. Ahearn, Jr., PB 121482, OTS, U.S. Dept. of Commerce, Washington 25, D.C.

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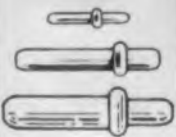
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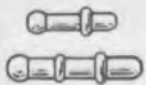
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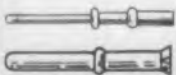
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Standards and Specs

Sherman H. Hubelbank

RETMA Standards—Revisions

The following RETMA standards proposals are being circulated for comment. Although the official comment period may have expired, you are encouraged to contact the RETMA Engineering Department, 11 W. 42nd St., New York 36, N.Y., if you are vitally interested.

S.P. 524, ENCODED COLOR BAR SIGNALS

The RETMA standard color bar signal is intended for use as a test signal as a criterion for the adjustment of encoders or colorplexers; for rapid checks of color television transmission systems; and for the adjustment of color monitors or monitor receivers.

S.P. 525, CIRCULAR WAVEGUIDES

S.P. 526, POWER FILTER REACTORS FOR RADIO TRANSMITTERS

This proposal is a revision of Standard TR-110-B.

S.P. 527, DRIVE PULLEYS

This proposal is a revision of Standard REC-102A.

S.P. 528, DEFINITIONS AND DIMENSIONAL CHARACTERISTICS OF QUARTZ CRYSTAL UNITS

This proposal is a revision of Standard TR-112-A.

CR Tubes

JETEC PUBLICATION 9, SUMMARY OF REGISTERED CATHODE RAY TUBES

This publication lists all cathode ray tubes registered through December 1956. It covers 1 inch to 30 inch sizes for radar, oscilloscope, and television applications. The pertinent characteristics for each tube type with the sponsoring company are listed. Copies of this publication are available from RETMA, 11 West 42nd Street, New York 36, N.Y. for \$2.00 per copy.

Bills of Materials

MIL-STD-295 (NOrd), PREPARATION OF BILLS OF MATERIALS, 30 OCTOBER 1956 . . . The scope of this standard is to permit the Bureau of Ordnance to assist the Department of the Navy and the appropriate civilian agencies in forecasting realistic and accurate material requirements for both current and mobilization planning purposes, and thereby aid in fulfillment of the defense mission. General policies, criteria, and detailed instructions for compiling bills of materials on forms DD346 and DD347 are covered by this standard.

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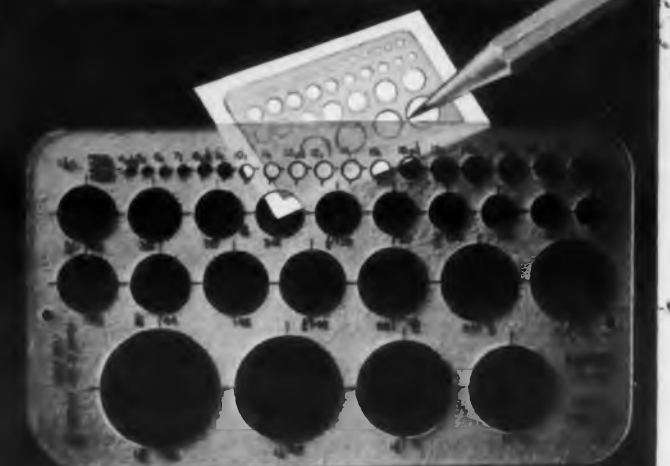
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Foreign Standards

ASA has announced the receipt of the following foreign standards, copies of which are available to ASA members. Unless otherwise indicated, standards are available only in the language of the country of origin.

UNITED KINGDOM

Recommendations for field and laboratory measurement of airborne and impact sound transmission in buildings. BS 2750-1956.

Classification of insulating materials for electrical machinery and apparatus on the basis of thermal stability in service. BS 2757-1956.

Fixed paper-dielectric capacitors for d-c for use in telecommunications and allied electronic equipment. BS 2131-1956.

ARGENTINA

Dry capacitors, polarized. IRAM 4019.

BULGARIA

Standard scale of nominal frequencies. BDS 1955-55.

Capacitors, nominal ratings. BDS 2342-56.

Standard rating of small motors from 6 to 600 watt, 50 cycles. BDS 2347-56.

CANADA

Construction and test of wire connectors. C22.2 No. 65-1956.

Construction and test of specialty transformers. C22.2 No. 66-1956.

Construction and test of varnished-cloth insulated wires and cables. C22.2 No. 78-1956.

GERMANY

Graphical symbols for power and telecommunication installations. DIN 40712.

Twelve standards for different electronic tube bases. DIN 41531/4 B1.1 and 2, 41537 B1. 2 & 3, 41539 B1. 2 & 3.

Four standards for miniature transformers. DIN 41303, 41304 BL. 2 & 3.

Soldering terminal strips. DIN 41498.

Nominal rating of fixed capacitors. DIN 41311.

Multiple telecommunication plugs and receptacle strips. DIN 41621/2.

Graphical symbols used in power and telecommunication installations. DIN 40700.

Fuses for telecommunication circuits. DIN 41584, B1.1,2.

Fixed capacitors, 125-500v, class 3. DIN 41387.

INDIA

Series of preferred values for capacitors and resistors. IS 824-1956.

Color code for fixed resistors. IS 825-1956.

NETHERLANDS

Graphical symbols used in telecommunication. V 2051.



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KM88	0-28 V.D.C. @ 20 Amps.	1%	1%	No. 100
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CIRCLE 237 ON READER-SERVICE CARD FOR MORE INFORMATION

Standards and Specs

Capacitors

MIL-C-19624 (SHIPS), CAPACITORS; FIXED, BY-PASS, METAL-ENCASED, HERMETICALLY SEALED, ALTERNATING AND DIRECT CURRENT (INTERFERENCE REDUCTION)

The design and construction of metal-cased, bypass fixed capacitors (a-c and d-c) for use in the reduction of conducted broadband interference is covered in this spec. The ambient conditions within which these capacitors must operate are also established. A typical type designation follows: BLOF123VA2.

MIL-C-20B, CAPACITORS, FIXED, CERAMIC DIELECTRIC (TEMPERATURE COMPENSATING), 9 NOVEMBER 1956

This spec covers temperature-compensating, ceramic-dielectric, fixed capacitors for use primarily in circuits where compensation is necessary for variations in capacitance due to temperature, and in bypass and coupling applications. A typical type designation is CC20AKOR5C. This spec supercedes JAN-C-20A, dated 4 December 1947.

Connectors

MIL-C-19572 (SHIPS), CONNECTORS, PLUG AND RECEPTACLE, ELECTRICAL MINIATURE, BAYONET LOCK, 2 NOVEMBER, 1956

These connectors are intended for use where the connector will be subject to heavy condensation and rapid changes in temperature or pressure, and where the connector is subject to very high vibratory conditions. A typical type designation for a connector meeting this spec is PFO11.

Thermocouples

SAMA RC9-10-1956, TEMPERATURE-EMF-RELATION FOR IRON-CONSTANTAN THERMOCOUPLES

Standard temperature-emf values are established by this spec for the iron-constantan thermocouple. Conversion tables are given in degrees C and Degrees F, and for even increments of emf, as well as even increments of temperature. Copies of this spec are available from the Scientific Apparatus Makers Association, 522 Fifth Avenue, New York 36, N.Y.

Locks and Keys

SAMA RC10-10-1956, LOCKS AND KEYS FOR INSTRUMENT CASES

A standard lock and key set is established by this spec in order to permit a standard key to operate the standard lock on the instrument cases of any manufacturer adopting the standard. Copies of this spec may be obtained from the Scientific Apparatus Makers Association, 522 Fifth Avenue, New York 36, N.Y.

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Records

MIL-R-7634C (USAF), HISTORICAL AND TECHNICAL INSTRUCTION COMPLIANCE RECORDS FOR AIRCRAFT AND RELATED EQUIPMENT, 4 SEPTEMBER 1956

The historical record forms covered by this spec are DD Form 829, entitled Historical Record for Aeronautical Equipment; DD Form 829-1, entitled, Historical Record—Technical Instruction Compliance Record; DD-Form 829-2, Historical Record—Significant Historical Data; AFTO Form 44, Turbine Wheel Historical Record; and AFTO Form 46, Turbine Wheel Bucket Layout Data Sheet on J-35 Engines. Included in this spec is information related to making the proper entries on the form.

Airborne Electrical Equipment

MIL-E-7080A, GENERAL SPECIFICATION FOR PILOTED AIRCRAFT INSTALLATION AND SELECTION OF ELECTRIC EQUIPMENT, 5 SEPTEMBER 1956

The requirements for the selection and installation of electric equipment for piloted aircraft are specified by this spec. Electric equipment is construed to include electric power generation and utilization equipment, and control and protective devices. This spec supersedes MIL-E-7080, 27 December 1950.

Reliability

MIL-R-19610 (AER), GENERAL SPECIFICATION FOR RELIABILITY OF PRODUCTION ELECTRONIC EQUIPMENT, 15 SEPTEMBER 1956

The minimum requirements which the contractor must perform on production equipment to assure the production of reliable equipment are outlined by this spec. For each type of equipment, a level of reliability is assigned, which the contractor is expected to meet. The three levels of reliability are: (1) Level A, Operation 200 hours with no more than one failure; (2) Level B, Operation 100 hours with no more than one failure; and (3) Level C, Operation 50 hours with no failure.

Data Systems Policy Council

By order of Directive 5105.11, the Department of Defense has established a Data Systems Policy Council and a Data Systems Research Staff. Membership to the Council will consist of people from the financial management and comptroller offices in each military department and in DOD. The Staff will be composed of people from the same departments, but those with backgrounds in data processing systems.

The reason for issuing the directive lies in the Department's recognition that "developments are proceeding so rapidly, that a more effective means is now necessary to foster the development of common policies and joint programs." The Staff, which has the bigger job, must conduct "a thoroughgoing research into techniques, equipments and applications of Automatic Data Processing Systems (ADPS)."



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You'll find this new, comprehensive Setko Catalog an invaluable reference manual in solving tough, puzzling Set Screw problems. Lists all standard set screws . . . plus many special types designed for unusual conditions of vibration; close precision setting; resistance to tampering, chemicals or heat; extra holding power; etc. Describes many specific ways in which Setko Set Screws cut costs and improve product quality.

Partial Contents of New Setko Catalog 21:

- * Hopper-Fed Headless Set Screws, with New Automated Feed System
- * Self-Tapping Set Screws and Fasteners
- * Standard Hexagon Socket
- * Zip-Grip Self-Locking
- * Nu-Cup Set Screws
- * Self-Locking Offset Point-Lok, Flush-Lok, Spread-Lok
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send for FREE catalog 21 today!

Use letterhead—or write name and address in margin of this page, tear out ad and mail.

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& Mfg. Co.**

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We Specialize in Solving Puzzling Set Screw Problems

CIRCLE 240 ON READER-SERVICE CARD FOR MORE INFORMATION

IBM

announces a

Ground-Floor Opportunity for Scientific and Engineering Men

in IBM's new

Special Engineering Products Division

It's like joining a new company—the ground-floor opportunities you will find in this new IBM Division—plus all the advantages of the stability and security of IBM.

REALLY NEW

We want men with creative ingenuity to solve problems *never encountered before* . . . who will significantly influence the new Division by their enterprise. Projects are not routine . . . and they are small enough to permit individual contributions that will establish your stature as a professional engineer.

OUTSTANDING OPPORTUNITIES

Career opportunities exist not only for electronic and mechanical engineers but also physical and chemical scientists and metallurgists with experience in any of the following areas:

- advanced component design
- analog or digital computers
- automation
- data conversion, transmission, processing or display systems
- design of intricate mechanisms
- electronic packaging
- instrumentation
- process control
- servo systems
- solid state devices and applications
- telemetering

Graduating E.E.'s, M.E.'s, physicists and mathematicians will find responsible, stimulating assignments in this Division.

PURPOSE OF THE DIVISION

The new Special Engineering Products Division has been created to enable IBM to apply systems knowledge, engineering and production skills to organizations seeking assistance on specific problems connected with the processing of industrial, commercial and scientific data. Its engineers will design, fabricate and install tailor-made systems for such applications as engine test stands . . . wind tunnels . . . flight test . . . industrial process control . . . machine tool and material handling control . . . nuclear reactors . . . innumerable others.

EMPHASIS ON VERSATILITY

It should be emphasized that the new Division has the responsibility for developing and building equipment related to, *but outside of*, IBM's regular line of products. The variety and diversification of projects call for ultimate creativeness to *develop nonstandard* computing and data-handling components, machines and systems for tie-in with existing IBM equipment.

FOR COMPLETE DETAILS, write today to Mr. R. A. Whitehorne, International Business Machines Corporation, Dept. 905, 590 Madison Avenue, New York 22, N. Y.

DATA PROCESSING
ELECTRIC TYPEWRITERS
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ENGINEERS, SCIENTISTS:

What did they say the last time you had an **IDEA?**

At Decision, we talk to hundreds of engineers, and many report how frustrating it is when they make a good constructive suggestion and are gently reminded that "ideas" are the responsibility of others. (Strangely enough, these same companies often talk about "creative engineering" in their recruiting ads.) Fortunately this attitude is not typical of most progressive companies today.

We know many companies who encourage and appreciate creative thinking . . . who know that youth, inspiration and progress all go together.

Whether you're thinking seriously about changing jobs or not, Decision can improve your job perspective confidentially and at no cost to you. We will send reproductions of your resume (without your name) to the hundreds of top ranking firms—our clients—who pay us to find good men. And, we will enter your name and resume in our unique Decision/Register, which we search daily to find engineers for specific job openings.

DECISION/INC

Publishers of the authoritative
Engineers' Job Directory

FIND OUT ABOUT COMPANIES WHO
NEED YOUR IDEAS.

MAIL THIS COUPON NOW!

CONFIDENTIAL

Oliver P. Bardes, President
DECISION/INC
Management Consultants
1672 First National Bank Bldg.
Cincinnati 2, Ohio

Dear Mr. Bardes:
I do have good ideas, and I want
to find out who needs them!

NAME _____

TITLE _____
(or job interest)

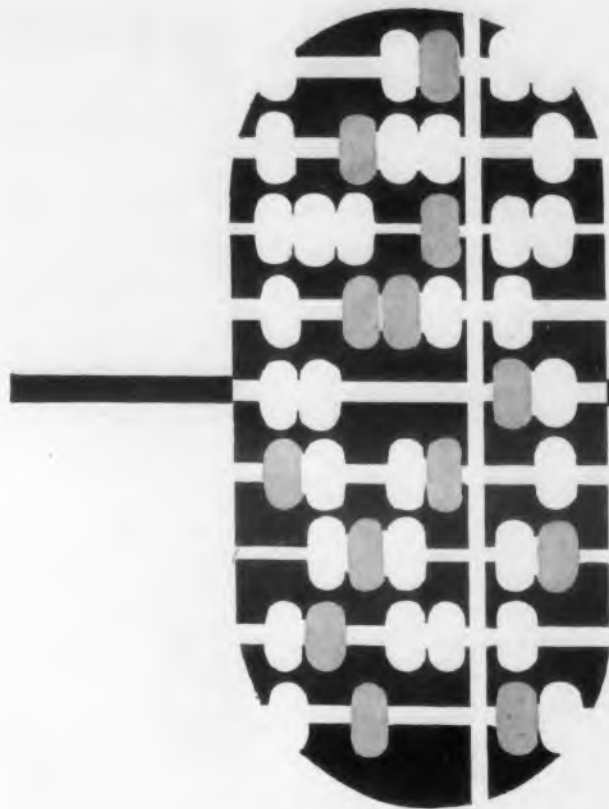
STREET _____

CITY _____

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ENGINEERS • SCIENTISTS

EVER TRY TO ADD TWO 22-DIGIT NUMBERS IN 5 MICROSECONDS?

Or multiply them - in 10 microseconds?

Well, that's exactly what Sylvania is doing — or to be more accurate, Sylvania is building a large-scale digital computer to do just that. It seems there is no existing computer that operates fast enough to simulate the flight of today's supersonic jets.

These special speeds call for a number of other important engineering developments. For example, into this new computer must be built a magnetic core memory system with a 5 microsecond repetitive random access time!

Two avenues of advancement open to Systems Engineers are Systems Management or Scientific Systems Specialties with parallel salary scales for both.

Check the list of current openings. Decide which interests you most, and then let us hear from you.

SYSTEM ANALYSTS, ENGINEERS, MATHEMATICIANS, AND PHYSICISTS

Interested in the analysis and block diagram design of systems. Interests in such subjects as radar analysis and design, antenna design, error analysis, statistics, communication theory, network theory, real-time computation, time varying and non-linear control systems, logistics, operations research, data transmission and missile analysis including aerodynamics, structures and heat transfer are desired.

ELECTRONIC DESIGN & DEVELOPMENT ENGINEERS

Openings at all levels in ECM systems and other circuitry. Work involves video, pulse and timing circuits, radar, digital radar processing equipment, advanced receiver and special transmission line techniques, with utilization of new as well as orthodox component types.

RESEARCH ENGINEERS & PHYSICISTS

Primarily interested in conducting research of new techniques which will lead to new electronic systems of the future. Experience in communications theory, automatic controls, airborne interceptor radar, infra-red systems, radar simulators, missile electronics, data processing, applied mathematics, or related fields is desirable.

PROJECT ENGINEERS

General responsibility for ECM, large scale general purpose digital computers, and other electronic systems including internal projects coordination and technical relations with contracting agencies.

DIGITAL COMPUTER DESIGN ENGINEERS

Responsible for all phases of development on several large scale computer and data processing projects; systems analysis and logical design; advanced circuit work on transistorized switching circuits, unusually high-speed core memory systems and input-output equipment; breadboard design and test prototype design and systems evaluation and testing.

MECHANICAL ENGINEERING, PACKAGING & PHYSICAL TEST ENGINEERS

Group supervisors responsible for mechanical engineering, design and product development of advanced airborne, missile borne, and ground electronic and electro-mechanical equipments. Responsible engineers for design of test facilities, equipment and instrumentation for complex physical and environmental testing of electronic equipment and antenna and radar components.

ANTENNA ENGINEERS

Design of array elements, power dividers, RF linkages, and other general transmission problems.

APPLIED RESEARCH LABORATORY | AVIONICS LABORATORY | MISSILE SYSTEMS LABORATORY

WALTHAM LABORATORIES Electronic Systems Division

If you are interested in any of these positions, please
send your resume immediately (in strict confidence) to:

ERLING MOSTUE 100-J11 First Avenue
Waltham, Massachusetts



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EECO Data Sheet

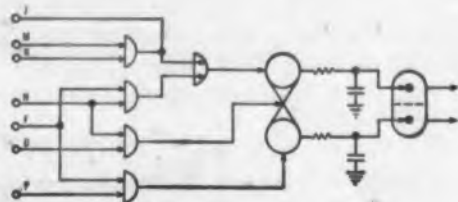
- Gray-to-binary code conversion with new EECO Computer-Series plug-in (Y-103).
- Small Engineering Company Organization—a philosophy and method for tailoring operating procedures.



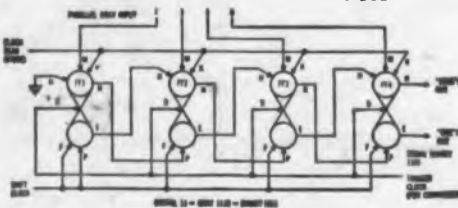
Y-103

Gray-to-binary Code Converter

Included among the many functional circuits available in EECO's new Computer-Series plug-ins is a Flip-Flop - Shift Register Element (Y-103) that is



Y-103



adaptable for use as a composite Gray-to-binary code converter and shift register. For this use, the Gray number is read into the shift register in parallel form (for example, from a code wheel or flip-flop register), converted internally to a binary number, and then shifted out in serial form.

In the schematic illustration, the input Gray number is 1110, corresponding to decimal 11 and binary 1011. The Gray-to-binary conversion is based on the rules that:

1. The most significant digit is identical in each code system.
2. Each succeeding Gray digit is complemented if the preceding *binary* digit is a 1, or repeated if the *binary* digit is a 0.

Trigger clock (conversion) pulses cause the Gray-to-binary conversion and must be one less in number than the number of digits in the Gray code. After conversion, the binary number is shifted out serially by shift clock pulses.

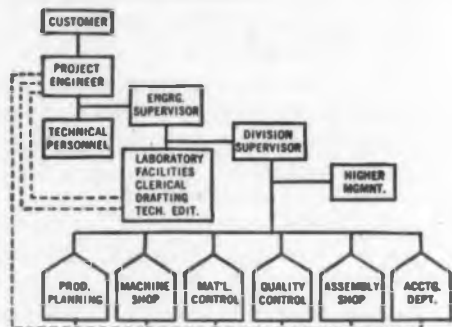
More detailed information on this and other applications of EECO Standard-Series and new Computer-

Series plug-ins is available in Catalog No. 856-A. Write for your copy.

Tailor-Making a Company Organization

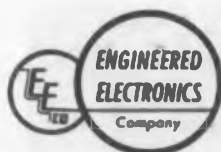
Each of the two classical types of company organization - "Project" and "Departmental" - has weak as well as strong points. By combining the strong and eliminating the weak points of the two (insofar as practicable within the limits imposed by the type of company activities and objectives involved) it is possible to evolve a third system superior to either of the original two.

This complete analysis and integration process is described in detail in the reprint of a talk delivered by T. W. Jarmie, president of Engineered Electronics Co. and a director of Electronic Engineering Co. of California, before the Professional Group on Engineering Management of the IRE. The final operation chart developed by this process (illustrated below) reflects the operating procedure that has proven so successful at EECO.



Although this talk was first delivered in 1955, so much recent interest has been shown in the subject that reprints of the paper have again been made available. Ask for Reprint J-2.

ELECTRONIC ENGINEERS AND PHYSICISTS: EECO offers career opportunities in challenging systems design and related projects. Send resume to R. F. Lander, Dept. DS.



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a subsidiary of

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506 EAST FIRST STREET - SANTA ANA, CALIFORNIA

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ENGINEERS! IMPROVE YOUR POSITION! COME WITH A LEADER IN GOVERNMENT ELECTRONICS



The key to Missile performance is its 'Heart Beat' . . . the electronic system that directs and guides its unerring flight. The Crosley Division of AVCO Manufacturing Corporation is expanding its programs in this important field. We have top positions for engineers in many different categories.

- **ADVANCED RESEARCH ENGINEERS**
- **PROJECT ENGINEERS**
Computer & Analytical Systems
Guided Missile Programs
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There Are Also Openings In:

- **GUIDED MISSILES**
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- **GROUND RADAR**
- **ANTENNA AND MICRO-WAVE EQUIPMENT**
- **SERVO-MECHANISMS**
- **COMMUNICATIONS**
Airborne Transmitters
and Receivers
- **AIRBORNE FIBRE CONTROL SYSTEMS**
- **TRANSISTORIZED EQUIPMENT**

Write us and find out where you can fit into the major programs now being started. Write for literature and we will also give you information about the advantages of family living in Cincinnati—the "Queen City of the West—closest to the Heart of America." There are numerous company benefits and you will be paid generous relocation expenses. Please send a resume to Mr. Nick M. Pagan, Manager Technical and Professional Employment Office, Dept. R.

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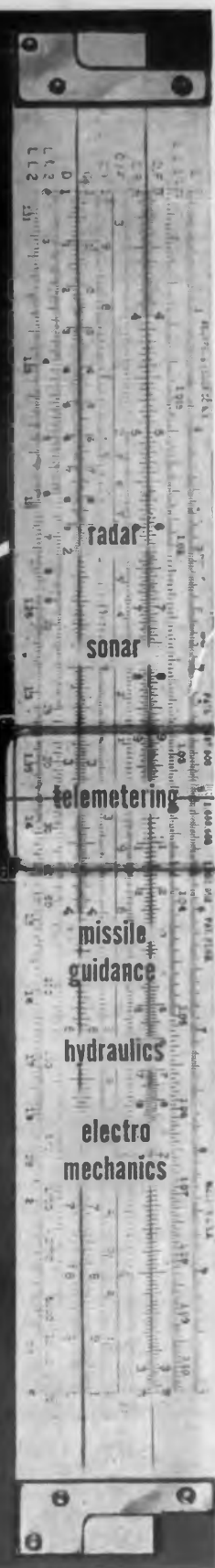
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Pacific Division, Bendix Aviation Corp.
11606 Sherman Way, North Hollywood, Calif.

I am interested in this engineering field _____
I am a graduate engineer with _____ degree.
I am not a graduate engineer but have _____
years experience.

Name _____

Address _____

City _____ Zone _____ State _____

CIRCLE 556 ON READER-SERVICE CARD

ENGINEERS-SCIENTISTS: TEMPERATURES TWICE AS HOT AS SUN'S SURFACE NOW PRODUCED AT G.E.'S AEROSCIENCE LAB

New "Water Arc" Advances Nose Cone Technology at
Missile & Ordnance Systems Department of General Electric

When MOSD became prime contractor for ICBM Nose Cone development, engineers and scientists here were faced with the necessity of creating not only new systems concepts, new components, new materials and new fabrication techniques, but also the *very tools and facilities to evaluate them.*

Meteors may melt on entering the earth's atmosphere, but the relatively thin-skinned nose cone must come through in full functional order. To test out heat-resistant materials capable of withstanding re-entry temperatures, a new instrument was devised under the direction of the research staff of MOSD.

...the WATER-STABILIZED ARC

How does the new water arc differ from the conventional electric arc? It is controlled—or stabilized—by a whirling blanket of water, which produces a "squeezing" effect, forcing the arc into the shape of a column. By causing a great amount of electrical current to flow across the column, extreme temperatures may be maintained continuously, subject only to the limitations of available power.

Valuable experiments are now being conducted at MOSD's Aeroscience Laboratory with the stabilized water arc. The most advanced heat-resistant materials are subjected to temperatures as high as 25,660°F—more than twice the heat of the sun's surface.

OTHER WAYS OF CREATING HYPERSONIC ENVIRONMENT AT MOSD

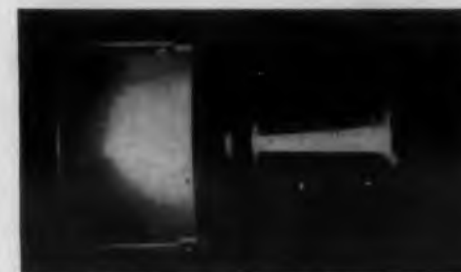
G.E. has built the largest, most powerful Shock Tunnel in the country in Philadelphia. Here free flight conditions in the order of Mach 20 can be matched. MOSD also utilizes a high power Centrifuge to test behavior of electromechanical and structural components under gravity loads up to 100G's.



STABILIZED WATER ARC and G-E designed TUNNEL shown during operation. Material undergoing test is held in front of the arc orifice by means of a rod or "string" running through the tunnel.



3000 KW used in operating this stabilized arc and evacuation tunnel. (Shown idle.) Has 1/4" nozzle diameter. Present plans call for construction of a 3" diameter model, requiring 80,000 KW for operation.



View of fluid-stabilized arc in operation. The liquid revolving inside the glass or plastic cylinder flowing at high velocity offers insulation as well as the material of which the plastic beam is composed.

OPENINGS FOR MEN WHO CAN EXPLORE NEW TECHNICAL AREAS

Engineers and scientists find an ideal research environment at MOSD. They work in small groups on problems of prime scientific interest—in close contact with managers and top specialists.

Located in downtown Philadelphia, adjacent to University of Pennsylvania and Drexel Institute, it is easy to take advantage of G.E.'s Tuition Refund Plan for graduate study.

EXCEPTIONAL GROWTH OPPORTUNITIES:

Organized only in '56, MOSD has been growing phenomenally, and continued expansion is scheduled for '57. This expansion creates many opportunities to rise to positions of higher responsibility and income level. All of the managers of technical groups are themselves engineers or scientists and the majority have come up from within this or other departments of General Electric.

YOUR INQUIRIES INVITED:

If you are a Graduate Engineer or Scientist and have experience in these or related fields:

MATERIALS AND PROCESSES • AERODYNAMICS • AEROPHYSICS • THERMODYNAMICS • ELECTRICAL DESIGN • ELECTRONIC OR ELECTROMECHANICAL COMPONENT DESIGN • STRUCTURAL DESIGN • STRESS ANALYSIS • DATA PROCESSING • SYSTEMS • SYSTEMS TEST • FIELD TEST • VIBRATION • INSTRUMENTATION • CONTROLS • GROUND SUPPORT EQUIPMENT DESIGN • TECHNICAL WRITING • ARMING AND FUZING • INERTIAL GUIDANCE

...send us your resume or, if you prefer, write us for a convenient application form.

Your resume will be carefully reviewed by the MANAGERS of our various technical components. If qualified, you will be invited to visit our offices and discuss the work we are doing directly with the managers with whom you would be working. All communications will be entirely confidential.

Mr. John Watt, Professional Placement, Room 70-2

MISSILE & ORDNANCE SYSTEMS DEPARTMENT

GENERAL ELECTRIC

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Experimental Electronic Fabricators



*You really live
in the great
Southwest*

New Mexico's climate is so ideal our state is the most visited in the West year after year. But living here is better than visiting!

You'll find year-round fishing or hunting . . . skiing . . . mountain climbing . . . all within driving distance of your home. And with our extremely generous vacation plan, you'll try them all.

You'll like working in our all-new, air-conditioned laboratories, in a city where there's no slush on the ground or smog in the air. There's no wearying, hour-long drive from home to Lab and Lab to home every day either . . . you'll live less than 30 minutes from work.

Albuquerque is a modern, metropolitan town, with University athletics, three TV stations and all the spectator entertainment you could ask for.

Our school system is excellent at all levels, including higher education.

We think our extra employee benefits are outstanding too.

And there's never been a layoff in our ten-year history.

But most of all there's the appeal of challenging and stimulating work in an all-new field.

If you'd like to know more, we'll send our brochure. Write to General Employment Section 557.

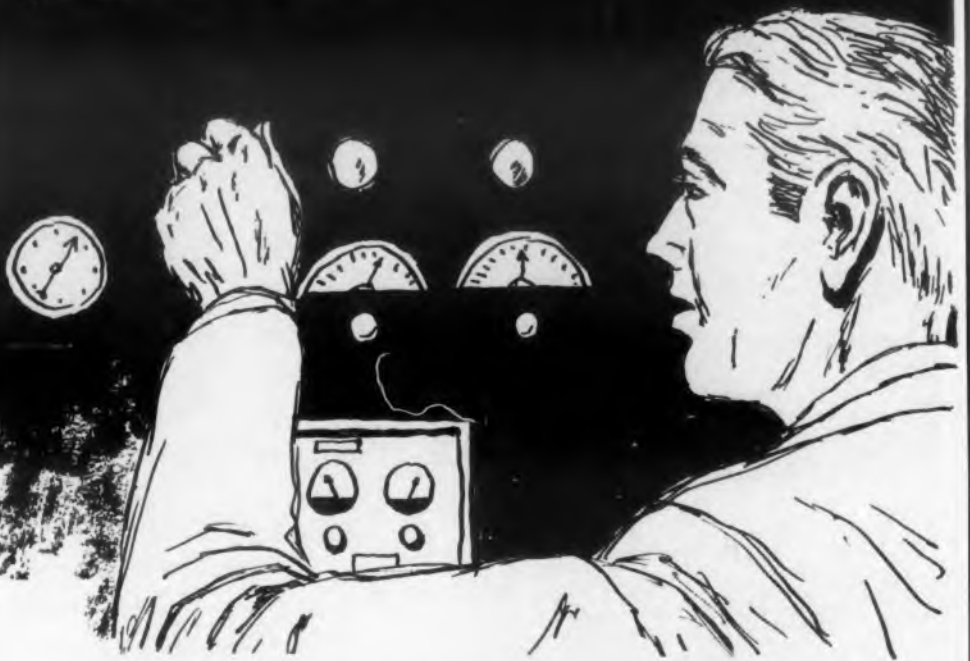
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SERVO DESIGN and SYSTEM ENGINEERS



We need an experienced servo design engineer to assume a prime responsibility in a new systems activity. Other attractive engineering opportunities are also available in this new program.

Enjoy challenging opportunities in the analysis and design of electro-mechanical servo loops, including laboratory experimentation and system development.

Work with the top men in the field and with the finest test, research and development facilities. New plant being added in suburban Milwaukee as a part of Major, Permanent, Expansion Program.

AC will provide financial assistance towards your Master's Degree. A Graduate Program is available evenings at the University of Wisconsin—Milwaukee.

GM's long-standing policy of decentralization creates individual opportunity and recognition for each Engineer hired.

You will enjoy, as will your family, Milwaukee's "small town" friendliness and metropolitan shopping and cultural advantages.



For immediate, confidential interview in your area or an invitation to visit Milwaukee—see our plant—talk with our engineering heads and discuss your possibilities, contact:

Mr. Cecil F. Sundeen,
Supervisor of Technical Employment



AC the Electronics Division
GENERAL MOTORS Corporation

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UNDER YOUR HAT...**



*Bendix York
needs*

Electronic & Mechanical Eng.

This is *your* chance to get
specific assignments
at the peak of the art in

Electronic & Microwave Development & Design

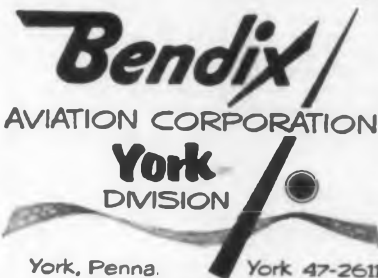
WITH BENDIX YORK YOU GET

- Professional Achievement
- Rapid Advancement
- Security
- Responsibility

We need capable professional personnel at all levels to fill responsible openings at this steadily expanding young Division of the Bendix Aviation Corporation. With us, you will find the true opportunity to move up in your chosen profession. You will like the life in our beautiful suburban area.

Yes, whether you be a Department Chief or a Graduate Engineer with a minimum of experience, we have the opening tailored to you and to your hopes for the future.

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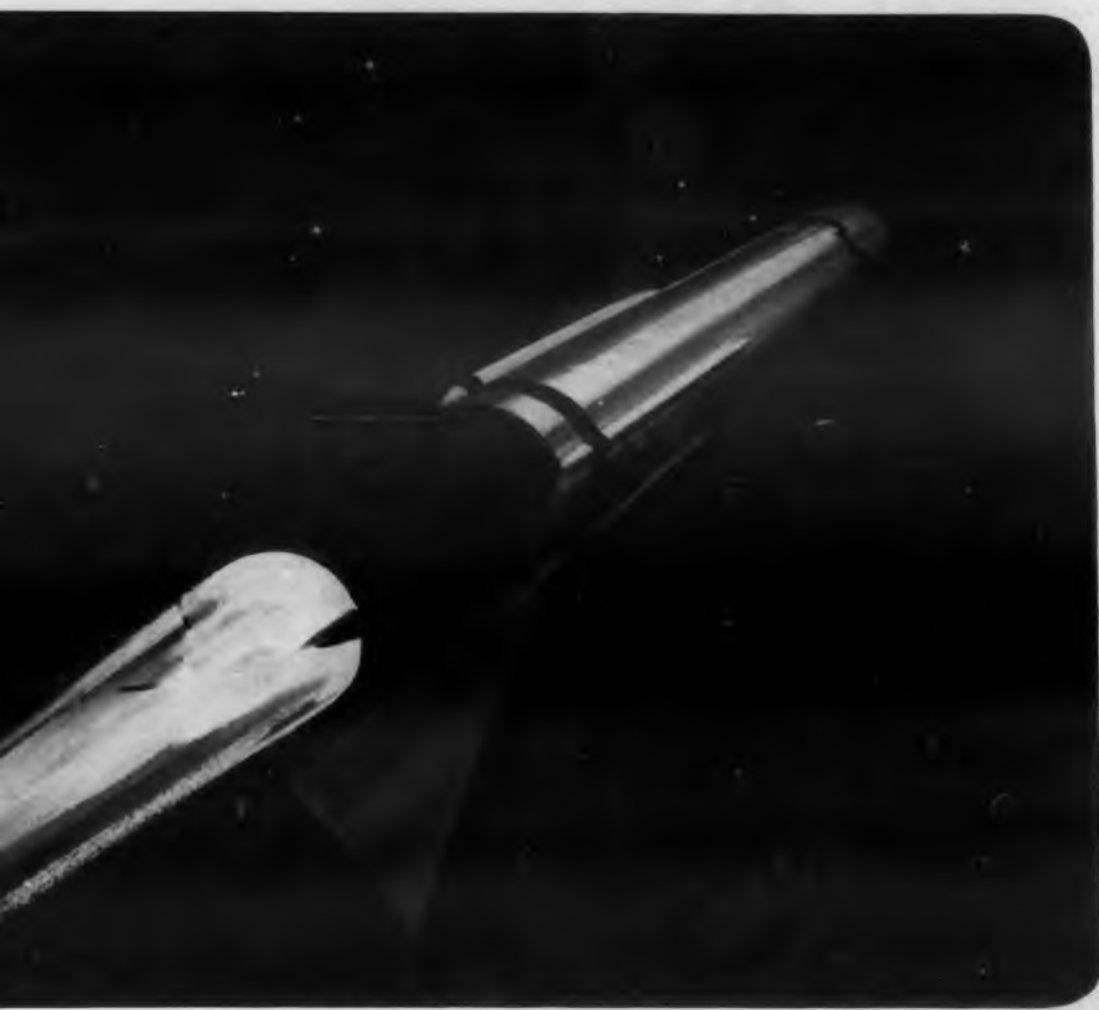
The Jet Propulsion Laboratory is a stable research and development center located north of Pasadena in the foothills of the San Gabriel mountains. Covering an 80 acre area and employing 1700 people, it is close to attractive residential areas.

The Laboratory is staffed by the California Institute of Technology and develops its many projects in basic research under contract with the U.S. Government.

Opportunities open to qualified engineers of U.S. citizenship. Inquiries now invited.

**JOB OPPORTUNITIES
IN THESE FIELDS NOW**





Weapons Systems Responsibility

In the development of guided missile systems, the Jet Propulsion Laboratory maintains a complete and broad responsibility. From the earliest conception to production engineering—from research and development in electronics, guidance, aerodynamics, structures and propulsion, through field testing problems and actual troop use, full technical responsibility rests with JPL engineers and scientists.

The Laboratory is not only responsible for the missile system itself, including guidance, propulsion and airframe, but for all ground handling equipment necessary to insure a complete tactical weapons system.

One outstanding product of this type of systems responsibility is the "Corporal," a highly accurate surface-to-surface ballistic missile. This weapon, developed by JPL, and now in production elsewhere, can be found "on active service" wherever needed in the American defense pattern.

A prime attraction for scientists and engineers at JPL is the exceptional opportunity provided for original research afforded by close integration with vital and forward-looking programs. The Laboratory now has important positions open for qualified applicants for such interesting and challenging activities.

ELECTRONICS • PHYSICS • SYSTEMS ANALYSIS
COMPUTER DEVELOPMENT • INSTRUMENTATION
TELEMETERING AND MECHANICAL ENGINEERING

JET PROPULSION LABORATORY

A DIVISION OF CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA • CALIFORNIA

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Electrical Engineer for Digital Computers

The Electronics Division of Curtiss-Wright Corporation has an opening in New Jersey for MS or Ph.D in EE for study and analysis of the applications of digital computer techniques to current and future equipment used in flight simulation. He will be responsible for the analysis, application, design and development of circuits, systems and equipment with initial emphasis on simulation of aircraft radio and navigational aids. To the right man this position will lead to supervisory responsibility for the digital computer program. Consequently, this presents an excellent opportunity for growth. High starting salary with unusual employee-benefits program. Write in complete confidence to:

R. G. CONRAD
MGR. ENGINEERING RECRUITMENT, DEPT. ET-4
CURTISS-WRIGHT CORPORATION, WOOD-RIDGE, N.J.



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Opportunities in Design & Engineering for

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ELECTRICAL ENGINEERS
PROJECT or SYSTEMS ENGINEERS
ELECTRONIC ENGINEERS
FIELD ENGINEERS

Kollsman's expansion in the airborne equipment field has created openings for additional engineers and electromechanical designers, and offers unusual scope to alert, capable and enthusiastic professional men. For engineers, a degree in Mechanical Engineering, Electronic Engineering or Physics is necessary, plus experience or a strong interest in airborne instrumentation or allied fields.

The congeniality at Kollsman, plus the modern facilities and top professional men provide an atmosphere conducive to creative effort and achievement. Here are designed America's finest aircraft instruments.

Please submit resume to
T. A. De Luca.

Confidential interviews arranged.



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"DIFFERENT"
DESIGN
ENGINEER who will accept
a challenge

. . . to do pioneering work in the design of airborne communications equipment at the G-E Light Military Electronic Equipment Department. We need a man who can work with little supervision and come up with some original concepts which he will follow through to production. Aircraft receivers and transmitters are the principal products to be developed, but the experience gained will be broad, as this field is expanding rapidly.

Three to five years' background in the design of this equipment is required. M.S., E.E. preferred.

Please reply in confidence to—
Mr. John Sternberg, Room 969

Light Military Electronic Equipment Dept.

GENERAL ELECTRIC

French Road, Utica, N. Y.

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ENGINEERS
advances in military electronics
TODAY
pave the way for commercial developments
TOMORROW
at Otis' electronic division

The full resources of the century-old Otis Elevator Company are available for expansion of its new Electronic Division. And engineers who join this division now will have the satisfaction of working in the forefront of the military electronics field . . . with the realization that its potentialities in commercial development will also be explored by Otis . . . that this is a long-range program in which Otis will spare no effort in broadening the position of its Electronic Division as a leader in this important field of industry.

Current prime contracts are on basic development work in the most advanced areas of bombing navigation systems, radar systems and missile launching test equipment.

Engineering know-how is required in servo-mechanisms, analog computers, pulse and sweep generators and in the field of microwaves.

If you are interested in a high level career in electronics . . . with promotions waiting to be earned . . . send your resume now to William B. DeFrancis. All inquiries in strict confidence.

Electronic Division
OTIS ELEVATOR COMPANY
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CIRCLE 565 ON READER-SERVICE CARD FOR MORE INFORMATION

ENGINEERS DO ENGINEERING WORK AT ELECTRIC BOAT

At Electric Boat an engineer does the work for which he was professionally trained.

He might be working on intricate packaging problems in submarine design, or on radiation shielding in nuclear propulsion—but whatever he works on, he does *engineering* work.

For at Electric Boat the engineer finds himself backed up by a staff of specialists and technicians—designers and draftsmen and metalsmiths, mathematicians and computer specialists, literature searchers and librarians—each as skilled in his particular field as the engineer is in his own.

This is one reason why engineers come to Electric Boat—to do *engineering* work on varied, non-routine problems. And engineers with BS, MS and PhD degrees, and with 0-10 years' experience, will find that they can take professional pride working in:

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There are other reasons why engineers enjoy working at Electric Boat, of course. Salaries are highly competitive; insurance, hospitalization, and retirement plans are among the best in the industry.

And the location on the Connecticut shore provides a relaxed way of life, with hunting, fishing, sailing, skiing—all manner of recreational activities for the entire family.

But come and see it with your own eyes. For an interview send a resume in full confidence to Mr. James P. O'Brien, Technical Employment Supervisor.

ELECTRIC BOAT DIVISION
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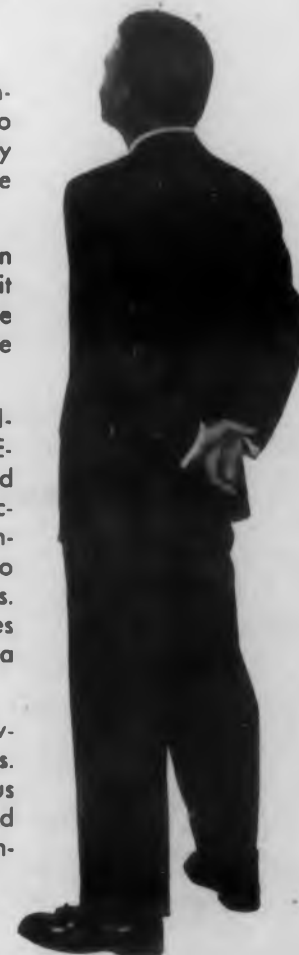
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Elmira, N. Y.

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Tubes



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By a sustained program of research, Eastern continuously extends the uses of the latest units in electronic tube cooling, pressurizing electronic equipment, and pumping fuels and hydraulic fluids. Research and testing laboratories, a model shop, and three manufacturing plants provide the specialized equipment and manpower to turn out fully qualified units to meet appropriate government specifications.

From our extensive line of existing units, adaptations of these units, or completely new designs, Eastern can provide equipment to handle your project well. Your inquiry is welcomed.



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Eastern Cooling Units provide coolant liquid for maintaining within safe operating temperature limits liquid cooled electronic tubes or similar devices. The units are completely self-contained and usually comprise such components as heat exchangers, fans or blowers, liquid pumps, reservoirs, flow switch, thermostat, etc. Cooling units can be modified as required for varying conditions encountered in land or sea as well as aircraft service. Almost all units are designed to meet such specification as MIL-E-9400 and MIL-E-9272.

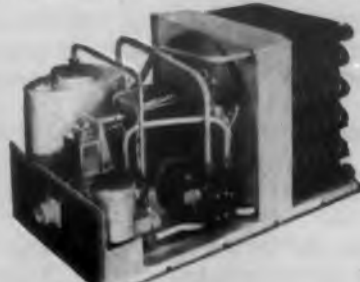
The units shown below are intended only to illustrate the varying requirements which can be satisfied. By utilizing fairly standard components and designs based on broad experience in this field, Eastern is able to provide at minimum cost equipment exactly suiting a specific requirement.

Eastern welcomes your consultation on liquid cooling problems ranging from 200 to 20,000 watts dissipation.

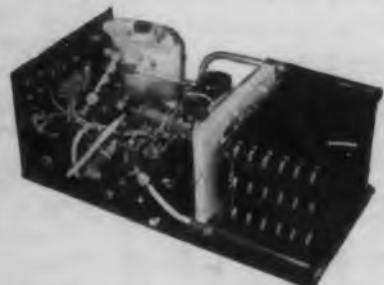
Write for Aviation Products Bulletin 330



MODEL MB-175, TYPE 200 DISSIPATION: 2,000 watts. **ALTITUDE RANGE:** sea level to 50,000 feet. **POWER REQUIRED:** 28 volts D.C. **WEIGHT:** 25 pounds. **SIZE:** 10" x 15-15/16" x 10 3/4" high.



MODEL E/HT-203, TYPE 200A DISSIPATION: 1600 watts. **ALTITUDE RANGE:** sea level to 5,000 feet. **POWER REQUIRED:** 28 volts D.C. **WEIGHT:** 25 pounds. **SIZE:** 10" x 21" x 10" high.



MODEL MB-177, TYPE 202 DISSIPATION: 1700 watts. **ALTITUDE RANGE:** sea level to 50,000 feet. **POWER REQUIRED:** 110 volt, 400 cycle, 3 phase. **WEIGHT:** 27 pounds. **SIZE:** 10" x 19 13/32" x 7 1/4" high, per JAN-C-1720A, size B1-D1.



MODEL E/HT-210, TYPE 200 DISSIPATION: 1500 watts. **ALTITUDE RANGE:** sea level to 10,000 feet. **POWER REQUIRED:** 208 volts, 400 cycle, 3 phase. **WEIGHT:** 35 pounds. **SIZE:** 11 1/4" x 19 1/2" x 12 1/2" high.



MODEL E/HT-200, TYPE 201 DISSIPATION: 1,000 watts. **ALTITUDE RANGE:** sea level to 50,000 feet. **POWER REQUIRED:** 28 volts D.C. **WEIGHT:** 14 1/2 pounds. **SIZE:** 10" x 10" x 6" high.



MODEL NO. 5-A DISSIPATION: 1,000 watts. **ALTITUDE RANGE:** sea level to 5,000 feet. **POWER REQUIRED:** 100 to 110 volts D.C. **WEIGHT:** 10 pounds. **SIZE:** 7 1/4" x 13 1/2" x 9-1/16" high.

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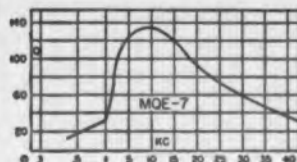
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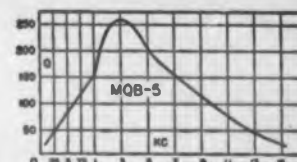
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MQ Series Compact Hermetic Toroid Inductors

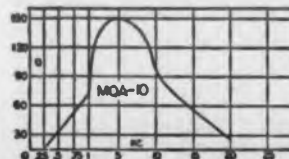
The MQ permalloy dust toroids combine the highest Q in their class with minimum size. Stability is excellent under varying voltage, temperature, frequency and vibration conditions. High permeability case plus uniform winding affords shielding of approximately 80 db.



MQE
15 stock values
from 7 Mhy.
to 2.8 Hy.



MQB
19 stock values
from 7 Mhy.
to 22 Hy.



MQB
12 stock values
from 10 Mhy.
to 25 Hy.



VIC case structure
Length Width Height
1-1/4 1-11/32 1-7/16



Type	Mean Hys.	Type	Mean Hys.
VIC-1	.0085	VIC-12	1.3
VIC-2	.013	VIC-13	2.2
VIC-3	.021	VIC-14	3.4
VIC-4	.034	VIC-15	5.4
VIC-5	.053	VIC-16	8.5
VIC-6	.084	VIC-17	13.
VIC-7	.13	VIC-18	21.
VIC-8	.21	VIC-19	33.
VIC-9	.34	VIC-20	52.
VIC-10	.54	VIC-21	83.
VIC-11	.85	VIC-22	130.

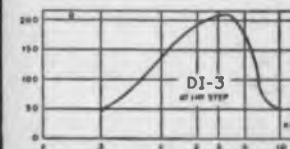


VIC Variable Inductors

The VIC Inductors have represented an ideal solution to the problem of tuned audio circuits. A set screw in the side of the case permits adjustment of inductance from +85% to -40% of the mean value. Setting positive. Curves shown indicate effect of Q and L with varying frequency and applied AC voltage.

DI Inductance Decades

These decades set new standards of Q, stability, frequency range and convenience. Inductance values laboratory adjusted to better than 1%. Units housed in a compact die cast case with sloping panel ideal for laboratory use.



DI-1 Ten 10 Mhy. steps.
DI-2 Ten 100 Mhy. steps.
DI-3 Ten 1 Hy. steps.
DI-4 Ten 10 Hy. steps.



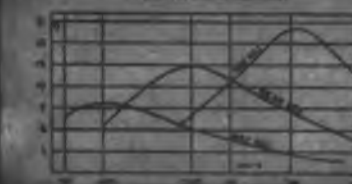
DI DECADE
Length 4 1/2
Width 4 3/8
Height 2 3/8

HVC Hermetic Variable Inductors

A step forward from our long established VIC series. Hermetically sealed to MIL-T-27... extremely compact... wider inductance range... higher Q... lower and higher frequencies... superior voltage and temperature stability.



Type	Mean Hys.	Type	Mean Hys.
HVC-1	.002	HVC-6	.8
HVC-2	.005	HVC-7	1.5
HVC-3	.011	HVC-8	3.0
HVC-4	.02	HVC-9	6.0
HVC-5	.07	HVC-10	10
HVC-6	.2	HVC-11	20
HVC-7	.5	HVC-12	50
HVC-8	1.1		
HVC-9	2.0		
HVC-10	7.0		
HVC-11	20		
HVC-12	50		



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RCA-5691—High-Mu Twin Triode. Similar to RCA-6SL7-GT, but has twice the heater current.

RCA-5692—Medium-Mu Twin Triode. Similar to RCA-6SN7-GT.

RCA-5693—Sharp-Cutoff Pentode. Similar to RCA-6SJ7.

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