ELECTRO
DES

B 650831

NIC IGN

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 Volt	Filament #1 Amp.	Filament #2 Volt	Filament #2 Amp.	MIL Case Size
MGP1	400/200	√	185	.070	6.3/5	2	6.3	3	HA
MGP2	650	√	260	.070	6.3/5	2	6.3	4	JB
MGP3	650	√	245	.150	6.3	5	5.0	3	KB
MGP4	800	√	318	.175	5.0	3	6.3	8	LB
MGP5	900	√	345	.250	5.0	3	6.3	8	MB
MGP6	700	√	255	.250					KB
MGP7	1100	√	419	.250					LB
MGP8	1600	√	640	.250					NB

FILAMENT TRANSFORMERS-STANDARD
All primaries 105, 115, 125 v., 60 c.p.s.

Cat. No.	Secondary Volt	Secondary Amp	Test VRMS	MIL Case
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 Osc.	Int. Coupl'g	Low. Pwr. Out.	Pulse Voltage Kilovolts	Pulse Duration Microseconds	Duty Rate	No. of Wdgs.	Test Volt. KVRMS	Char. Imp. Ohms
MPT1	√	√		0.25/0.25/0.25	0.2-1.0	.004	3	0.7	250
MPT2	√	√		0.25/0.25	0.2-1.0	.004	2	0.7	250
MPT3	√	√		0.5/0.5/0.5	0.2-1.5	.002	3	1.0	250
MPT4	√	√		0.5/0.5	0.2-1.5	.002	2	1.0	250
MPT5	√	√		0.5/0.5/0.5	0.5-2.0	.002	3	1.0	500
MPT6	√	√		0.5/0.5	0.5-2.0	.002	2	1.0	500
MPT7	√	√	√	0.7/0.7/0.7	0.5-1.5	.002	3	1.5	200
MPT8	√	√	√	0.7/0.7	0.5-1.5	.002	2	1.5	200
MPT9	√	√	√	1.0/1.0/1.0	0.7-3.5	.002	3	2.0	200
MPT10	√	√	√	1.0/1.0	0.7-3.5	.002	2	2.0	200
MPT11	√	√	√	1.0/1.0/1.0	1.0-5.0	.002	3	2.0	500
MPT12	√	√	√	0.15/0.15/0.3/0.3	0.2-1.0	.004	4	0.7	700

AUDIO TRANSFORMERS
Freqs. resp. 300 to 10000 cps ± 2 DB. All Case Sizes AB

Catalog No.	Application	Impedance Pri. Ohms	Impedance Pri. Ct.	Impedance Sec. Ohms	Impedance Sec. Ct.	DC Current Prim. P. Side MA	DC Current Max. Unbal. MA	Min. Level DBM
MGA1	Single or P.P. Plates — to Single or P.P. Grids	10K	√	90K Split	√	10	10	+15
MGA2	Line to Voice Coil	600 Split		4, 8, 16		0	0	+33
MGA3	Line to Single or P.P. Grids	600 Split		135K	√	0	0	+15
MGA4	Line to Line	600 Split		600 Split		0	0	+15
MGA5	Single Plate to Line	2.6K 4.8T		600 Split		40	40	+33
MGA6	Single Plate to Voice Coil	7.0K 4.8T		4, 8, 16		40	40	+33
MGA7	Single or P.P. Plates to Line	15K	√	600 Split		10	10	+33
MGA8	P.P. Plates to Line	24K	√	600 Split		10	1	+30
MGA9	P.P. Plates to Line	60K	√	600 Split		10	1	+27

TELEMETERING COMPONENTS

BAND PASS FILTERS

Catalog No. Z_o = 500 Ω	Catalog No. Z_o = 2,500 Ω	3DB Bandwidth per cent of F_o ± ¾	3DB Bandwidth per cent of F_o ± 1½	Center Frequency F_o (KC)
FBP-10	FBP-34	√		4
FBP-11	FBP-35	√		5.6
FBP-12	FBP-36	√		7.3
FBP-13	FBP-37	√		9.6
FBP-14	FBP-38	√		13
FBP-15	FBP-39	√		17
FBP-16	FBP-40	√		23
FBP-17	FBP-41	√		30
FBP-18	FBP-42	√		39
FBP-19	FBP-43	√		54
FBP-20	FBP-44	√		73.5
FBP-21	FBP-45	√		105
FBP-22	FBP-46	√		123
FBP-23	FBP-47	√		145
FBP-24	FBP-48	√		220
FBP-25	FBP-49		√	220
FBP-26	FBP-50	√		300
FBP-27	FBP-51		√	300
FBP-28	FBP-52	√		400
FBP-29	FBP-53		√	400
FBP-30	FBP-54	√		525
FBP-31	FBP-55		√	525
FBP-32	FBP-56	√		700
FBP-33	FBP-57		√	700

DISCRIMINATORS

Per cent Deviation of F_o ± ½	Per cent Deviation of F_o ± 1.5	Per cent Linearity 0.5	Per cent Linearity 1.0	Catalog No.
√		√		DST-10
√		√		DST-11
√		√		DST-12
√		√		DST-13
√		√		DST-14
√		√		DST-15
√		√		DST-16
√		√		DST-17
√		√		DST-18
√		√		DST-19
√		√		DST-20
√		√		DST-21
√		√		DST-22
√		√		DST-23
√		√		DST-24
	√		√	DST-29
√		√		DST-25
	√		√	DST-30
√		√		DST-26
	√		√	DST-31
√		√		DST-27
	√		√	DST-32
√		√		DST-28
	√		√	DST-33

DISCRIMINATOR LOW PASS FILTERS

Catalog No.	Center Frequency F_o (cps)	Catalog No.	Center Frequency F_o (cps)	Catalog No.	Center Frequency F_o (cps)	Attenuation
OUTPUT						
LPO-10	6	LPO-19	81	LPO-28	790	3 DB to 0.5 F_o; 7 DB to 1 F_o; 20 DB to 2 F_o; 30 DB from 2.5 F_o
LPO-11	8	LPO-20	110	LPO-29	900	
LPO-12	11	LPO-21	160	LPO-30	1,030	
LPO-13	14	LPO-22	185	LPO-31	1,280	
LPO-14	20	LPO-23	220	LPO-32	1,680	
LPO-15	25	LPO-24	330	LPO-33	2,100	
LPO-16	33	LPO-25	450	LPO-34	7,200	
LPO-17	45	LPO-26	600	LPO-35	10,000	
LPO-18	60	LPO-27	660			
Characteristic impedance of all = 330Ω						
INPUT						
LPI-10	400	LPI-17	3,000	LPI-23	14,500	.05 DB at 9½% F_o; 30 DB at third Harmonics; 50 DB at fifth Harmonics
LPI-11	560	LPI-18	3,900	LPI-24	22,000	
LPI-12	730	LPI-19	5,400	LPI-25	30,000	
LPI-13	960	LPI-20	7,350	LPI-26	40,000	
LPI-14	1,300	LPI-21	10,500	LPI-27	52,500	
LPI-15	1,700	LPI-22	12,300	LPI-28	70,000	
LPI-16	2,300					
Characteristic impedance of LPI-10 thru 23 = 30,000Ω; of LPI-24 thru 28 = 5,100Ω						

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

MINIATURE AUDIO TRANSFORMERS

Catalog No.	Input	Coupling	Power Level DBM	Balanced DC Current MA	Unbalanced DC Current MA	Impedance Ohms pri.	Impedance Ohms 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	50/200/500
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 ± 2 DB 30 to 20,000~; PMA 5 and 7 ± 2 DB 200 to 10,000~. Case size 15/16"D x 1½" high, flanges 1⅓" long.

TRANSISTOR TRANSFORMERS

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

Case size 1"D x 1.5" high, flanges 1⅜". 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
to 15 KC		10 to 50 KC		30 to 75 KC		50 to 200 KC	
F2050	1	F2100	0.1	F2140	0.1	F2180	0.1
F2051	3	F2101	0.2	F2141	0.2	F2181	0.2
F2052	5	F2102	0.3	F2142	0.3	F2182	0.3
F2053	10	F2103	0.4	F2143	0.4	F2183	0.4
F2054	15	F2104	0.5	F2144	0.5	F2184	0.5
F2055	30	F2105	1.0	F2145	1.0	F2185	0.6
F2056	50	F2106	2.0	F2146	2.0	F2186	0.7
F2057	75	F2107	3.0	F2147	3.0	F2187	0.8
F2058	100	F2108	4.0	F2148	4.0	F2188	0.9
F2059	150	F2109	5.0	F2149	5.0	F2189	1.
F2060	200	F2110	7.5	F2150	7.5	F2190	2.
F2061	300	F2111	10.	F2151	10.	F2191	3.
F2062	400	F2112	15	F2152	15.	F2192	4.
F2063	500	F2113	20.	F2153	20.	F2193	5.
F2064	750	F2114	30.	F2154	30.		
F2065	1,000	F2115	50	F2155	50.		
F2066	1,250	F2116	75.	F2156	75.		
F2067	1,500	F2117	100.	F2157	100.		
F2068	1,750						
F2069	2,000						

Case size: ¾"x11/32"x25/32h.

Encapsulated 1"dx⅞"h. When ordering hermetically sealed units add H, encapsulated units MR to Cat. No.

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

FREED TRANSFORMER CO., INC.
1727 WEIRFIELD ST., BROOKLYN (RIDGEWOOD) 27, NEW YORK

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ELECTRONIC DESIGN

Contents

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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 elements, 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 antiaircraft 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

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 workhorse 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.

Engineering Review

Electronic Phone Exchange

A fully electronic automatic telephone switchboard has been developed for the French Navy by the Laboratorie 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.

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.

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 220 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, the Tungsten and Chemical Division of 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 this voltage, a signal is generated which can regulate the supply of air to suit the patient's need.

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

ngineering Review

ountains Aid Uhf Transmission

A phenomenon noticed by American is's in the mountainous terrain of ce rea was recently re-investigated by d- group of radio engineers. Known as ay bstacle gain," the effect is that of m accountably improved radio recep- ni n when a mountain obstructs the ne h of transmission.

in A series of tests conducted at differ- en locations in California verified that rp mountain peaks blocking the 00 nsmission path actually strengthen 22 signal by as much as 100 million ail es. These tests utilized a wide mo ge of frequencies above 50 mcs. nc theory was advanced that these ve es act much like light waves, and are bent down toward the ground pp n they pass over sharp mountain su ges, just as light waves are dif- sup ted when passing by the edge of righ paque object.

tical of Computer Advantages

esent day electronic equipment data processing is not suited to the 9, th s of all but a few giant retail or- n izations and many of these are pr tical of the vaunted advantages, allo rding to Milton Woll, Research cate ctor of the Retail Research Insti- ov of National Retail Dry Goods use c.

bo the basis of a study of data ssing equipment of member s of the NRDGA, Mr. Woll ictim ted out that most retailers were lun yet using mechanical tabulating whi pment let alone electronic. Al- espir gh there is a great interest among ases lers in all parts of the country in h co development of automatic data ontra ssing equipment, most store man- ontra ents feel that the cost of the e whi pment available is much too high ctro tify its installation.

ing th . Woll was critical also of the whi liose approach to electronic ap- to s tions and indicated his preference gradual and experimental type still proach. He expressed conviction Nation the step-by-step licking of one Paraly m after another is the only way to po ke progress in adjusting to the le. ndous procedural rigidity of data ssing.

CARD LE 9 ON READER-SERVICE CARD

E CARD

CIRCLE 10 ON READER-SERVICE CARD ➤

Engineering Review

Mathematical Handbook

The National Bureau of Standards ha begun preparation of a comprehensiv "Handbook of Mathematical Table In addition to the elementary fun tions, the Handbook will cover almo the entire field of transcendental fun tions. Expected to be ready before t end of 1958, it will appear as a volu of about 1000 pages—750 pages tables, 50 pages of graphs and 2 pages of text.

Numerical tables of mathematic functions are in continual demand scientists and engineers, as shown the success of such works as Jahn and Emde's "Tables of Functions wi Formulae and Graphs." A grea variety of functions and higher ac racy of tabulation are now requir as a result of scientific advances a especially, of the increasing use automatic computers. In the lat connection, the tables serve mai for preliminary surveys of proble before programming for machine eration.

The project is supported by National Science Foundation, and being carried out by the Bure computation laboratory and numer analysis group. Correspond should be addressed to Dr. M. Abr owitz, National Bureau of Standa Washington 25, D.C.

Reliability Conference

The emphasis on reliability was tinued with increasing fervor at 27th USAF-Aircraft Industry Sa Conference held a few weeks ag Santa Barbara, Calif. The failure multi-million dollar missile becaus a faulty 50-cent part, especially w that missile might be carrying atomic warhead, was the perspe on reliability taken at the confer

Within the last seven years, r bility has come to the forefront a of the hottest subjects within the Force and the aircraft industry. three-day conference served to cate the aircraft and electronic in tries as to what they might expe

◀ CIRCLE 11 ON READER-SERVICE CARD

bility stipulations in future con-
cts, such as:

- Cradle-to-grave responsibility for
bility of a product.
- Exhaustive testing-to-failure of
velopmental models.
- Exhaustive testing of initial pro-
tion models and healthy samplings
reafter.
- An accurate determination of
an time to failure, and perhaps a
rantee of this lifetime for parts,
ponents and systems.

man's Voice for Lost Pilots

tuning in a VHF receiver to 124.6
a pilot approaching Teterboro
port, N.J., can pick up his compass
dings in the feminine tones of a
rded woman's voice. Called the
king beacon," the equipment was
ently demonstrated by Air Asso-
es, Inc., of Teterboro.
pecifically designed for planes not
ipped to pick up and read coded
cons, the system allows a pilot to
r two or three compass headings
5-sec intervals. When two of these
dings are equally audible he will
w he is halfway between two
ms. The louder one sounds, the
rer he is to that beam. Thus, when
a single beam, he will hear one
ding loud and clear, and two
rs will come in faintly.

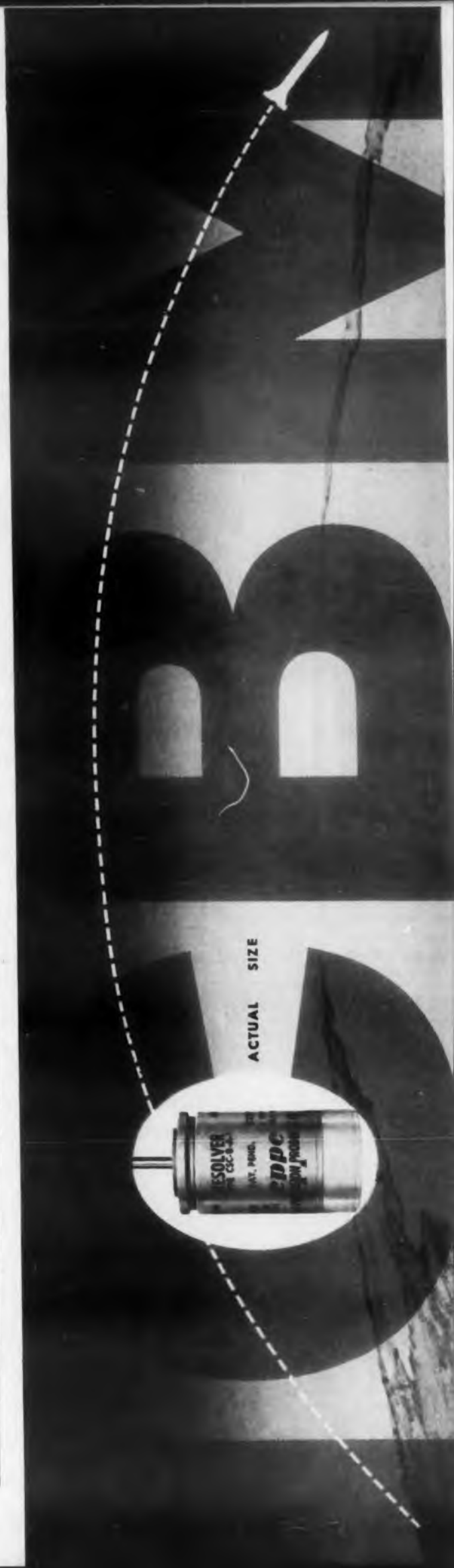
itary Expenditures Increase

imated Department of Defense
itary electronics expenditures in
or categories of military functions
eased substantially during the sec-
quarter of fiscal year 1957 over
first quarter. According to a
TMA compilation issued recently,
l expenditures in the first half of
fiscal year 1957 exceed $1.53 bil-

ircraft electronics expenditure in-
sed from $213 million during the
quarter to $566 million in the sec-
quarter. Other significant in-
es over the same period were in
munications and guided missiles.
munications showed an increased
nditure of $263 million over $130
on in the first quarter, and guided
les showed an increase of $216
on over $205 million.

CARD

CIRCLE 12 ON READER-SERVICE CARD ➤



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

for

HIGHEST ACCURACY

		ROTOR AS PRIMARY						STATOR AS PRIMARY						D.C. RESISTANCE		IMPEDANCE				
SYNCHRO FUNCTION	CPPC TYPE	Input Voltage (400 ~)	Input Current (Amps.)	Input Power (Watts)	Output Voltage (Volts)	Sensitivity (MV/deg.)	Phase Shift (deg. lead)	Input Voltage (400 ~)	Input Current (Amps.)	Input Power (Watts)	Output Voltage (Volts)	Sensitivity (MV/deg.)	Phase Shift (deg. lead)	Rotor (Ohms)	Stator (Ohms)	Zro (Ohms)	Zso (Ohms)	Zrs (Ohms)	Max. Null Voltage (MV)	Max. Error (Min.)
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 **cppc**

CLIFTON PRECISION PRODUCTS CO. INC. Clifton Heights, Pa.

Engineering Review

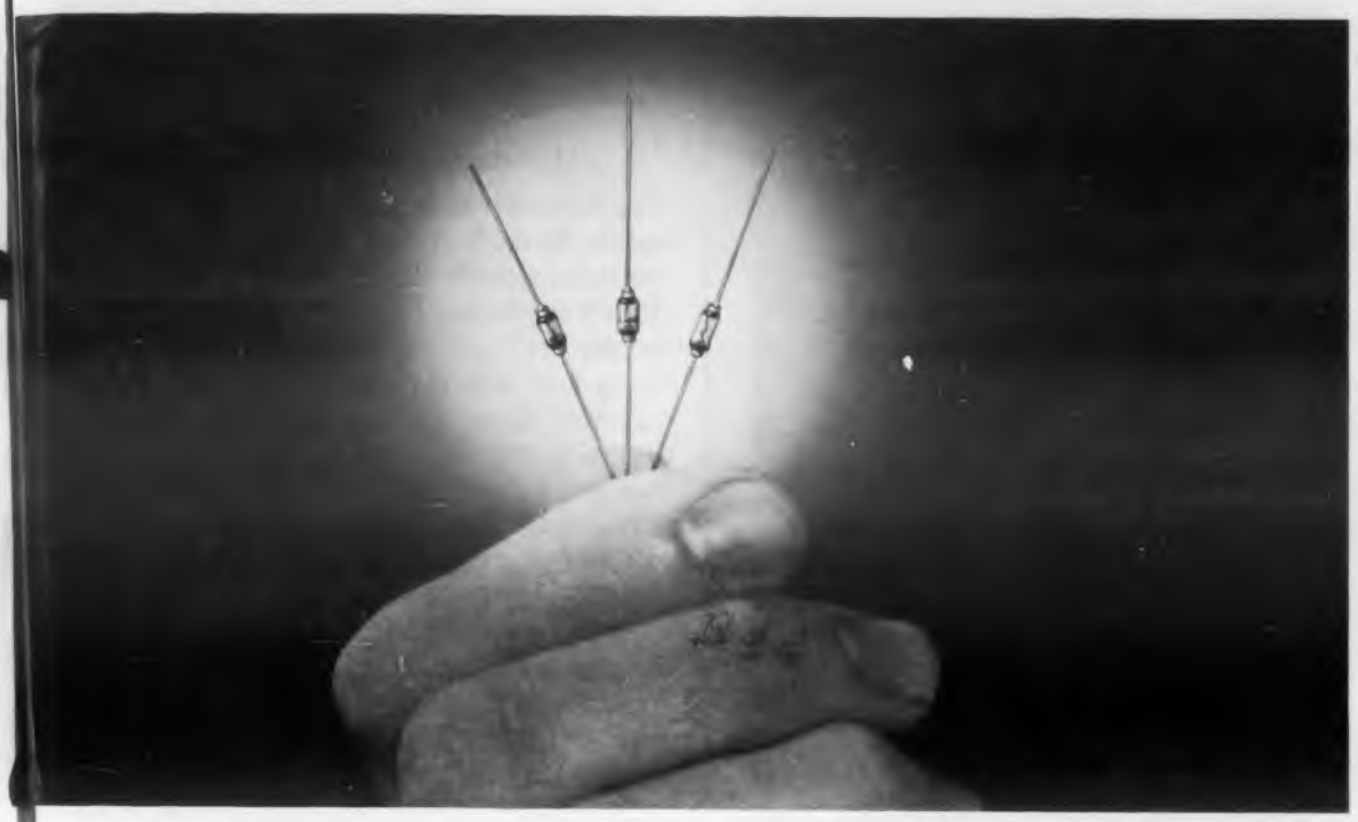
Global Noise Recorders

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.



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 u sec (Note 3)	Stability
IN67A	4 ma	50 ua @ −50 volts 5 ua @ −5 volts	100 volts				
IN90	5 ma	750 ua @ −50 volts	75 volts				
IN98	20 ma	100 ua @ −50 v 8 ua @ −5 v	100 v				
IN126	5 ma	850 ua @ −50 v 50 ua @ −10 v	75 volts				
IN127	3 ma	300 ua @ −50 v 25 ua @ −10 v	125 volts				
IN128	3 ma	10 ua @ −10 v	50 volts				
IN191	5 ma	Note 1	Note 1				
IN198	4 ma (5 ma @ 75° C)	50 ua @ −50 v (Note 2) 10 ua @ −10 v	100 volts				
IN631				3.5 v (Note 4)	500 kohms (Note 5)	500 ua	Note 7
IN632				1 V If = 7 ma	500 kohms (Note 5)	800 ua	Note 7
IN633				1 V If = 125 ma	500 kohms (Note 6)	1650 ua	Note 7
IN634	50 ma	45 ua @ −45 v 100 ua @ −100 v	115 volts				
IN635	50 ma	175 ua @ −150 v	165 volts				

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

The reverse recovery time will not exceed 0.5 usec at 700 ua or 3.5 usec at 0.5 ua of current when rapidly switched (at a 60 cycle rate) from +30 ma forward current to −35 volts.

Note 2: For type IN198 at 75° C the maximum reverse current at −50 volts is 250 ua and at −10 volts is 75 ua.

Note 3: a) Forward current exposure = 5 ma. b) Reverse test voltage = 40 ±2 volts. c) DC circuit resistance = 2000 ohms.

Note 4: Peak measurement with half sine wave of 50 ma peak current, 0.1 usec pulse width, and 100 kc pulse repetition frequency.

Note 5: 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 6: Minimum resistance in thousands of ohms when E/I characteristic is swept at 60 cycles from 0 to −100 volts and resistance slope observed between −20 and −90 volts.

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

"Sylvania—synonymous with Semiconductors"

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.

Washington Report

Herbert H. Rosen

Allocations between 25 and 890 Mc:

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

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

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

The current proceeding is companion to the fa finding hearing regarding the allocation of quencies in the bands above 890 Mc (Doc 11866). The latter pertains mainly to aviation Government, fixed point-to-point relay and f common carrier operations, and some broadcast non-broadcast relay.

The commission hopes to:

- Determine whether a more efficient utiliza can be made of these frequencies (25 to 890 M
- Evaluate the long-range requirements of exist and potential users.
- Obtain data as to the feasibility of apply known and potential techniques and methods lating 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 tween the requirements of non-government r services and the space allocated to Governm users.
- Consider long-range plans for the future us the radio spectrum, and in particular, to deter the impact, economic or otherwise, upon users o spectrum and the general public of implemen desirable future changes.
- Assist the Commission in formulating its posi with regard to the preparation of United States posals at the International Radio Conferenc 1959.

he Commission points out that this proceeding ot intended to freeze or otherwise impede other ceedings which have been, or may be, instituted the Commission with respect to specific services l allocations in these bands. Such cases will be lt with on an ad hoc basis.

At the same time, the FCC also warns the elec- ic industries that they had better consult them ore designing equipment for use at certain fre- ncies. Such developments should be aligned h the Commission's Table of Frequency Alloca- s. Better still, more companies should adopt the cy of including an office or individual in their nization primarily responsible for such matters.

Rocketing to the Moon:

cientists from the Martin subsidiary RIAS, Inc. e recently proposed an idea for a recoverable ket carrying an instrument payload out 2000 miles the atmosphere. A preliminary study has indi- d feasibility of sending such a craft into the sky ecord cosmic radiation. Exposed emulsions, on very, would indicate magnitude of the radia- s as well as probably give evidence of other erto undiscovered particles. The Martin three- e IGY vehicle—or a close second cousin—would y the 150-pound payload aloft. The RIAS peo- have calculated that the payload would spend t 40 minutes above the earth. It would attain p speed of about 13,000 miles per hour upon ntering the earth's atmosphere.

stensibly, the disclosure was made at a special ting solely to stimulate thinking in this direc- A special committee of Government, industry, educational scientists has been formed to look her into this idea. They, at least, believe it has icient merit to warrant additional study.

n a still related subject, the Air Force recently ounced that they have given Rocketdyne Di- n of North American a contract to study an rocket. This disclosure falls on top of a paper n by a Rocketdyne engineer on what he calls onic missile. This ion-propelled rocket would be able of "snooping" around the solar system. ce, the name "Project Snooper."

he ionic missile would be almost all wings,— bat-like affairs that radiate heat generated in l. A nuclear reactor, through suitable heat ex- gers and turbines would supply electrical r to an electrostatic field generator and to the tronic test equipment. The electrostatic field ld propel ionized cesium atoms, which would ti ute the small propellant force needed to drive missile in rarified atmospheres. Conventional kets would raise the missile out of the earth's osphere. To all but members of the American ket Society—before which the paper was pre- ed—this sounds like pure science fiction. But so radar not too many years before World War II.

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 Labs, Murray Hill, N.J.

May 13-15: National Aero and Navigational Electronics Conference

Dayton, Ohio. Sponsored by Professional Group on Aeronautical and Navigational Electronics, Dayton Section. For more information, write John E. Wilkinson, 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. 10 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

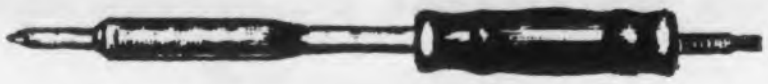
Syracuse, N.Y., Hotel Syracuse. Symposium emphasizes the practical aspects of achieving reliability. Sessions will be held on mechanical design, selection and use of components, proof of mature design and case histories of reliable and unreliable designs. A panel discussion is planned on industry vs. military responsibility on contract and specification control for reliability. Advance registrations will be handled by the RETMA Engineering Office, Rm. 650, 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.

Paper deadlines

Aug. 1: Deadline for papers proposed for the Oct. 31-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., Somerville, N.J. Subject matter should concern developmental techniques and devices, such as electron tubes and transistors, rather than basic research or circuit applications.



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) H_2SO_4. 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.

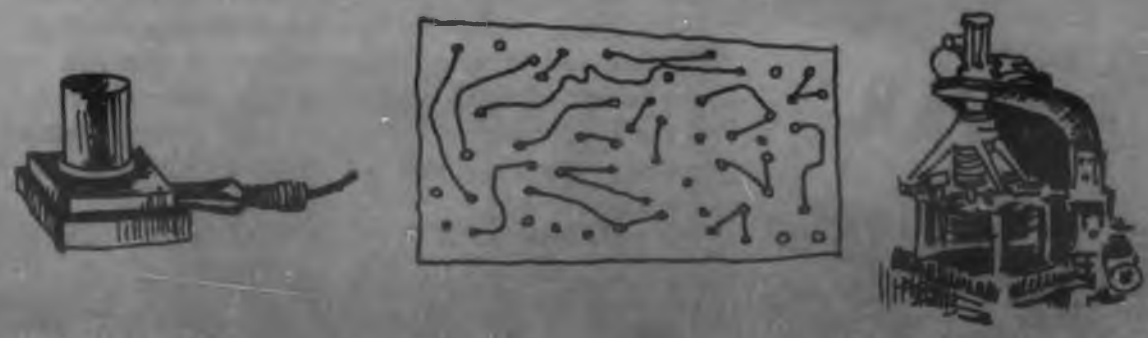
Does prefluxing of copper etched surfaces preserve the solderability of the copper? If so, what fluxes and methods of application are recommended?

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.



ufficient coverage for protection for periods up to ne month.
William L. Lehner, Sylvania Electric Products, Inc.

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

The temperature of a soldering bath used in mechaized soldering is critical with relation to the dwell ime or contact time and the solder alloy used. By inreasing the temperature, shorter dwell time can be btained.
illiam L. Lehner, Sylvania Electric Products, Inc.

The solder temperature is important and should be osely controlled. The temperature of the bath has be high enough to allow the solder to wet the conuctors and leads without reaching the range where e adhesive bond between the conductor and the minate is affected. Adequate wetting of the parts the solder is usually obtained when the solder mperature is approximately 100 F above the liquidus mperature for the particular solder being used. The rmal temperature range is 450 to 550 F when the -lead eutectic solder is used. Immersion time can 2 to 7 sec depending on the mass and thermal conctivity of the parts exposed to the solder and on the mperature of the solder bath. If the surfaces do t wet with solder in 2 to 7 sec, the indication is at they were not properly prepared. Longer immern times usually do not result in significantly imved wetting.
R. White, Bell Telephone Labs., Inc.

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

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 when 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 cored solder preforms?

In my opinion, the best joint is obtained when the solder preform can be placed outside the joint area and the solder allowed to flow into the joint by capillary action. The assembly can be accurately prepositioned 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.

Ralph 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 connection on solid wire or on sizes smaller than No. 16.

Franklin H. Wells, Aircraft-Marine Products.

Is the measurement of contact resistance at 0.1 amp a 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 Formvar 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-

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 run tests under conditions of high humidity and elevated temperature. No corrosive or electrical leakage were 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.

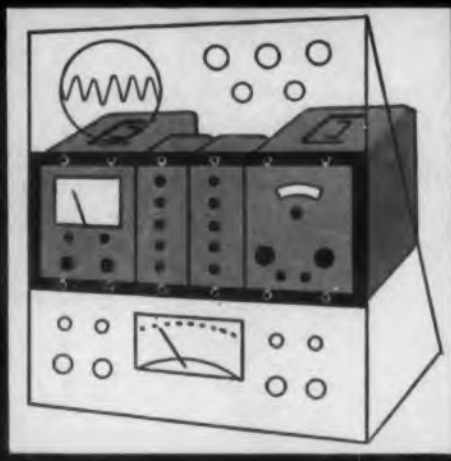
What is the present state of the art in regard to fluxless soldering of terminals? We are primarily concerned with the flux that may be trapped in sealed containers and resultant malfunction.

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.

MODULAR INSTRUMENTS

RACK STACK CARRY



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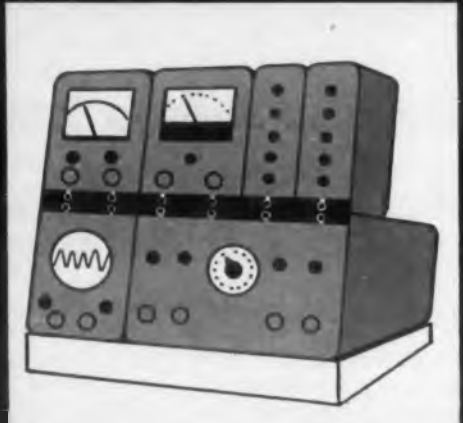

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Adjustable Precision R

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 th

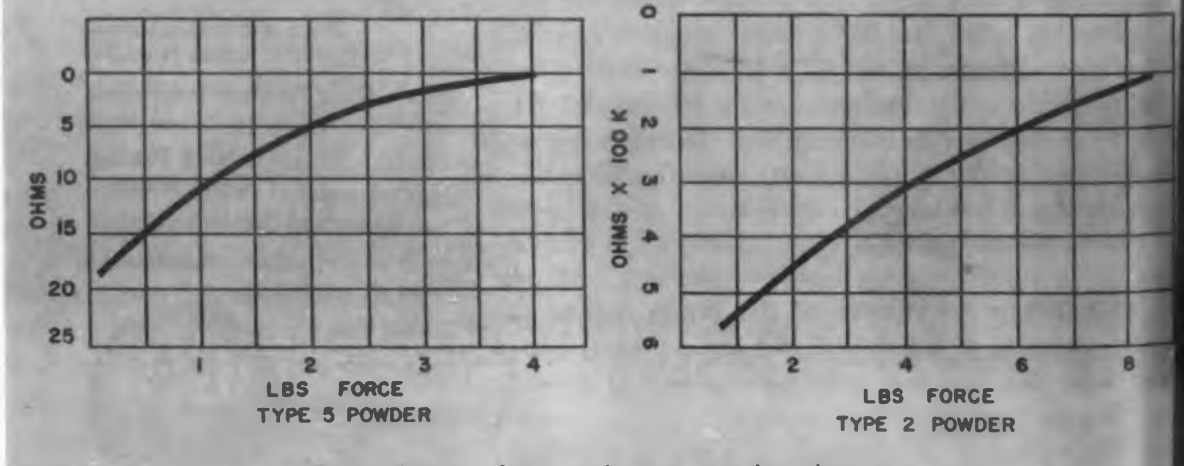


Fig. 1. Curves of two resistance powders show generally what may be expected in the way of resistance vs pressure as 23 C ambient. The curves may be changed due to area of material, and thickness.

n Resistor

esistor 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.

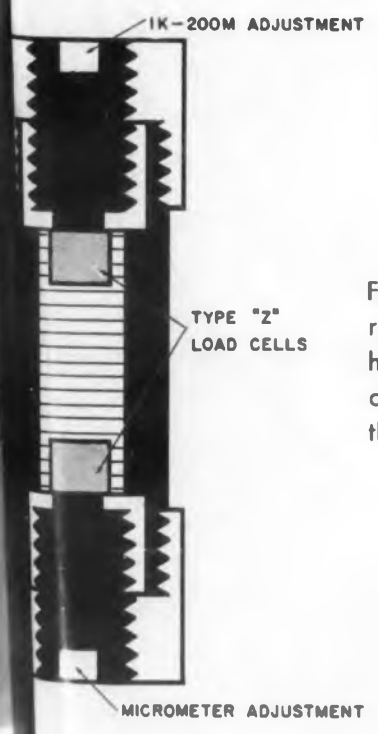


Fig. 2. Resistance is varied by turning socket head screws which change the pressure on the "Z" load cells.

Jamming Figure of Merit for Radar Designers

A. Mandell* and W. G. Madison

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

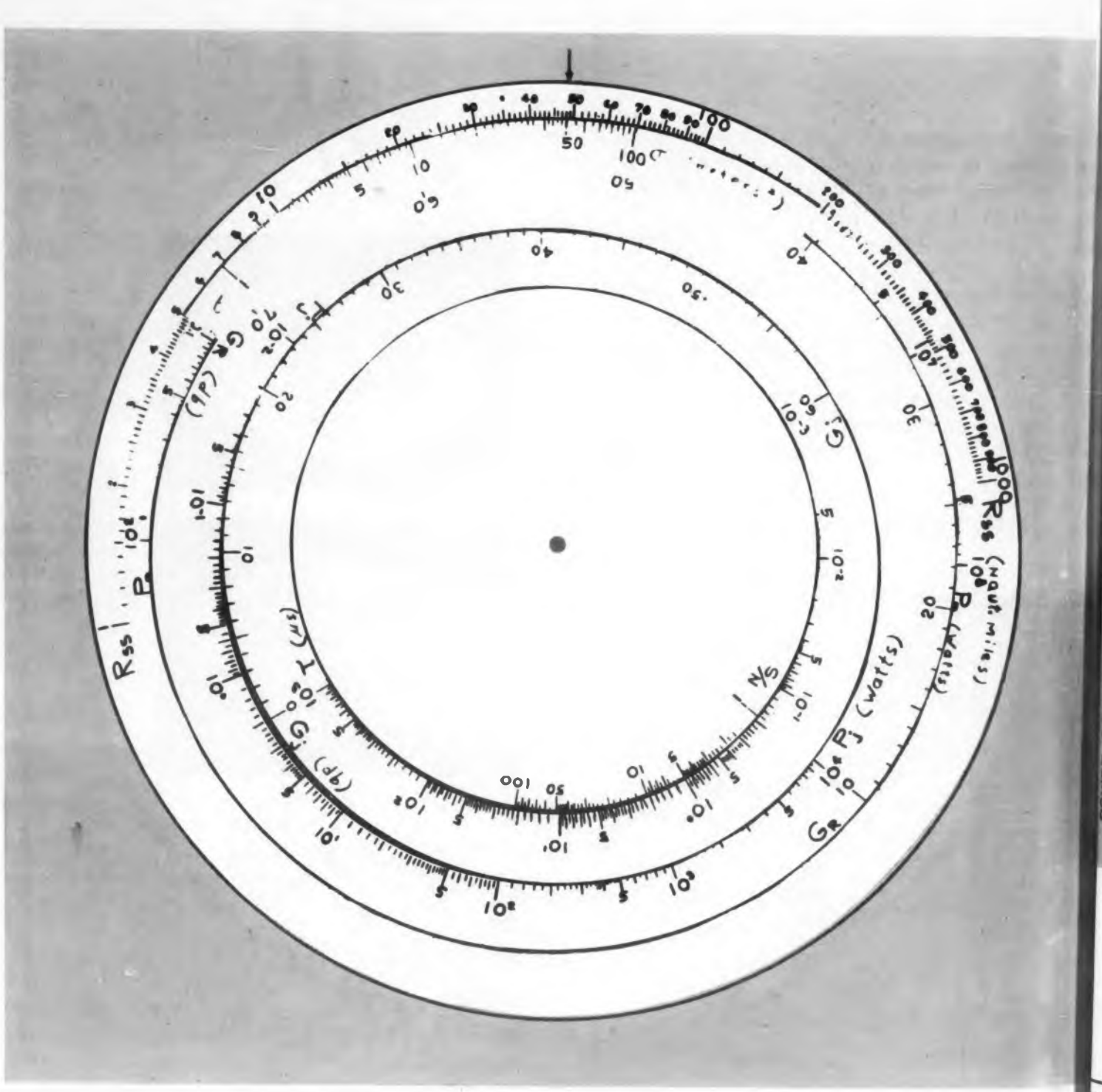
RADAR jamming and electronic countermeasures are almost as old as radar itself. The recent publicity given to the new B-58 Bomber, the Hustler, stresses the number of black box electronic countermeasures systems carried on board for defense against radar equipped fighters or ground radar controlled defensive 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 radar in a hypothetical jamming situation with the following characteristics, we may arrive at a figure of merit:

$P_R = 10^6$ w
$G_R = 43$ db
$P_j = 2$ w/mc
$G_j = 0$ db
$\tau = 1$ μsec
$S/N = 5$
$\sigma = 50$ meters^2

Longhand Solution	Calculator Solution
Convert G_R into a ratio 43 db = 20,00 = 2 x 10^4	Find 10^6 on P_R scale
Multiply $P_R G_R$ 10^6 x (2 x 10^4) = 2 x 10^{10}	Set 43 on G_R scale opposite 10^6 on P_R scale
Convert G_j into a ratio 0 db = 1	Hold previous settings and find 2 on P_j scale
Multiply $P_j G_j$ 2 x 1 = 2	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.

Longhand Solution	Calculator Solution
Generate the quotient $\frac{P_R G_R}{P_J G_J} = \frac{2 \times 10^{10}}{2} = 1 \times 10^{10}$	Hold all previous settings and find 1 on the τ scale
Multiply by $\tau = 1$ μsec $10^{10} \times 1 = 10^{10}$	Set 5 on the S/N scale opposite 1 on the τ scale
Multiply by $\sigma = 50$ m² $10^{10} \times (5 \text{ v } 10^1) = 5 \times 10^{11}$	Find 50 on the σ scale
Generate $4\pi = 12.57$	Find $R_{ss} = 48+$ naut-mi. opposite 50 on the σ scale
Generate $4\pi\ (S/N)$ $12.57 \times 5 = 62.85$	
Form the quotient of steps 7 and 9 $\frac{5 \times 10^{11}}{6.285 \times 10^1} = 7.955 \times 10^9$	
Extract the square root $\sqrt{7.955 \times 10^9} = 8.92 \times 10^4$	
Convert meters to nautical miles $R_{ss} = 48.168$ 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 x 10^6 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.

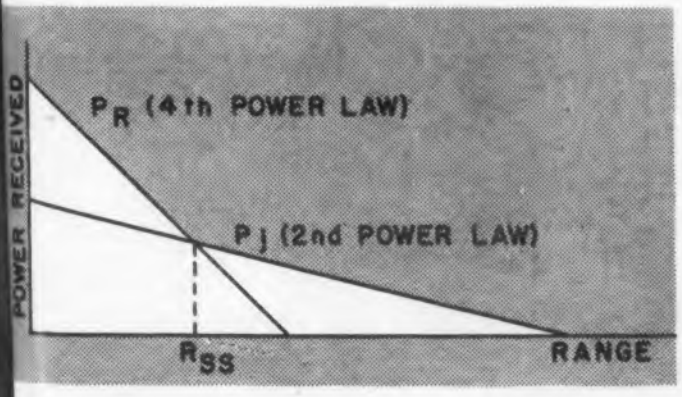


Fig. 1. R_{ss}, the figure of merit in nautical miles, is found at the cross-over point of the radar transmitted power and the jammer transmitted power per mc curves. The ordinate and abscissa are log scales in this illustration.

A. Mandell now at B. M. Harrison Labs., Newton, Mass.

Working Derivation of Merit Figure

A jamming figure of merit can be derived for a radar from the well known radar and beacon equations[1].

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

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

where S_R and S_L 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 (ft²)
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:

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

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}

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

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 scan[2]. For a radar with a large number of hits per scan, say approximately 100, then $S/N \cong 1$. For a radar with hits per scan $\leqq 5$ then $S/N \cong 5$.

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 jammer[3]. 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. Slawsby.
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."

RECOGNIZED ii LEADERSHIP

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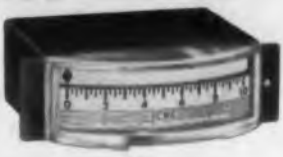

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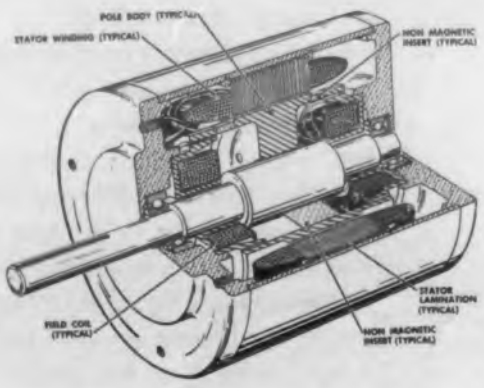
Brushless Alternator



Brushless Alternator has no rotating windings.

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.

Operating Theory

The armature or stator is the conventional type found in ordinary wound synchronous machines. A rotating portion and two duplicate stationary portions made 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.

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.

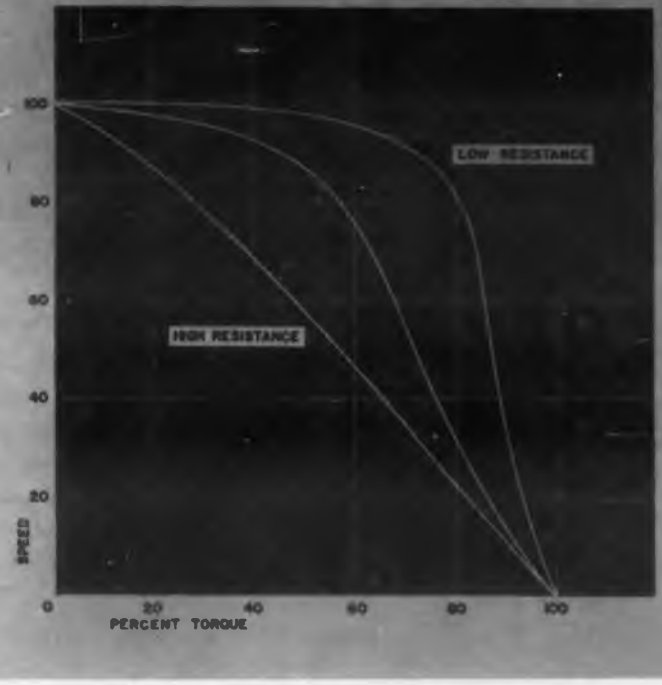


Fig. 2. Speed-Torque characteristics of Brushless Machine operating as induction motor, using rotor resistance as parameter.

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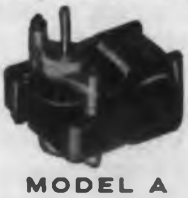
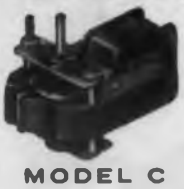


MODEL A
2-pole, shaded pole AC Induction Type



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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 connevtion. 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.

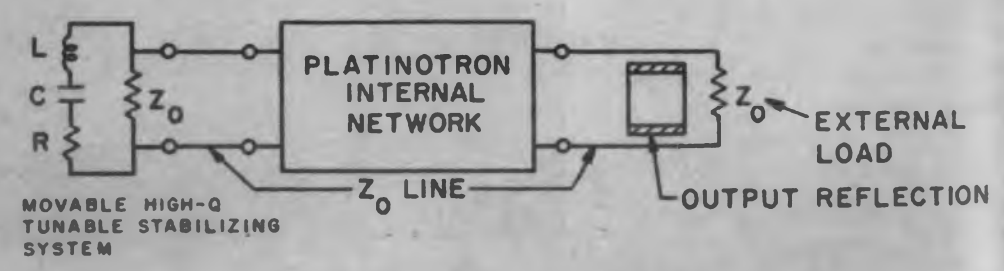


Fig. 2: Oscillator system using a platinotron, a feedback mismatch in the putput circuit, and a tunable high-Q stabilizing system.

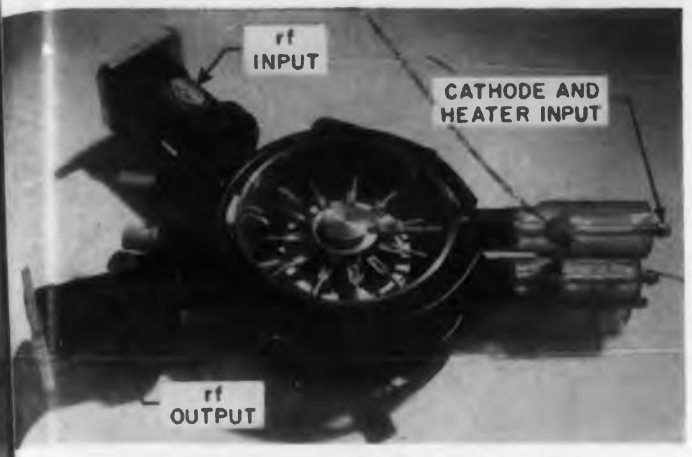


Fig. 3: Physical appearance of the L-Band platinotron, (with anode cover removed).

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 50-75 per cent across the tuning range. Pulse widths up to 20 μsecs 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 duplexing equipment. This arrangement allows the duplexer 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.

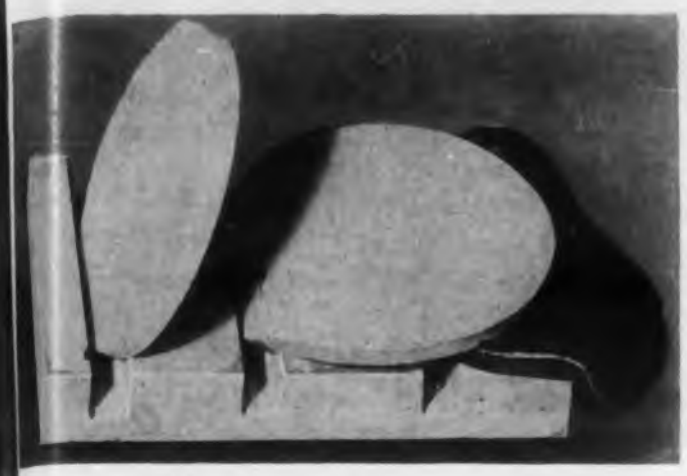
Temperature Test—Supramica 560 ceramoplastic insulation (left) is compared to Supramica 555 ceramoplastic (center) and Mycalex 410 glass-bonded mica (right)—the best previously available materials with comparable properties.

500 C ln

CONTINUOUS operating temperatures in excess of 500 C cause no damage to Supramica 560, a 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 of America, Clifton Boulevard, Clifton, New Jersey, Supramica 560 retains the electrical properties common to other ceramoplastics. It can be precision molded to very close tolerances and is dimensionally stable during and after fabrication. Because it has a thermal expansion coefficient close to that of steel, functional or reinforcing inserts may be molded in 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.

ision molded parts before high tempera- test are shown at right. Dimensional ge and distortion are shown below, after ected to 75 minutes at 550 C plus 15 min- at 650 C.

Dimensional Increase During Test

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

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 problem 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 40¼ 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 would assure that all such factors that are important to the designer would be taken into account.

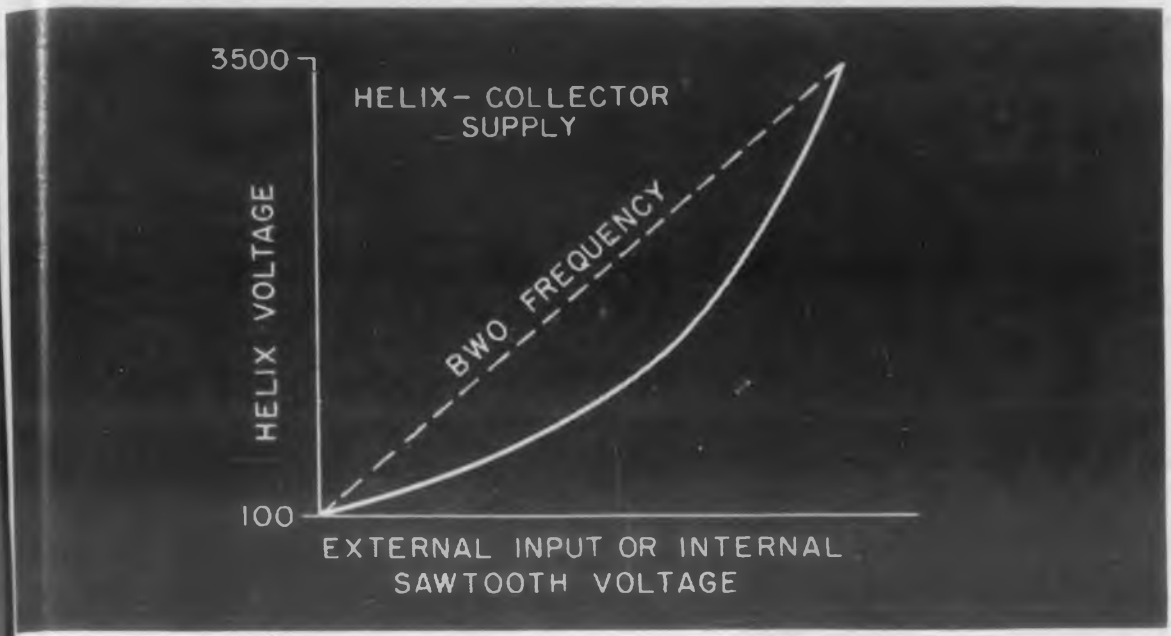
Sweeping p

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

The helix-collector supply of this instrumen manufactured by Alfred Electronics, 897 Comme cial Street, Palo Alto, Calif.—employs a non-line feedback amplifier to provide voltage in the ran of 100 to 3500 v. By means of panel controls t supply may be selected to provide any of four typ of output—dc, dc plus a small sinusoidal 60 c modulation of helix voltage only, nonlinear ampl cation of an external input signal, or voltage incre ing exponentially with time. Both the amplif signal and exponential sweep can cover the en voltage range or any portion of it. The sweep m be single or recurrent at rates suitable for eithe chart recorder or oscilloscope display.

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

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



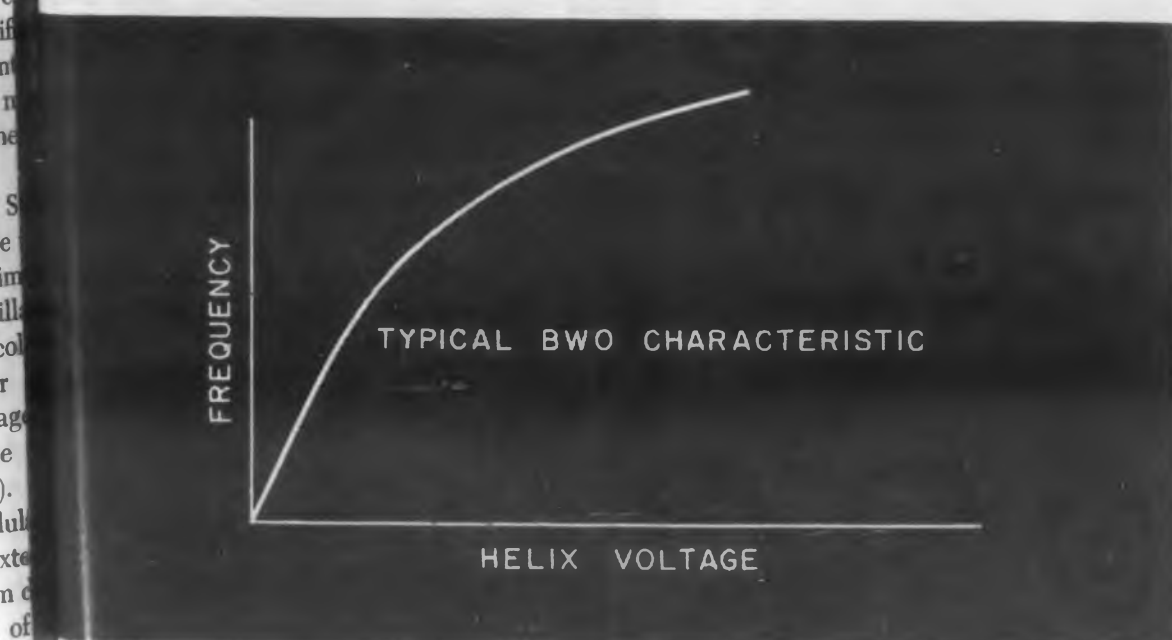
ng Power Supply

...ected oscillator output for automatic amplitude ...ntrol. The heater power source is magnetically ...gulated for stable traveling-wave tube operation. ...he solenoid supply provides well filtered dc for ...w focusing modulation.

Specifications

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

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

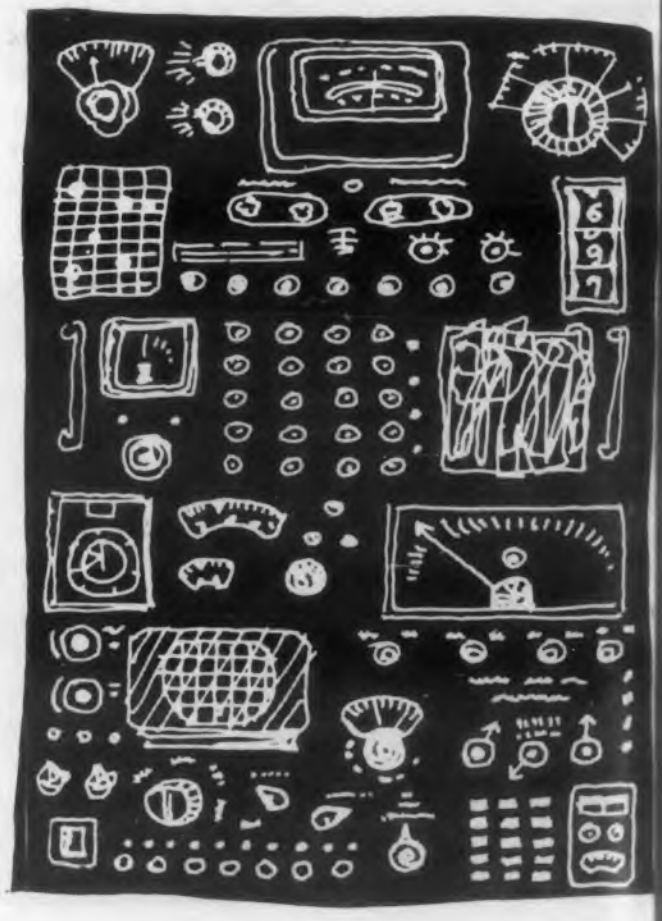


CIRCLE 42 ON READER-SERVICE CARD FOR MORE INFORMATION

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.

Design Aid

Transformer Design Nomograph—I

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 elements. The value of μ referred to is the actual d sign μ of the core structure, taking into account th effect of air gaps. The μ value is found from man facturers' curves applicable to the particular mat rial and operating condition.

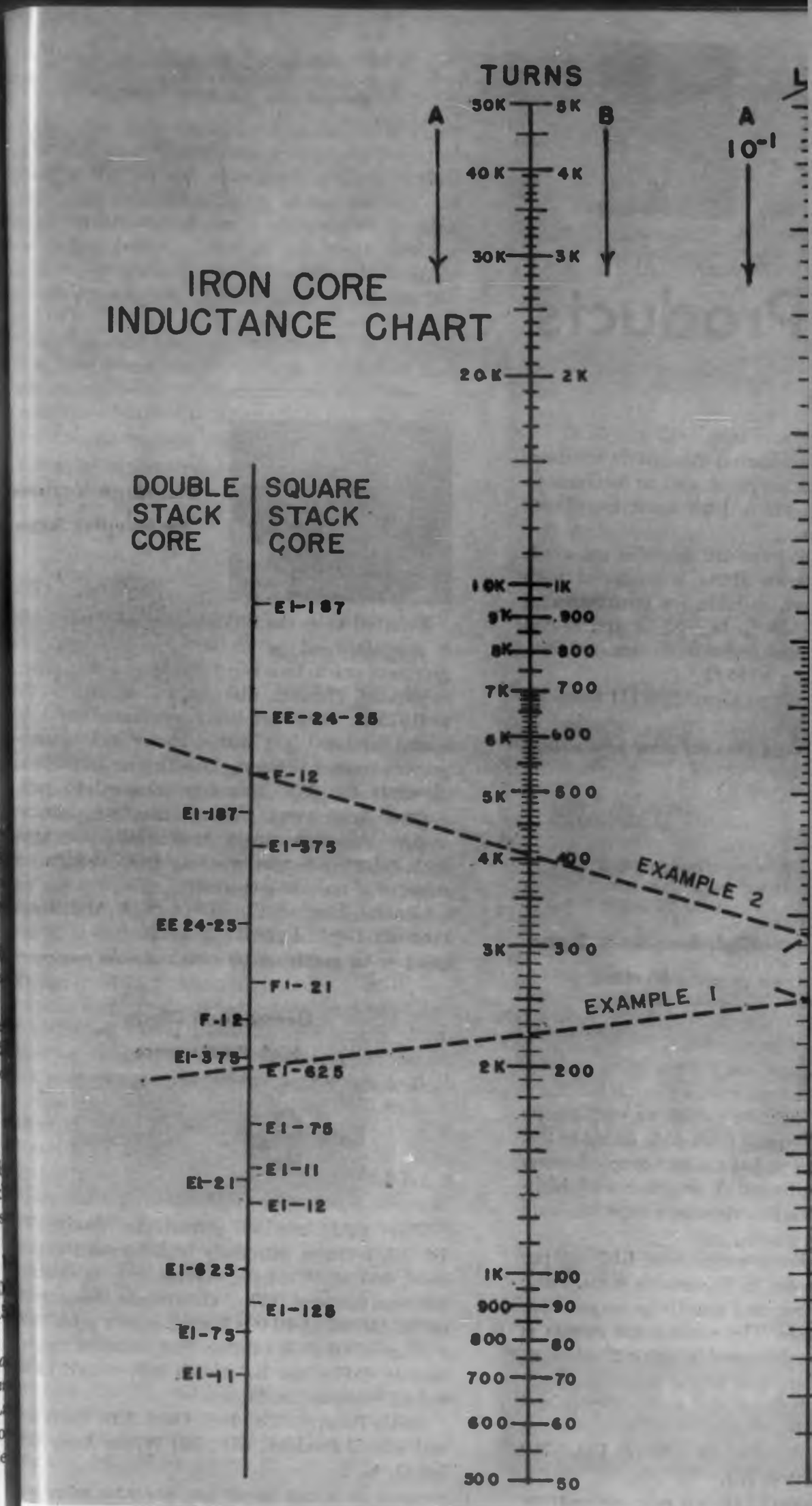
Two steps are required for the solution of a pro lem, the *L*/μ *scale* serving as an intermediate refe ence point.

Example No. 1. How many turns would be requir to obtain an inductance (*L*) of 1.5 h on an EI-6 square-stack core, assuming an expected permeab ity of 10,000?

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

Example No. 2. An F-12 square-stack choke is to 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-st core scale* through 4K on the *A* side of the *tu scale* crosses the *L*/μ *scale* at about 0.18×10^{-1}. L ing the straight edge from this reference po through 1150 on the μ *scale*, 20 h is read on th *scale*.


TURNS
A
B
A
10^{-1}
50K
5K
40K
4K
30K
3K
20K
2K
IRON CORE
INDUCTANCE CHART
DOUBLE STACK CORE
SQUARE STACK CORE
EI-187
EE-24-25
E-12
EI-187
EI-375
EE 24-25
F-12
EI-375
F-1-21
EI-625
EI-75
EI-11
EI-21
EI-12
EI-625
EI-125
EI-75
EI-11
10K
1K
9K
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8K
800
7K
700
6K
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5K
500
4K
400
3K
300
2K
200
1K
100
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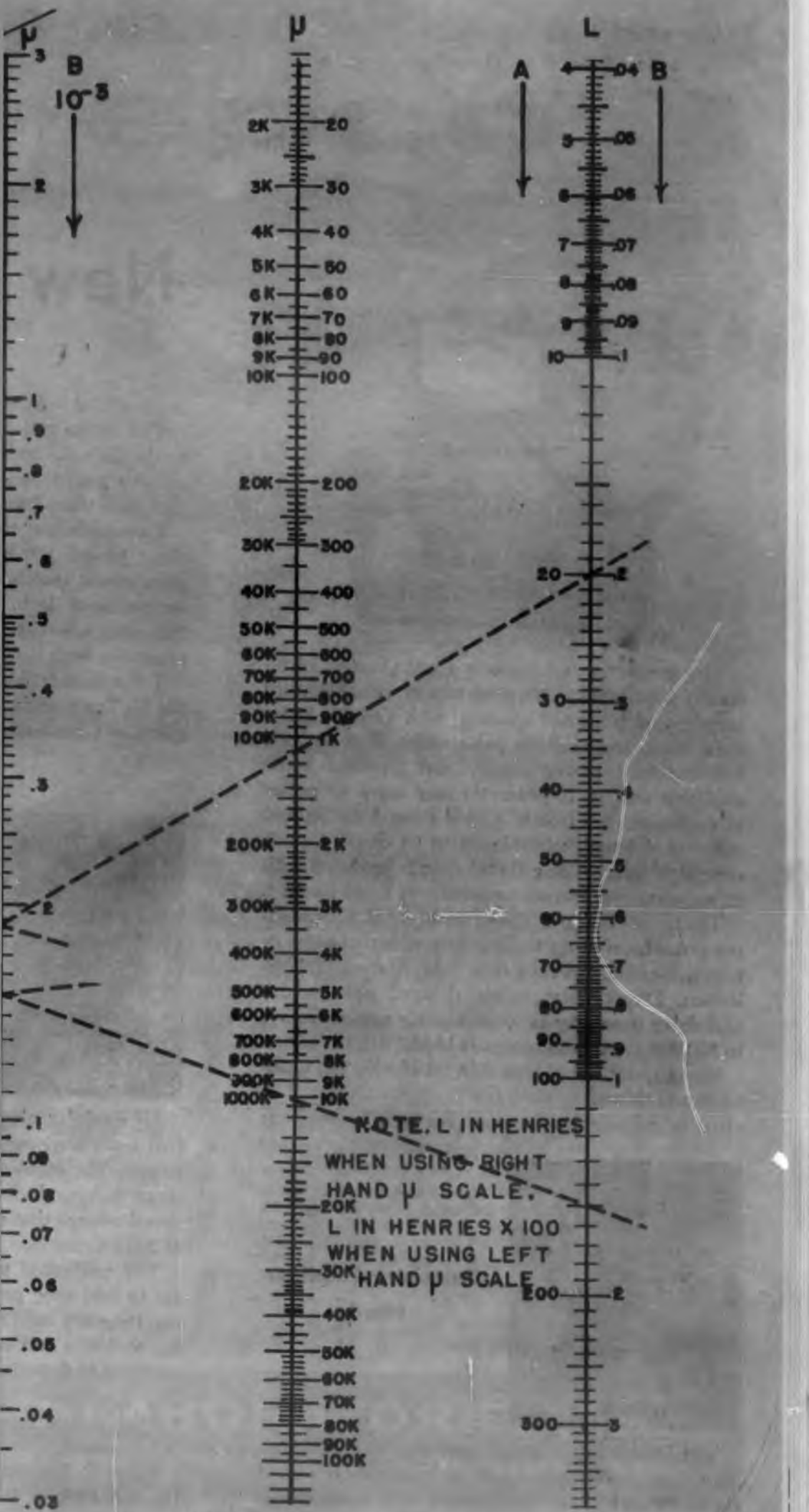
800
80
700
70
600
60
500
50
EXAMPLE 2
EXAMPLE 1


μ
B
10⁻³
2K
3K
4K
5K
6K
7K
8K
9K
10K
20K
30K
40K
50K
60K
70K
80K
90K
100K
200K
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400K
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L
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.05
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.08
.09
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4
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8
9
1
2
3
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 μsec, 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 μsec. 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 μsec per cm in 20 variable steps. Pulse rise time is 7 milli-μsec, 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 0.08 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, mounts at 5400 mc, handles an average power of 75 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; and 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

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 μv 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: Bandpass 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 mμsec.

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

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

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 6 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 Cutter 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 Eccofoam LM, this ceramic foam can e used continuously up to 1600 F. Density is about lbs per cu.ft. Foam structure is extremely fine nd uniform. The foam is supplied to the user in a rm resembling damp sand, and is packed or mped into the cavity to be filled. Complete filling complex volumes and/or the embedment of elec- nic items in foam is thus accomplished. Other es include thermal insulation and as the core ma- ial in sandwich structures, including radomes. At th room temperature and 1600 F compressive ength of Eccofoam LM is above 400 psi. Dielec- c constant is about 1.5 and dissipation factor is low 0.005.

Emerson & Cuming, Inc., Dept. ED, 869 Wash- gton St., Canton, Mass.

CLE 64 ON READER-SERVICE CARD FOR MORE INFORMATION

Magnetic Cores

Good Heating Stability

A new magnetic core, trademarked Hipermag is w available for magnetic amplifier reactors, trans- tors, current transformers and other magnetic ices. Hipermag cores are toroids wound with 1, nd 4 mil thick magnetic material. This material n iron-nickel (50-50) alloy with a high degree of stal orientation. The characteristics of the alloy excellent temperature stability and a very high anent flux accompanied by low coercive force. se properties include a very rectangular hy- esis loop.

ipermag cores are tested by the Robert's Con- t-Current Flux-Reset method. This method al- s the test values to be used directly as constants magnetic amplifier design. Saturation induction, and remanent induction, B_r, are 15,500 and 14,- for 60 and 400 cy and dc. The cores are avail- in sizes from 5/8 in. to 4 in. inside diam., 3/4 in. 1/4 in. outside diam. and 3/16 in. to 2 in. high. ght is from 2.80 to 2010.0 grams.

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

E 65 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 40 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 per cent 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 is 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 μv to 1000 v, 0 current ranges, from 100 μμamp to 100 milli-mperes, can be read by this improved combination d-c microvoltmeter, microammeter and ampli-ier. It employs a chopper-amplifier, and a zero-enter indicating instrument which shows polarity n two mirrored scales that cover all ranges. The nit is available in either cabinet or 19-in. rack ount models. Output terminals on the front panel low the instrument to be used as a low-drift dc mplifier with up to 80 db gain and very high input pedance. On the 100 microvolt-to-10 millivolt nge input impedance is 10 megohms; on the 30 illivolt range it is 30 megohms, and on the ranges 100 millivolts and above, 100 megohms. These ted impedances are accurate to 1.5 per cent. utput impedance is less than 2 ohms and output oltage is 1 v full scale across 1000 ohms or more. eter accuracy is 3 per cent on all ranges. Drift ter 15 minutes warm-up is less than 10 μv. Desig-ated Model 203, the instrument is offered as ighly versatile tool for research and development such uses as, for example, recorder driver.

Kin Tel, Dept. ED, 5725 Kearny Villa Rd., San iego 11, Calif.

CLE 70 ON READER-SERVICE CARD FOR MORE INFORMATION

H-Plane Folded Hybrid T
Wide Frequency Range

These hybrid T's feature high performance and e available for a wide range of frequencies from 0 to 36,000 mc, for most waveguides from 3 x 1 to 0.360 x 0.220 in. O.D. They are precision cast either aluminum or beryllium copper, and are rmally supplied terminated in flat flanges, but e available on request with special adapters. Op-tional characteristics include broad bandwidth, w S.W.R., and high isolation.

Microwave Development Labs., Inc., Dept. ED, Broad St., Wellesley 57, Mass.

CLE 71 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 tool 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 of ±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 St., Waltham 54, Mass.

CIRCLE 75 ON READER-SERVICE CARD FOR MORE INFORMATION

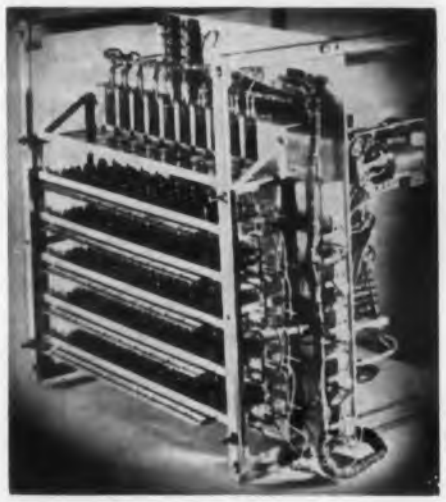
Toroid Coil
Molded

This series of molded toroids is cased in a molding compound which has successfully met government specifications covering the complete range of sizes and types. These coils are offered with one to five sturdy terminals, as required, and have either a linear bushing or threaded center to permit easy mounting. 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 Mills, 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 instrument capable of scanning in response to a contact closure 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 automatically 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 10 groups. The scanner utilizes the three-dimensional conductor arrangement of the crossbar switch to make selections in three coordinates.

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

CIRCLE 77 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-Coax 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 of 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 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, for the 5/8 x 1-1/4 waveguide, and is 1-3/4 in. long. And Model 9910, 10.0 kmc center frequency, is for 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, tinuous and simultaneous visual recordings of all nsmissions in the VHF range from 30 to 330 mc. e system, designated as type FT-FBS, consists of igh quality VHF band receiver, which mechani- y and continuously sweeps the 30 to 330 mc d, and a moving-paper recorder swept laterally a recording stylus which visually marks on the er all transmissions taking place in the band be- swept.

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

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

CIRCLE 83 ON READER-SERVICE CARD FOR MORE INFORMATION

Synchro Indicator

Compact

new aircraft synchro indicator Type 26800 can used in any electronic system that provides a chro output, or in any electrical system in which ote position indication is desired. The hermeti- y sealed unit, one inch in diameter and weighing than three ounces, meets the military specifica- I-25540A. The miniature indicator, designed 26 v, single-phase, 400 cy operation, will operate h many standard pressure transmitters to indi- e oil, fuel, hydraulic or water pressure.

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

CIRCLE 84 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.

SG57-1

SANGAMO
Electric Company
Electronic Components Division
SPRINGFIELD, ILLINOIS

CIRCLE 85 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. It power consumption is 70 mw. The device operate at 70,000 ft altitude, and is capable of withstanding 30g.

Autonetics, Div. No. American Aviation, Inc. Dept. ED, 9150 E. Imperial Hwy., Downey, Cal.

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 therm

pile and indicated on a remote meter in terms of ilowatts 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 SWR 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

Decade Counter Tubes
High Speed

Designated types 6909 and 6910, these tubes are ed for 100 kc operation, and are particularly ited for nuclear and radiation measuring equipt, as well as for other industrial controls where re is a great demand for high-speed counting de-es. Both tubes have reliable operation from 1 to 0,000 cy, with low power dissipation at approxiately 1/2 ma. The glow of the high-speed tubes is arly visible, with neon characteristics. The tubes ve a short resolution time between pulses—on the der of 5 μsec—which permits random counting of nals such as those from a geiger radiation tube. be life is at least 2000 to 2500 hours. Sylvania Electric Products, Inc., Dept. ED, 1740 adway, New York 19, N.Y.

CLE 89 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

Using Thermistors

Edited by
FENWAL ELECTRONICS

Thermistors, with their almost incredible sensitivity to temperature change, now get a 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:

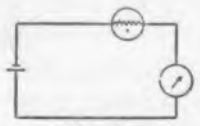


FIG. 1

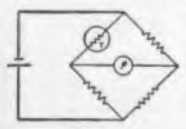


FIG. 2

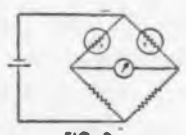


FIG. 3

The first is a battery, a thermistor, and a 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

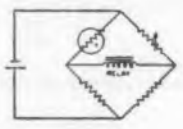


FIG. 5

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., 64 Mellen St., Framingham, Massachusetts.

Fenwal Electronics

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

COMPLETE SERVICE

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

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.

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

New Products

Instrumentation Amplifier

1/2 Cps to 2 Mcps

This amplifier, Type 104, is capable of reproduction of fast transients and provides voltage gains 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 μμfd. 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, 4-1/4 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 a null 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 O-150, O-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 scalers 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 mev alphas from RA D + E and from U_3O_8, for 2-pi geometry. Probe AP4, in association with instrument 2112-P, will measure alpha contamination from a minimum of 2 alphas per cm²/minute to 5000 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 50μv 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

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

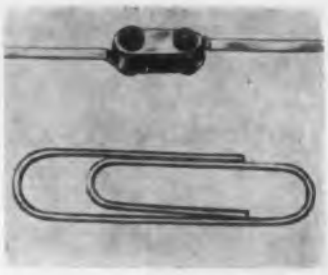
Simulates Sand and Dust

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



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

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

CIRCLE 113 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

Nylon Bonding Agent

High Bond and Peel Strength

An epoxy-based compound that onds nylon to itself, to metal, or to her materials has been brought out. esignated Bonding Agent R323, it ossesses high bond and peel strength, d may be used with rubber.

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

CIRCLE 118 ON READER-SERVICE CARD

Neon Glow Lamp

For Ultra-Miniature Units

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

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

CIRCLE 119 ON READER-SERVICE CARD

Time Integrating Instrument

Measures Analog Integral

The Model 270 integrating system tains the time integral of rapidly rying, short or long term analog gnals. It is supplied as a portable or ck-mounted instrument, and gives user accurate digital display of th the integral and the action time the phenomenon being measured. utput connectors are provided so at this information can be automatically printed by a typewriter or d onto tape. The Model 270 has a unting rate of 10,000 counts per sec hich permits the measurement of lues over time intervals as short as msec.

Alleghany Instrument Co., Dept. D, 1091 Wills Mountain, Cumberd, Md.

CIRCLE 120 ON READER-SERVICE CARD

CIRCLE 121 ON READER-SERVICE CARD ➤

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, nonhydrolizing 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 nonmetallic 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.

CIRCLE 124 ON READER-SERVICE CARD FOR MORE INFORMATION

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 26 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.

CIRCLE 128 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 rachets 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 Specs, in addition to listing "Teflon" tubing. Birnbach Radio Co. Inc., 145 Hudson St., New York 13, N.Y.

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.

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.

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, macroscopes and comparators. Bausch & Lomb Optical Co., 635 St. Paul St., Rochester, 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.

ANOTHER NEW ELECTRONIC DESIGN SERVICE

Mail

Readership

Measurement

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HAYDEN PUBLISHING COMPANY, INC.
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Mail Readership Measurement

While other publications fight the battle of promotion, *Electronic Design* continues to improve its services for both reader and advertiser. MRM (Mail Readership Measurement), in effect since January 1, 1956, has proven to be an extremely valuable aid, both in rating individual advertisements, and in telling us which editorials you like best.

Since many of our readers are also advertisers, a special booklet has been prepared which outlines the methods, objectives, and results of MRM. Copies are available on request to the publishers.

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• NEW YORK • CHICAGO • LOS ANGELES

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.

3 PHASE VARIABLE FREQUENCY

Electronic Generator—Power Supply

750 VA OUTPUT—360 to 440 CPS

CML's Model 1450 Electronic Generator has a power output of 750 volt-amperes with output voltage regulation of better than 2% from no load to full load. Harmonic content is below 3% at full load.

CML's Model 1450-C is available as a fixed frequency unit employing a tuning fork oscillator to give a frequency accuracy and stability of 1 part in 50,000. This stability is independent of line voltage or frequency.

Specifications for the Model 1450 and 1450-C are available on request.

We custom-build units to your exact specifications. Our design engineering department will be happy to help you with your particular problems at no cost or obligation.

CML COMMUNICATION MEASUREMENTS LABORATORY, INC.

250 LELAND AVENUE, PLAINFIELD, NEW JERSEY

CIRCLE 148 ON READER-SERVICE CARD FOR MORE INFORMATION

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Install McLean Fans and Blowers in Computers, Control Systems, etc. They're small, ready to use, packaged units with smart stainless steel grilles and easily replaceable filters. Standard RETMA notching allows mounting on rack without cutting or fitting.

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CIRCLE 149 ON READER-SERVICE CARD FOR MORE INFORMATION

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 dicussion 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 ouput 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.

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.

In addition, the usefulness of 72's in telegraph service is also substantially increased by the following three related items:

STANDARD REPAIR KIT for the 72 contains normally (and easily) replaceable parts: two contact screws and one ferro-nickel armature.

MAINTENANCE AND ADJUSTMENT 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, 5¼" 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.

SIGMA

SIGMA INSTRUMENTS, INC.
91 Pearl St., South Braintree 85, Mass.

CIRCLE 162 ON READER-SERVICE CARD FOR MORE INFORMATION

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.

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, ratemeters, 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.

Ideas for Design

Get $10.00 plus a by-line for the time it takes you 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.

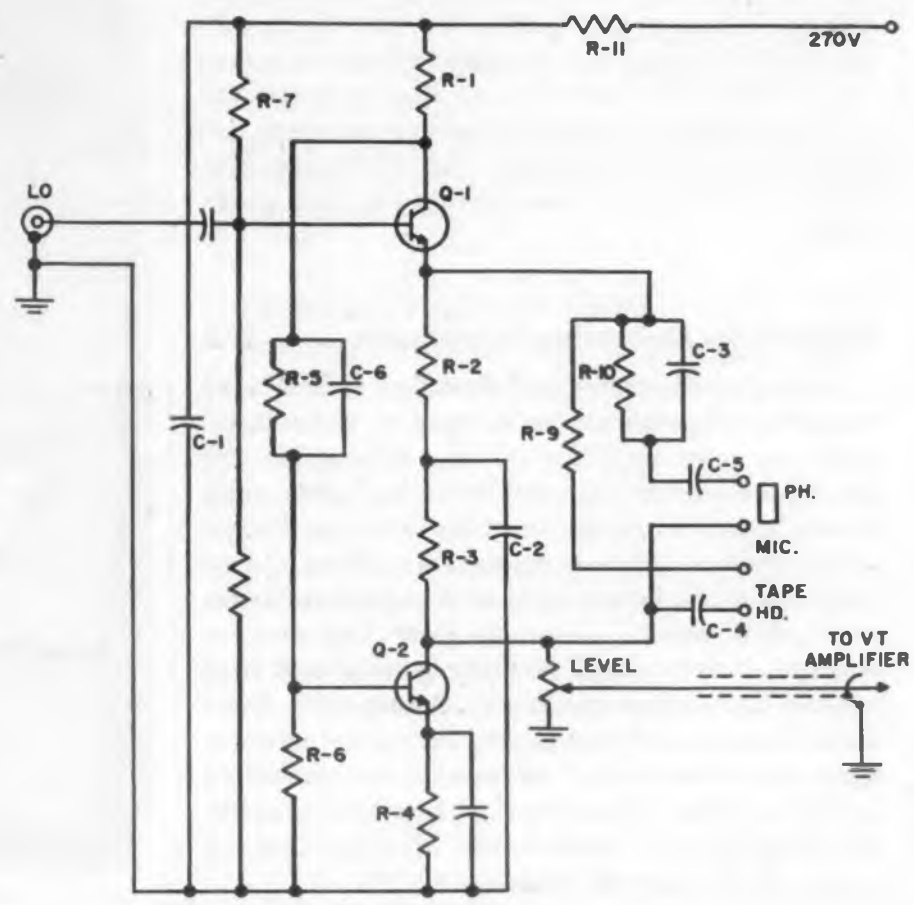
Hybrid Hi-Fi Amplifier

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 entire series string of transistors and their respective emittter and collector resistors is placed directly across the supply voltage. The collector currents in 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 it moves toward cutoff and will itself be stabilized. Additional circuit stability is provided by the en



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_3 and R_4 and by the bleeder line resistors R_7 and R_8. However, because of the requisite high input impedance the value of R_3 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_2 bypassed to avoid a high input impedance (10,000 ohms) by means of emitter degeneration. The junction R_3 and R_5 is bypassed to ground by C_3. 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 together with the decoupling capacitor C_1 and d-c filtering is more than adequate.

The overall gain of the preamplifier is better than 60 db. An input of 10 mv will give 0.5 v output at 1000 cps in the phono position. This gain includes 20 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 NARTB playback curve). All equalization is accomplished by feedback for improved distortion by 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_5 determines the bass cross-over frequency, R_{10} determines the amount of mid-frequency feedback, and C_8 determines high frequency de-emphasis. In the microphone position, only resistive feedback is employed (flat response) and in the tape-head playback pasition, the cross-over 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 can to shield the high-impedance input stage from the pickup, and the circuit itself is printed on a 1/16 in. phenolic board.

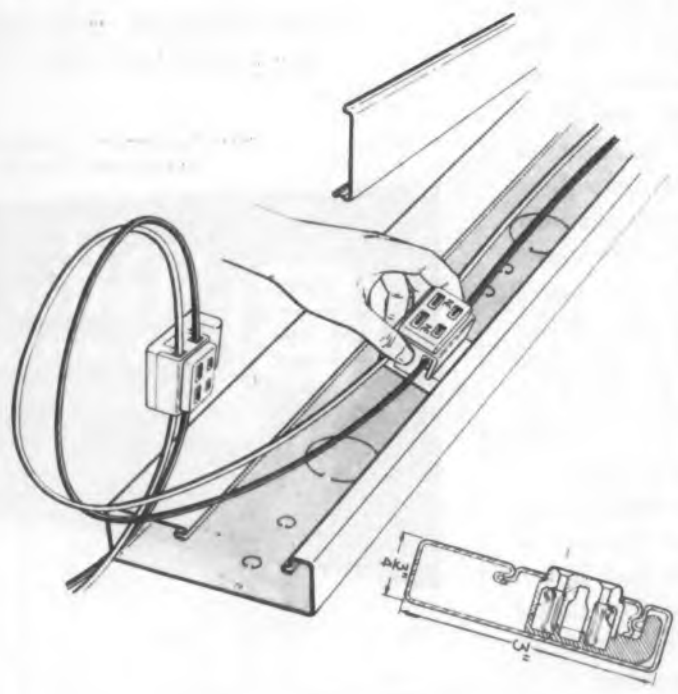
Ideas for Design

Convenient AC Outlets

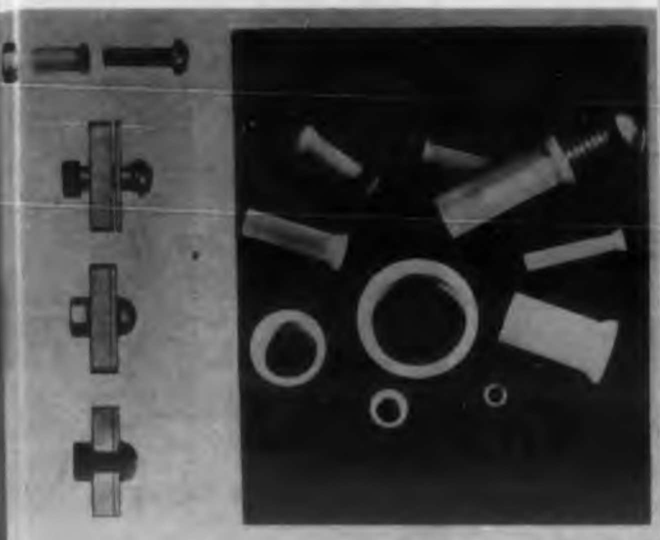
Featuring feed-through wiring, this baseboard wiring system could find wide use in many design laboratories. It is installed directly on the floor and requires no footers, trim, nor capping. Outlets can be conveniently located wherever desired. To effect reduced installation time and expense, only three 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.



Convenient "Slip-On" Outlets



Quick Hole Seal

A design, which won for William Gould of Key-
ne Plastics, Inc., Union, N.J., a $1000 first prize
m Cadillac Plastic and Chemical Co., is a nylon
eve designed so as to cold flow into a seal be-
een work, bolt, and nut, as shown. This design
ns to an advantage one of nylon's less desirable
perties—its cold flow characteristic.

Appearance Design

Attractive appearance is achieved in plastics for
part of the new Rockola 200-selection juke box.
e turntable for the 45 rpm player rests in the
ter of the piece shown. Injection molded from
gh acrylic plastic by G. Felsenthal & Sons, Inc.,
icago plastics molding and fabricating firm. The
t is then sprayed with silver-colored metallic
nt. A vacuum-plating process covers each star
h a coating of gold. Finally, the gold is covered
h an additional coat of paint to prevent it from
dizing. Since all of the silver and gold paint is
the underside of the part, and is seen through
clear plastic, it cannot be scratched or damaged.

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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)

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(Place illustrations on separate sheet if necessary)

A new sealed, shaft-driven precision AC voltage divider for accurate positioning and calibration.

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100-turn or 1000-turn models available, both in anodized aluminum cases, sealed against dirt and moisture. Ratio is controlled by a single ball-bearing mounted shaft. An internal mechanical counter provides easy readout. Printed silver switches assure long life and reliability.

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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.*

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.*

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.*

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.*

Report Briefs

Oscillation Criteria

This paper is concerned with the differential equation $y'' + p(x)\,y = o$, where $p(x)$ is a continuous non-negative function for $0<x<oO$. *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.*

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, diagrs, 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.*

Patents

Improved Electronic Trigger Circuit

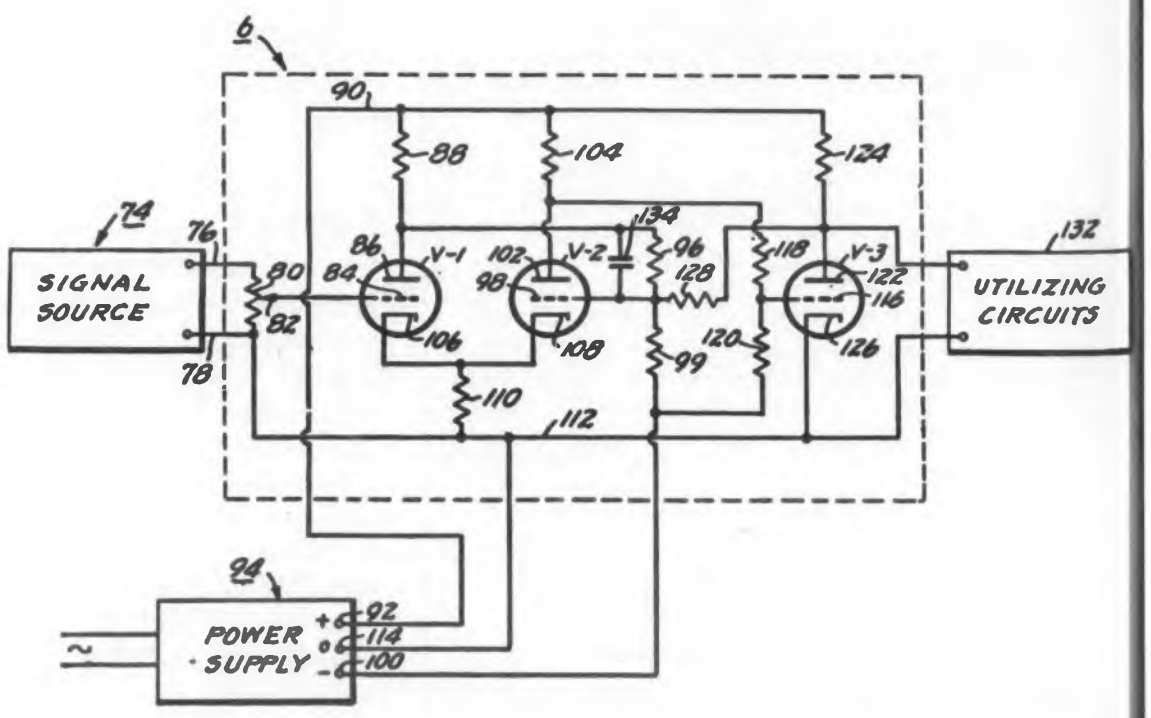
Patent No. 2,744,957. L. M. Carver. (Assigned to C. G. S. Laboratories, Inc.)

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 con- dition by the negative polarity of the in- coming pulse.

The trigger signal source *74* applies th incoming pulse to the control grid *84* of first tube *V-1* the positive polarity of whic renders this tube conducting. A second tub *V-2* has its control grid *98* connected wit the anode *86* of the first tube so that whe tube *V-1* becomes conducting, tube *V-2* be comes negatively biased to non-conductio firstly, because the drop in potential on th anode of the first tube reduces the poten tial on the control grid *98* of the secon tube and, secondly, because of an increas in potential across the common cathode re sistor *110*. The negative potential of th signal pulse triggers the tube *V-1* to non conducting condition whereupon the tub *V-2* again becomes conducting.

It is necessary for proper operation o the pulse generating circuit that the tub *V-1* be prevented from becoming conduct ing upon termination of trigger pulse which would restore zero potential on th control grid of this tube. This is accom plished by a separate biasing circuit pro vided by a third tube *V-3* and its circuitry operative such that when the tube *V-2* i conducting, tube *V-3* is non-conductive an when tube *V-2* is non-conducting tube *V-3* is conductive. The potential on contro grid *116* of tube *V-3* is controlled by th potential between resistors *118* and *12*



nnected as a voltage divider between the node of the second tube and the negative rminal *100* of the power source *94*. As ng as the second tube *V-2* is conducting, e potential on the anode of this second be is of relatively low value which main-ins the potential on the control grid of the ird tube biased below cut-off and it is aintained non-conductive. As long as the be *V-3* is non-conductive its anode po-ntial is relatively high and increases the ositive potential on the control grid of the cond tube through resistors *128* and 99. he second tube, therefore, continues to re-ain conductive whenever the potential on e control grid of the first tube becomes ero. An incoming pulse triggers tube *V-1* that it becomes conductive, whereupon be *V-2* becomes non-conductive so that s anode potential increases which drives e control grid of the third tube in a posi-ve direction and it becomes conductive. he resistors *128* and 99 are selected to ave a value to maintain the second tube nductive.

With this trigger circuit the generated ulses have a time duration substantially rresponding 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.

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 resarch 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.

troduction to Operations Research

West Churchman, Russell L. Ackoff and Leonard Arnoff. John Wiley and Sons, c., 440 Fourth Ave., New York 16, N.Y., 5 pages, $12.00.

The essential background for evaluating growing field and for understanding its tentialities and procedures is supplied in is introductory treatment. For prospective nsumers and practitioners of operations search the book offers a survey which can rm the basis of further education. The au- ors present a general coverage of such pics as inventory, linear programming, iting line, replacement, competitive and her mathematical methods useful in op- ations research. A case example has been esented to illustrate each method and odel. The book emphasizes the import- ce of administration and defining man- gement problems in terms of objectives.

merican Institute of Physics Handbook

ight E. Gray, Coordinating Editor. cGraw-Hill Book Co., 330 W. 42nd St., ew York, N.Y., 152[illegible] 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.

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.

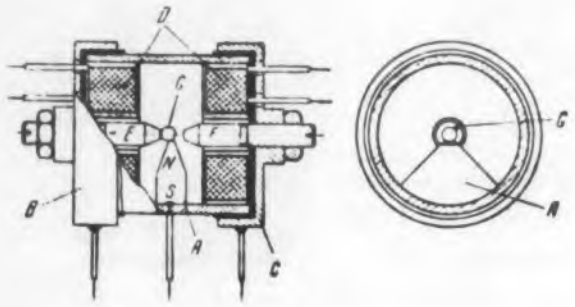


Fig. 1: Ball G is the only moving part of this polarized relay.

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).

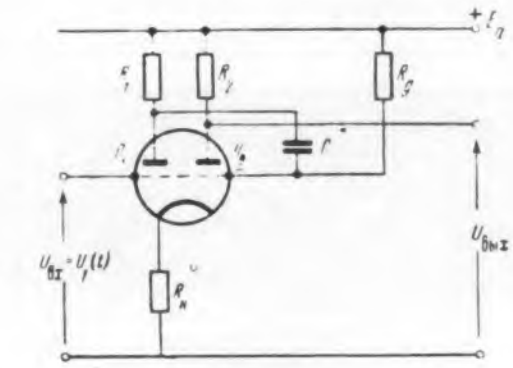
A method is shown for converting the logarithmic amplitude characteristic, in the form 20 log $[1 + K_{oc}(j\omega)K_z(j\omega)]$, into a logarithmic characteristic of the form 20 log $[K_{oc}(j\omega)K_z(j\omega)]$, thereby facilitating considerably the synthesis of parallel correcting networks (K_{oc} is the transfer function of the additional feedback [parallel correcting] network, and K_z is the transfer function of the portion of the system included in the feedback loop).

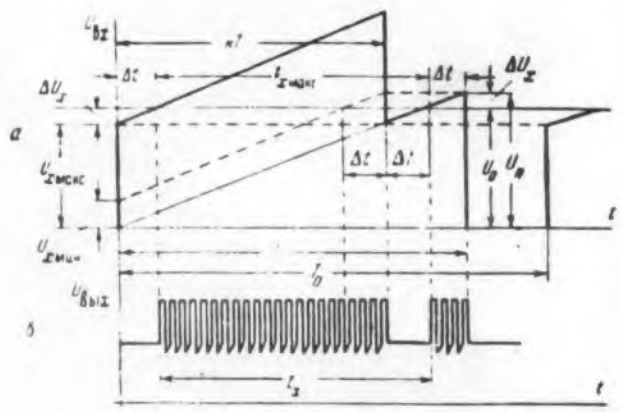
Topics in the General Theory of Circuits with Non-Linear Magnetic Elements, S. A. Ginzburg, (12 pp, 10 figs).

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. Zakhariia, 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 multivibrator 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.

Servomechanism Theory

Use of "D-Expansion" to Plot the Root Loci and to Analyze the Response of Automatic Control Systems, Iu. 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.s 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. Slepushkin, (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.

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.

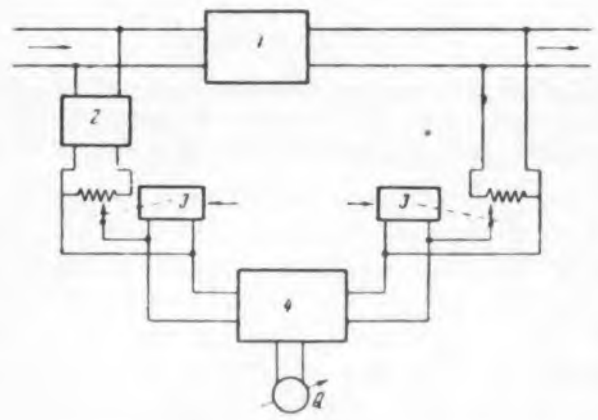


Fig. 4: 1. Channel, 2. phase compensator, 3. automatic stabilizers, 4. multiplier, Q. correlation coefficient meter.

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 calulating 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).

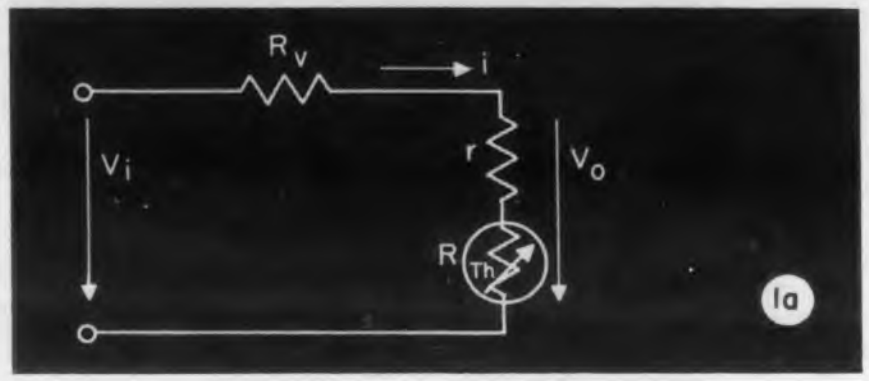
The ultrasonic interferometer is one of the most widely-used instruments for the measurement of the velocity of sound in gases and in liquids. The article gives new equations for the absorption coefficient of ultrasonic waves by means of interferometric measurements. Refers to several American works.

Other articles in this issue:

"Propagation of Sound in Inhomegeneous 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 Accoustics," 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).

Abstract—German

Stabilization With

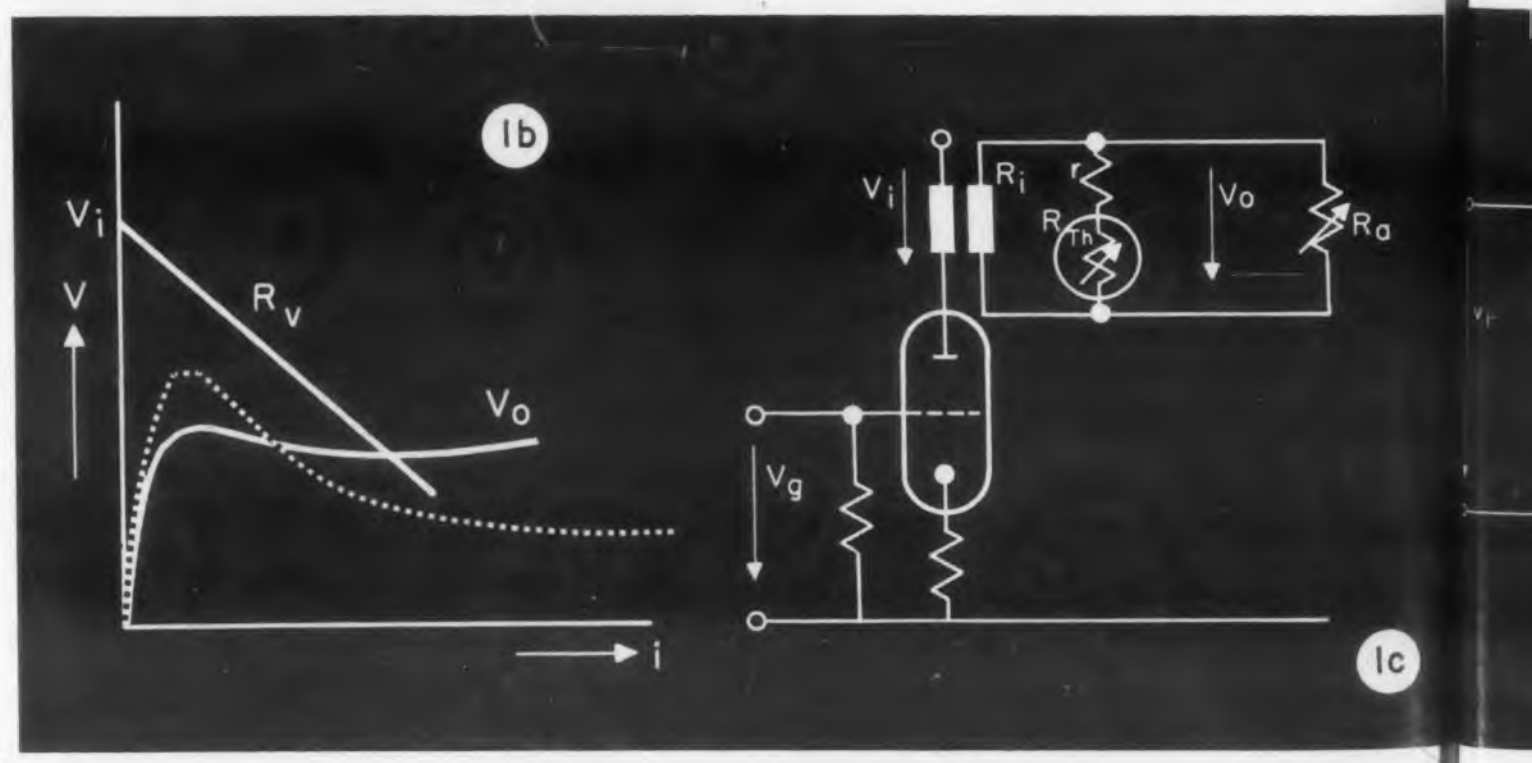


Basic stabilization circuit for a wide range of currents.

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 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_v 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 $R_{c'}$, 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



Characteristic curves of basic circuit on which a schematic (fig. 1c) can be based or . . .

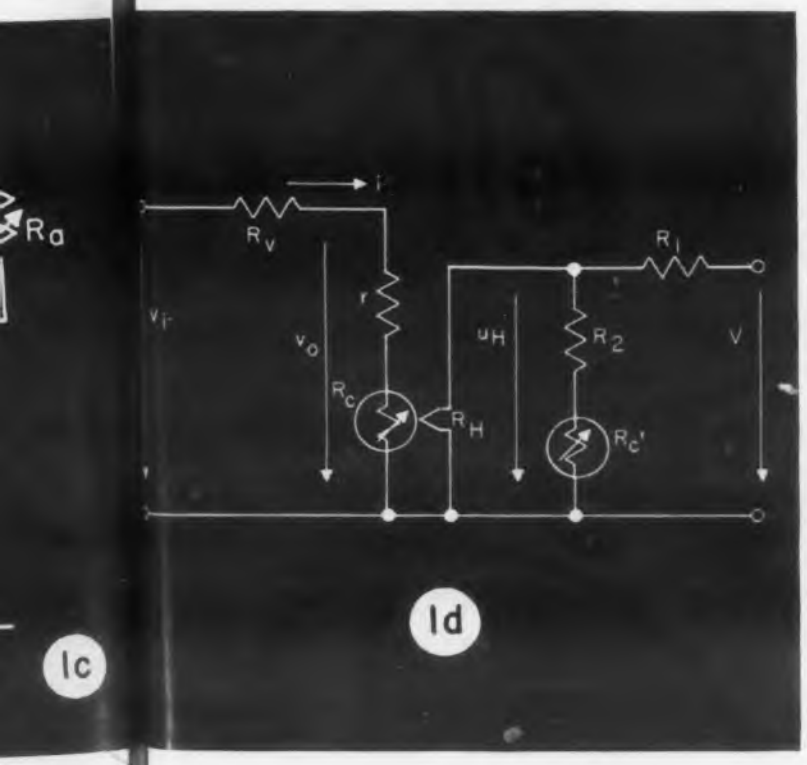
Temperature Compensated Thermistors

E. Brenner

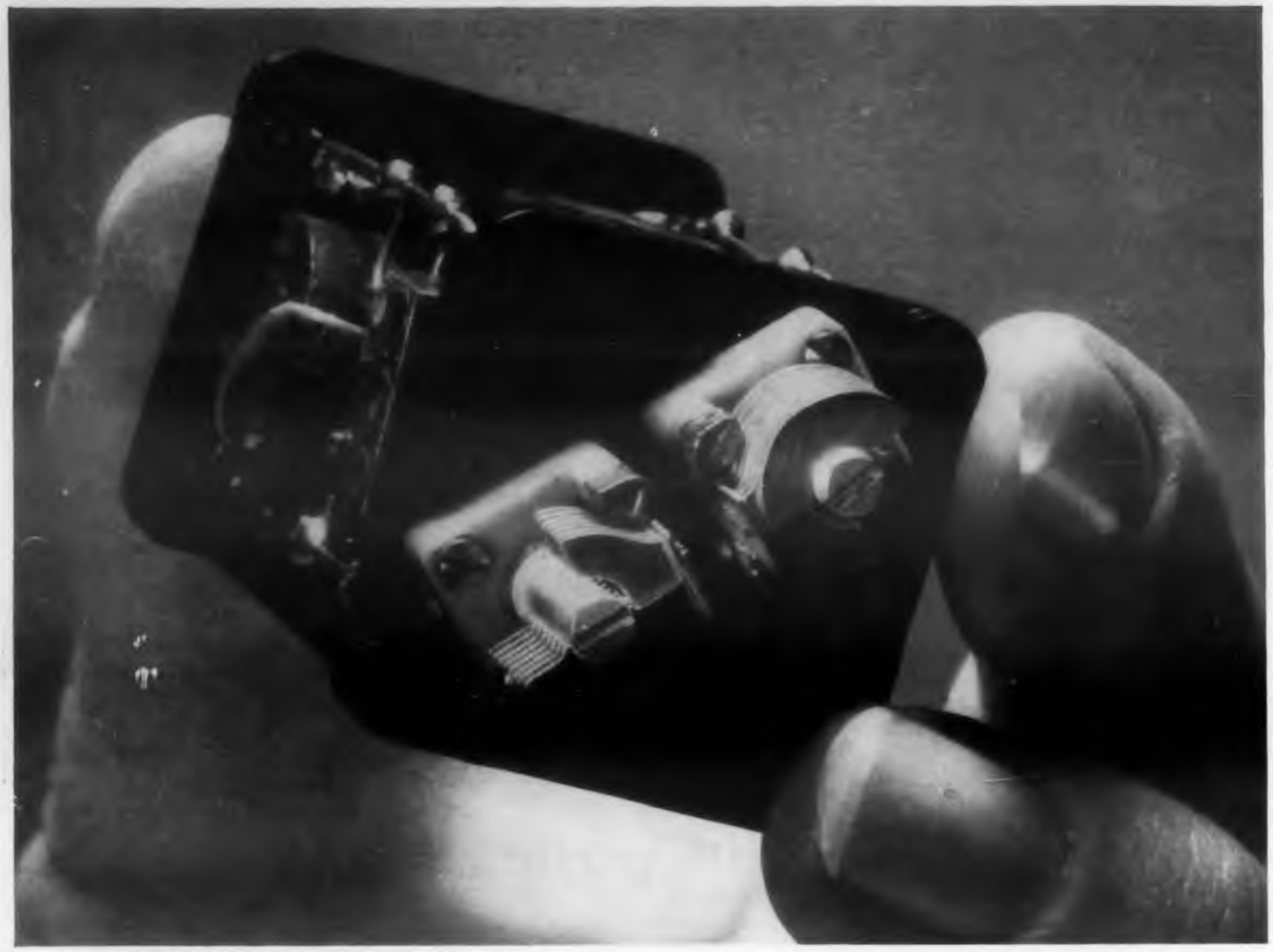
t of the crease in ambient temperature. The design can depend- e executed for increase of ambient temperature up ply volt- about 60 C.

ponds to The control thermistor, R_c, is a power-sensitive g. 1c. pe while the compensating thermistor $R_{c'}$ is a scheme mperature-sensitive type (disc construction). Al- ermistor, hough for all thermistors the characteristics ap- that its roach an exponential curve, there is, for tempera- ambient re-sensitive types, a small region in which the urrent, *i*. esired temperature dependence is achieved (if the controls ermistor is supplied from a low voltage, low im- esistance dance source).

20 C) be- The article also treats limiting action without ecreasing id current, stabilization under conditions of choice of ightly varying load and stabilization of oscillators. just suffi- xperimental data are included. *Abstracted from* ature) so *article by W. Dietrich* Electronische Rundschau s for the *ol. 10, No. 11, Nov. 1956, p 302.*



A circuit for temperature compensation of an indirectly heated thermistor.



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.

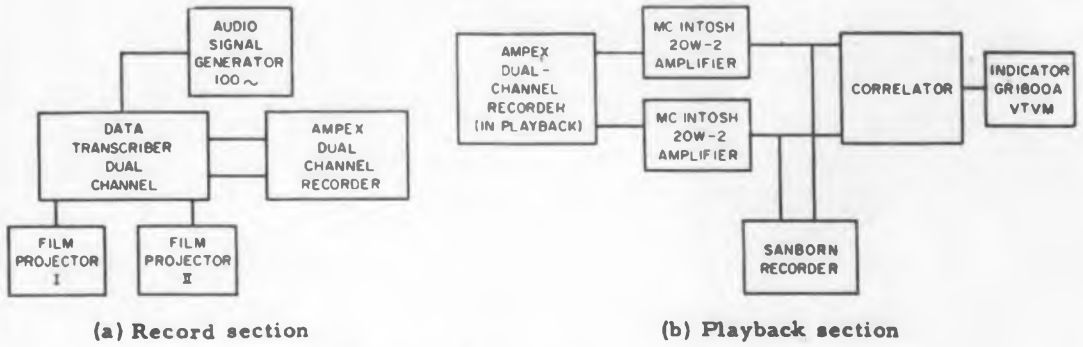
The computer system consists of a record and playback mechanism as shown in the block diagram of Fig. 1. The record section contains a dual-channel data transcriber and a dual-channel Ampex magnetic recorder.

The playback section is composed of the recorder feeding two amplifiers in playback from duel-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 1/10 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



(a) Record section (b) Playback section

Fig. 1. Block diagram of computer system.

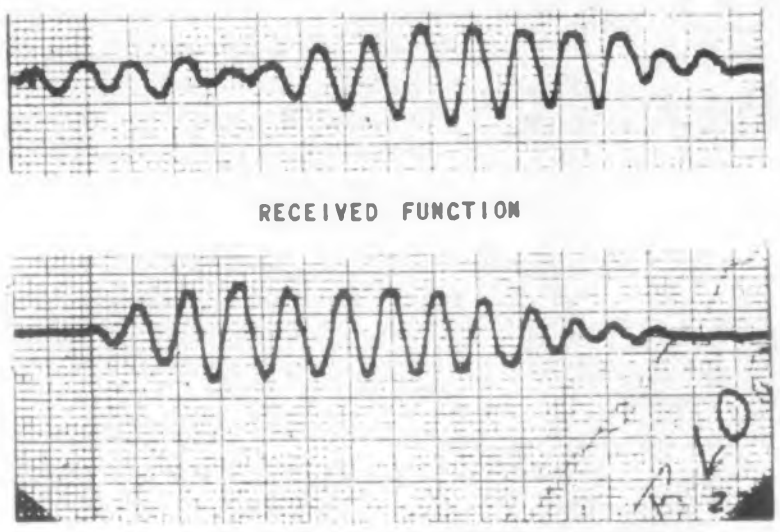


Fig. 2. Typical correlation input waveforms as would be displayed on Sanborn recorders.

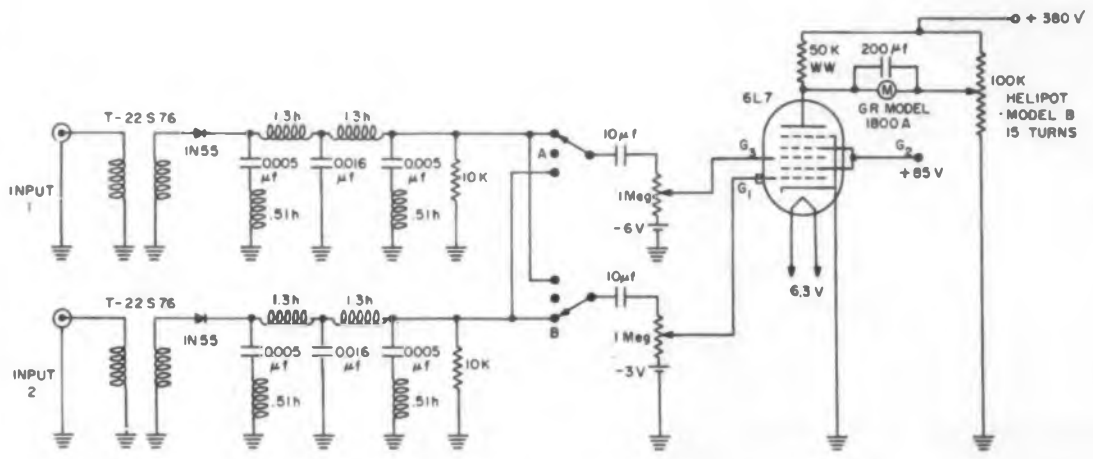


Fig. 3. Correlator unit schematic.

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

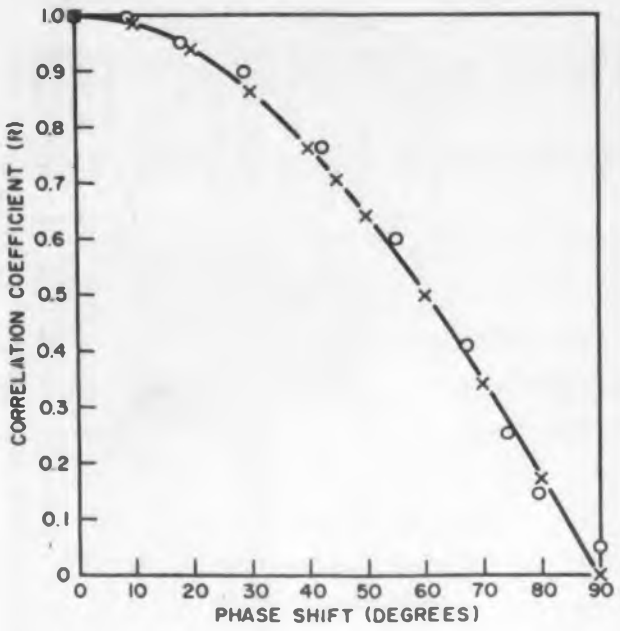
$$\left\{ f_1(t)\, f_2(t+\tau) \right\}_T$$

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

$$R = \frac{\{ f_1(t)\, f_2(t+\tau) \}_T}{\left[\{ f_1^2(t) \}_T \{ f_2^2(t+\tau) \}_T \right]^{1/2}}$$

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 a 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.*

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.

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.

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, by-pass 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.

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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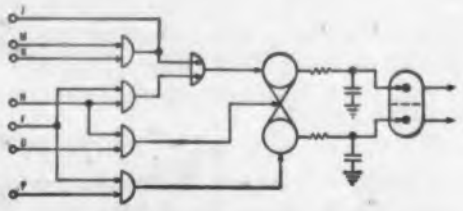
EECO Data Sheet

- 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.

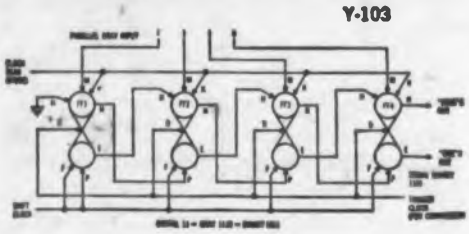
Y-103

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.

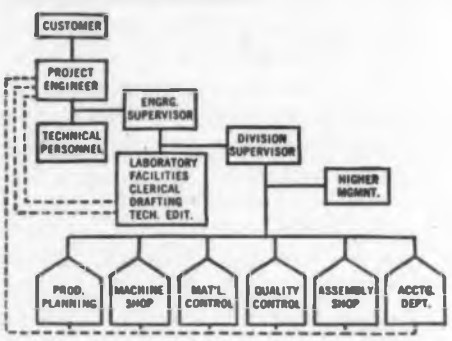
Trigger clock (conversion) pulses cause the Gray-to-binary conversion and must be one less in number than the number of digits in the Gray code. After conversion, the binary number is shifted out serially by shift clock pulses.

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.

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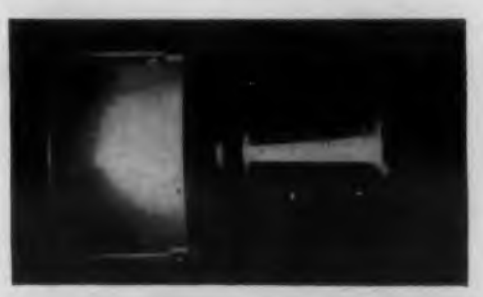
3000 KW used in operating this stabilized arc and evacuation tunnel. (Shown idle.) Has ¼" nozzle diameter. Present plans call for construction of a 3" diameter model, requiring 80,000 KW for operation.



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.

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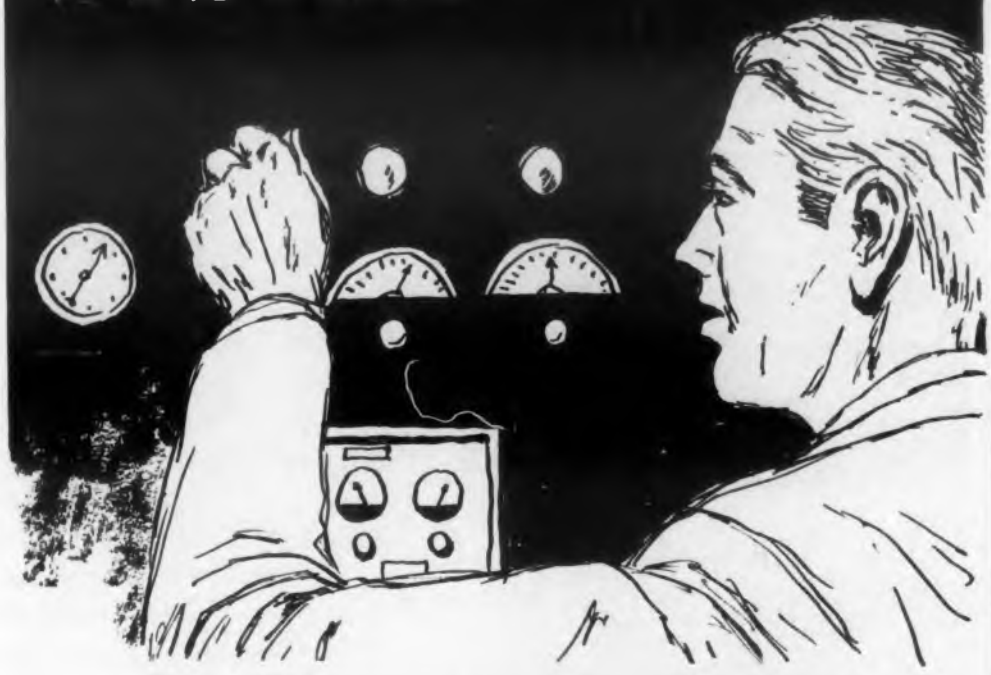

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Supervisor of Technical Employment

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