ELECTRONIC DESIGN

AUGUST 8, 1959

Memory device shrinks and speeds computers . . . p. 28

PREVIEW OF WESCON PRODUCTS

HIGHLIGHTS OF ISSUE

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Digital Telemetering Helps Control London Ship Traffic

Operations room of the new Thames Navigation System at Gravesend, England, houses radar display of ship traffic, (only one of seven screens is now installed) vhf radio-telephony links with traffic, and readout of tide and visibility recorders.

CONTROLLING London-area ship traffic along 69 winding miles of the Thames River required the design of special electronic gear. Up-to-the-minute data on tides and visibility were needed, as well as radar surveillance information and effective ship-to-shore radio facilities.

The Port of London Authority organized a control system, overhauled existing communications facilities, had digital-telemetering equipment designed, and set up a Thames Navigations Service, which is now in operation in a new center at Gravesend, near the mouth of the Thames.

Tide Data Unit Designed

Existing tide recorders were modified with new equipment to telemeter the exact time of tide rise to a central recording station. Main requirements of the design were high reliability (for continuous operation in hard-to-reach areas), use of only one radio channel for all telemetering stations, and high accuracy (±0.25 per cent).

The accuracy requirements and 450-mc radio link forced selection of a digital rather than analog system, though the short sampling time of analog technique would have been advantageous. Designers picked a binary code as the best compromise between simplicity of equipment and short sampling time.

In the system, tide rise is broken into eight "0" and "1" pulses that give 256 combinations. Different audi-frequency tones distinguish the "0" from the "1" pulses. Because the system must operate on one vhf channel, three binary pulses are used at the beginning of each signal to distinguish telemetering sites from one another.

The tide information unit encodes with a printed circuit disc that also initiates at each 1.5-inch change of tide. The decoding unit, with 14 relays and a stepping switch, takes pulses, stores them in the "0" and "1" positions of the relays and gives them up to a readout switch at the end of each signal.

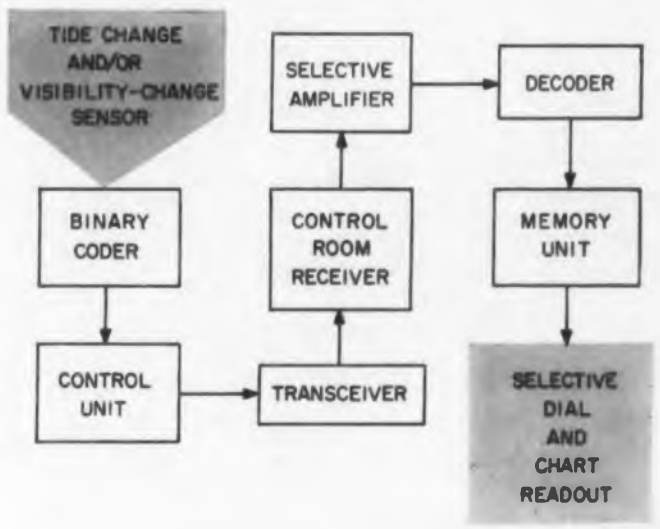
The system's control unit generates the "0" and "1" tones with two transistorized oscillators and houses the relays that switch the transmitters and receivers on and off.

Visibility Data Also Telemetered

In the visibility unit, which, in effect, measures fog, a coder flashes a special lamp that emits short, intense light pulses. A photocell receiver looks for the pulses and converts light scatter caused by fog droplets into an electrical signal.

An amplifier sends the signal to a normally closed gate circuit synchronized by a control pulse from the code unit to open when the light pulses flash.

The gated signal passes to a detector that positions a selector switch in one of five positions in-



Operating sequence of tide and visibility recording telemetering system ends with both chart readout and dial readings, which can be selected by pushbutton.

NEWS

Console houses five vhf radio telephone circuits for broadcasting tide and weather data.

Tide coder records water-level changes and broadcasts data to Operations.

Fog detector under test flashes pulses of light to photocell that codes and records dispersion.

Tape-recorder memory unit stores ship-to-shore conversations and information reports.

The selector has banks wired to give digital information. This information is passed to the coding unit for telemetering to the communication center. The detector has contacts that initiate transmission of information whenever visibility changes, or after 30 minutes of no change. A monitor circuit is included to transmit a detector-fail code.

The visibility information itself can be coded into three pulses. A complete train of information consists of 14 pulses and is transmitted in less than three seconds; there is no reason for shortening transmission time.

If each of the sites, whether tide or visibility recording or both, was interrogated, each would need a constantly operating receiver. The telemetering system chosen, however, requires only intermittently operating receivers at each site. This is the operation sequence:

1. A signal is initiated at a site.
2. The information (tidal and visibility) is stored.
3. The receiver is switched on. If it detects a signal from another site, it holds off the high-voltage supply to the transmitter.
4. When the channel is free, the receiver switches on the transmitter, which sends out the stored, coded signal.
5. Transmitter and receiver are switched off until another signal is initiated by a tide or visibility change.

At the Gravesend communication center the decoded digital information is passed from the decoding unit to a memory and readout panel.

(Continued on following page)

NEWS

The panel can memorize data from up to eight detectors, and it supplies outputs for the indicator lamps and recorders.

Harbor surveillance radar and frequency-modulated vhf ship-to-shore radio telephony facilities complete the traffic-control system.

Only one radar is now installed, a high-definition, X-band set using an antenna of six-foot span and feeding display to a 15-inch tube in the control room. Six more sets will be installed as the system is developed. Two transmitters and receivers are installed with remote-controlled changeover switching for continuous operation. ■ ■

AF Video Integrating Equipment Uses Extensive Static Storage

Awarding of an Air Force contract has revealed some of the design features of video integrating equipment that will be used to eliminate unwanted information from military radars.

Under the contract, Airborne Instruments Laboratory will build 29 video integrating groups. The groups will use time correlation techniques throughout.

In operation, the integrating equipment will link radar and the units that process video information for display, ranging and other purposes.

Stages include:

■ A moving target indicator velocity shaping canceler that is a double cancellation system employing feedback to adjust velocity response of the system for optimum performance against scanning clutter. In this system, two single cancelers with velocity shaping are cascaded with feedback around one of them to cancel signal return from stationary targets.

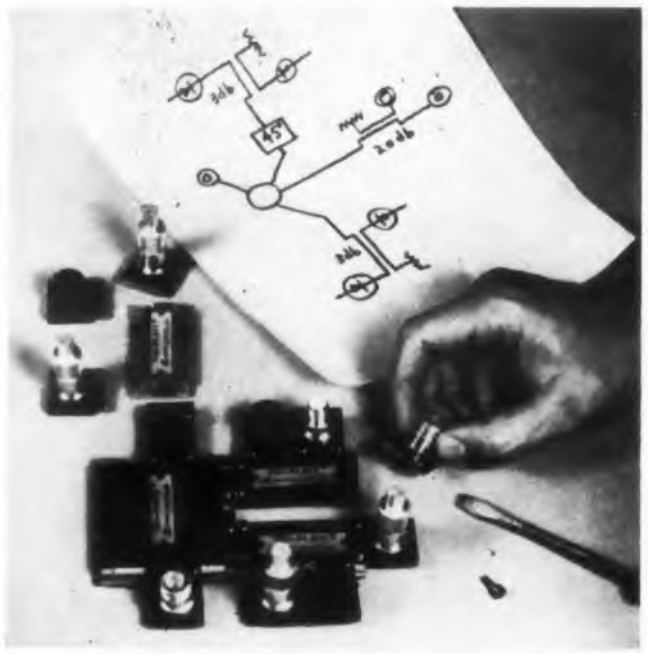
Video integrating equipment minimizes unwanted information on radar displays. Cabinets house (from left to right) velocity canceling and anti-jamming equipment, static storage facilities (drum-shaped container houses quartz delay lines), canceling equipment for anti-jamming, and, at right, main control and junction equipment.

- A pulse-width discriminator, which permits only radar video returns to come through.
- A pulse repetition frequency staggering unit that staggers prf every other period, shifting it back and forth between two rates.
- A pulse interference separator and blanker—essentially an inverted video integrator that does not enhance the signal. The unit measures coherence to determine whether video information from adjacent radar should be gated past the output circuits and automatically blanked out.
- A novel velocity filter.
- A video integrator for signal improvement.

In the design, static storage in the form of quartz delay lines is used for all processing, which is on a pulse-period-to-pulse-period basis.

The 1000-tube video integrating units are expected to reduce interference from all sources: fixed objects, natural moving targets like birds, adjacent radars, communications systems, electrical equipment, and intentional sources (jamming).

Breadboarding Made Easy



Modules for transferring transmission line schematics to breadboards can be put together with only a screw driver, according to designer, Sanders Associates, Inc.

Standard Due on RF Radiation Peril

The American Standards Association may draw up a standard for radio-frequency electromagnetic radiation hazards. The project, recommended by an ASA conference, and requested by the Navy's Bureau of Ships to pinpoint perils emanating from radar and other equipment, would include terminology, instrumentation and safety. Medical research into the biological effects of the radiation would be taken into consideration.

NEWS

Thermoelectric Air-Conditioner Being Designed for Submarines

The Peltier Effect cooling principle, already reported in use in Russian refrigeration and cooling units, will be used in a submarine air-conditioning design. The Radio Corporation of America has received a Navy contract for the project.

Modular blocks of solid-state thermoelectric materials will be assembled in banks to cool without moving parts. One of the design objectives will be to minimize effects of electrical losses and of heat flow back to the liquid-cooled system.

Solid-State Inverter Starts Jets

A fully transistorized inverter incorporating magnetic amplifiers provides a 3-amp surge to start the jet engines of Northrup's T-38 trainer.

The unit, one of a line of static inverters designed by Magnetic Amplifiers, Inc., of New York City, converts 18-24 v dc to 100-145 v, 320-360 square-wave cps, and is rated at 125 va.

The magamps are used to stabilize voltage, current and frequency and to provide a stable output voltage matched to changes in line or load voltage.

The company says its design is the first application of a solid-state inverter to jet-engine starting.

Static inverter using transistors and magnetic amplifiers weighs 3.5 pounds, measures 8 x 5 x 3 inches.

How to Talk to Flies

A Rutgers University scientist has recorded a blowfly's likes and dislikes by measuring vibrations of the insect's leg hairs through an oscilloscope.

A small, chloride-coated wire was attached to one hair of a fly's leg. Over both the leg and the wire a tiny glass capillary tube containing an electrolyte was placed. The tube was connected to the oscillator. Another wire to another of the fly's legs completed the circuit. Tasty food registered as low-amplitude lines on the scope, disliked food, as higher-amplitude lines.

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JEDEC No.	PIV	RMS Volts	Max. Average Rectified Current mA	Max. Surge Current One Cycle (amp)	JEDEC No.	PIV	RMS Volts	Max. Average Rectified Current mA	Max. Surge Current One Cycle (amp)
1N846	50	35	200	2A	1N868	50	35	100	1.0
1N847	100	70	200	2A	1N869	100	70	100	1.0
1N848	200	140	200	2A	1N870	200	140	100	1.0
1N849	300	210	200	2A	1N871	300	210	100	1.0
1N850	400	280	200	2A	1N872	400	280	100	1.0
1N851	500	350	200	2A	1N873	500	350	100	1.0
1N852	600	420	200	2A	1N874	600	420	100	1.0
1N853	700	490	200	2A	1N875	700	490	100	1.0
1N854	800	560	200	2A	1N876	800	560	100	1.0
1N855	900	630	200	2A	1N877	900	630	100	1.0
1N856	1000	700	200	2A	1N878	1000	700	100	1.0
1N857	50	35	150	1.5	1N879	50	35	50	.5
1N858	100	70	150	1.5	1N880	100	70	50	.5
1N859	200	140	150	1.5	1N881	200	140	50	.5
1N860	300	210	150	1.5	1N882	300	210	50	.5
1N861	400	280	150	1.5	1N883	400	280	50	.5
1N862	500	350	150	1.5	1N884	500	350	50	.5
1N863	600	420	150	1.5	1N885	600	420	50	.5
1N864	700	490	150	1.5	1N886	700	490	50	.5
1N865	800	560	150	1.5	1N887	800	560	50	.5
1N866	900	630	150	1.5	1N888	900	630	50	.5
1N867	1000	700	150	1.5	1N889	1000	700	50	.5

Storage temp. −65° to +200°C.
Max. Leakage current full cycle average 20μA.

Typical Full Load Forward Voltage Drop Full Cycle .6 Volts.

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Static Switch Operates Electrochemically

Electrochemistry, a completely new approach to switching and modulating ac power has been applied to a component that may set new horizons for design engineers interested in a device capable of an unlimited number of operations without apparent wear or deterioration.

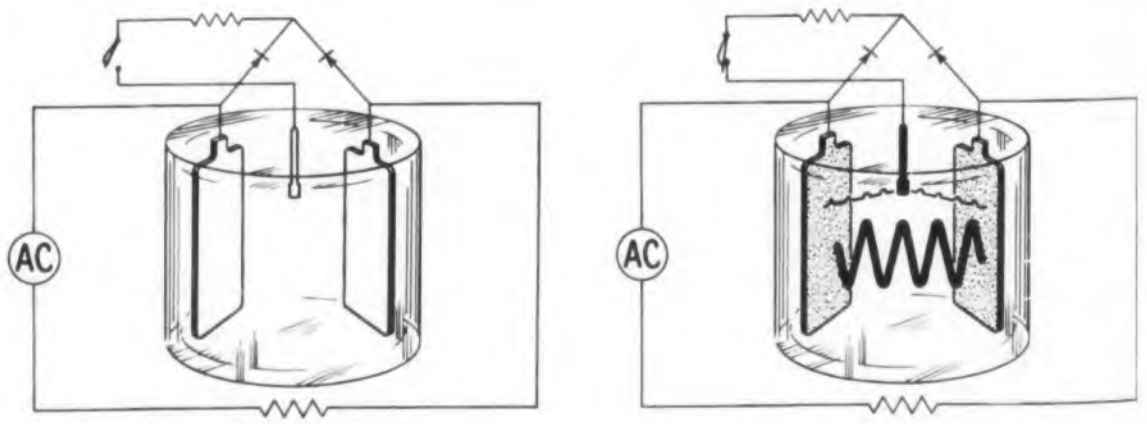
The device shown above consists simply of two load-connected electrodes and a grid-control element, all immersed in an electrolytic bath sealed in a container.

A small signal on the acid-resistant platinum grid element makes the two load electrodes permeable to ions and instantaneously changes the state of the electrodes from nonconducting to conducting. Large quantites of ac current can then flow from one electrode to the other through the electrolyte of acid and free metal ions. The load electrodes can be made of a film-forming material such as tantalum. Their area determines current-handling capacity of the device.

Control of the load current by the stimulating signal can be for full-on, full-off, or for modulation purposes. When the control signal is removed from the grid, or when another signal of opposite polarity is applied, the conductive surfaces of the electrodes are immediately restored to their original nonconductive state, blocking load-current flow through the unit. It switches without chopping or causing other distortions.

According to the Ovitron Corp., Detroit, developers of the electro-ionic control, the device has been lab tested for

How Chemical Switch Can be Used as Modulator



OFF CONDITION — ON CONDITION

In "off" position no dc flows to platinum grid immersed with electrodes of film-forming metal in electrolyte bath. One electrode connects to ac supply, the other to load. When a tiny dc bias is passed through back-to-back diode rectifiers that keep ac from the grid control circuit, the grid is energized, resistance of the electrolyte drops, and power passes between electrodes. The variable resistor in the grid circuit can modulate load circuit.

Chemical control unit for static switching is size of 1.5-inches cube, can handle from 3 to 70 v ac at 4 amp with no internal wear.

application in proximity switches, logic devices, modulators, circuit breakers, error detectors, amplifiers, regulators and time delays.

The new switch is intended to improve on performance of existing static switches like switching transistors (which cannot yet handle high power directly without amplification), magamps (which are still costly), tubes (whose hot filaments place them between true static switches and mechanical devices that wear out), and silicon controlled rectifiers, which cannot handle ac directly.

Though the version shown permits a current leakage between the control and load circuits in the "off" position, designs have been developed using inexpensive filament transformers to provide full isolation.

Available in sample quantities is a unit rated at 4-amp, 3-v-min to 70-v-max, with a rated temperature rise of 55 C. Ovitron claims relatively stable operation from −10 to +150 C regardless of vibration, shock, impact or position.

The unit is designed to plug in and is sealed in an epoxy container. Control dc is obtained from ac passed through two small silicon rectifiers. Above a peak surge of 140 volts, power will short through the electrolyte, but fail-safe operation is provided for dangers from high gas pressures caused by severe overcurrents through the electroylte. ■ ■

NEWS

Biggest Industrial Sales Boom In DP and Nuclear Equipment

ACCORDING to the latest Electronic Industries Association Factbook, sales of data-processing equipment captured 21 per cent of the industrial electronics market in 1958. The previous year DP equipment held only 7 per cent of industrial sales.

Nearly 2000 computers and DP units are installed in 1200 companies, and going into 1959 there were 3000 units on

Nine Years of Electronic Growth

	1950	1951	1952	1953	1954	1955	1956	1957	1958
Factory sales									
in millions of $	2600	3500	4400	5000	5100	5500	6100	7800	7940
consumer	1500	1400	1300	1400	1400	1500	1600	1700	1600
replacement	250	350	400	500	650	750	850	900	860
industrial	350	450	500	600	650	750	950	1300	1380
military	500	1300	2200	2500	2400	2500	2700	3900	4100
TV set production[1]									
in thousands	7464	5385	6096	7216	7347	7757	7387	6399	4920
Value of TV sets									
in thousands of $	1350	957	1049	1230	1029	1071	939	833	668
AM, FM, TV stations, US									
AM	2232	2330	2391	2521	2669	2824	3008	3180	3318
FM	676	637	616	560	552	540	530	537	571
TV[2]	107	108	129	356	439	482	511	521	546[3]
Tube sales, mfg[4]									
in millions of tubes	383	376	369	437	385	480	464	456	397
Transistor sales, mfg									
in thousands	—	—	—	—	1318	3647	12840	28738	47051
Transistor value									
in thousands of $	—	—	—	—	5122	12253	37352	69739	112730
Semiconductor diode & rectifier sales, mfg									
in millions of $	—	—	20[5]	25[5]	20[5]	30[5]	50[5]	103	116
Component sales, mfg									
in millions of $	1140	1261	1730	NA	2008	2200	2280	2435	2200
Manufacturers									
Radios[6]	84	70	63	69	65	64	45	38	40
TV sets[7]	140	110	94	90	83	72	51	45	38
Employment									
In communications mfg. monthly av.									
in thousands	350.7	405.8	474.2	556.0	490.1	515.7	557.8	579.8	545.0
Maint., install. costs									
in millons of $ est.	—	1000	1300	1500	1800	2100	2300	2700	2800

(1) 1947: 179, 1948: 475, 1949: 3000 (2) 1947: 19, 1948: 50, 1949: 98 (3) 463 vhf, 83 uhf (4) 1947-49 average: 201
(5) germanium & silicon only (6) 1941: 120 (7) 1941: 2

order at prices ranging up to $3 million each.

But fastest percentage riser among the main types of electronic equipment in actual sales during 1958 was electronic equipment for nuclear applications. Sales in 1958 were 30 per cent greater than the $27 million registered in 1957.

Sales of testing and measuring devices ranked second to those of data processing in 1958 in sales to industry, rising by $10 million over the $270-million-worth sold in 1957.

Other facts on the U. S. electronics industry brought out by the EIA's 1959 Factbook and not included in the adjoining tables are:

- Expenditures for military electronic R & D is rising fast; R & D costs reached $390 million during fiscal 1958 from $270 million during fiscal 1955.
- There are 4600 electronic plants in the U. S.; 46 per cent employ 50 workers or less, only 15 per cent employ over 500.
- Since 1947 the number of electronic employees has more than doubled to today's 700,000. Nearly 100,000 of these are engineers and 110,000 are executive and salaried employees. ■ ■

Industry: A $1.38-billion Market

Factory Sales To The Industrial Market (In Millions of Dollars)

Type of Equipment	1954	1955	1956	1957	1958
Computers & Processing	$ 47.0	$ 72.0	$125.0	$ 265.0	$ 290.0
Testing and Measuring	110.0	145.0	170.0	210.0	220.0
Navigational Aids	60.0	65.0	70.0	95.0	100.0
Landmobile Microwave Broadcasting	90.0	95.0	120.0	150.0	155.0
Industrial Controls			115.0	150.0	160.0
Nuclear-Electronic Apparatus			22.0	27.0	35.0
Medical and Therapeutic	343.0	373.0	110.0	139.0	145.0
Commercial Sound			110.0	136.0	140.0
Communication			30.0	36.0	40.0
Miscellaneous			78.0	92.0	95.0
TOTAL	$650.0	$750.0	$950.0	$1,300.0	$1,380.0

NEWS

Parley Shows U. S. in Computer Lead, But Gap is Closing Fast

THE data-processing gap is narrowing rapidly . . . Europe's small-team approach is getting results . . . If the Russians are ahead of the rest of the world in data processing, they are not talking about it . . .

These facts emerged from the International Conference on Information Processing, sponsored by UNESCO earlier this summer in Paris.

Another outgrowth of the conference was the virtual assurance of a permanent international body devoted to the science of data processing. Future international conferences will probably be held under the sponsorship of the International Federation of Information Processing Societies, now being formed. The organization is expected to hold its first meeting for members sometime in 1960.

Chairman of the provisional bureau of the new federation is I. L. Auerbach of Auerbach, Narberth, Pa. He represented the National Joint Computer Committee of the U.S. at the Paris conference.

The new federation will have its headquarters in Brussels, and its first international conference will probably be held in 1963 at a site still undetermined.

UNESCO's role in the conference just held, the first international one in this field, was unofficial except for its promotion of the idea of international exchange of data-processing information.

The United States, however, played a rich-uncle part at the conference. Americans organized fully half of the symposia, presented more than a quarter of the papers and made up some 400 of the conferees. Their representation was exceeded only by French registrants.

More than 210 conferees came from Germany, upward of 160 from England, about 80 each from Sweden, Italy and the Netherlands, and 38 from the USSR.

Altogether more than 1800 computer

Honeywell 800 Unveiled in Model

Henry Dreyfus-styled, all-transistorized computer is shown in medium-size configuration. Honeywell's Datamatic Div. expects to start delivering the highly touted unit in October, 1960. According to the company, the 800 can handle up to eight separate computations simultaneously.

engineers, scientists and mathematicians were at the conference; they came from 37 nations.

Some first-hand observations:

• The U. S. is still ahead in computer technology and data processing. But with the fairly free interchange of information and intense world-wide activity in data processing, other nations are rapidly catching up. They will soon be—if they are not already—in a position to compete with U. S. companies in the American market.

• Japan, Germany and France, through papers and exhibits at an equipment show held in conjunction with the scientific conference, impressed Americans with their advances.

• Though German machines were not transistorized, they were competently designed and were built by the latest production techniques.

• The Japanese showed three medium-speed machines, all with parametrons, and reported no parametron failures in the machines for two years. The units were excellently packaged and showed fine industrial design.

• The aggressive French company Compagnie Générale des Machines Bull showed parts of its Gamma 60 machine, which compares favorably with some of the best U. S. units. It is using molded wiring in some components. Two other French companies, SEA and Nouvelle Electronique, also exhibited first-class developments.

• One observer attributed much of the European success to the use of small design teams. Common practice is to have four or five outstanding men, rather than a platoon of assorted engineers, work on a problem. German Standard Electric Co. started from scratch to design a computer and got what it wanted from a five-man design team. Small groups are also the practice in Great Britain and Japan.

• General feeling at the conference was that the industry was moving into a period of concentration on use of computers rather than one of rapid development of new machines.

• The Russians were not talking about any major developments in data processing or machine translation, though they reported heavy work in mathematical analysis.

• The Red Chinese, according to the Russians, have made a "big jump." They have designed and readied for production a machine capable of 10,000 operations per second. The unit is a good one, though not transistorized, a Russian expert reported, and is an improvement on the Russian unit that was used as a model. The Chinese are now working on transistorized designs.

• One sum-up of the conference was that though a knowledgeable U. S. engineer might not have learned of any important technical innovation, he did well to get a first-hand acquaintance with foreign data-processing work. ■ ■

NEWS

Changes in S-band Standing Wave Operate Surveillance Device

A miniature surveillance device has been designed to register disturbance of a self-generated microwave field. It works this way:

A uhf oscillator in the transistorized detector generates a low-repetition-rate S-band field. A high-Q fm detector transforms disturbances of the received standing-wave to a high-amplitude fluctuation of output voltage which activates an indicator.

A five-element semiconductor circuit of almost infinite gain monitors the cable connecting the transponder and indicating unit. The same tightly designed circuit distinguishes between permitted disturbances of the field, as in daylight operations around a factory, and disturbances that must be registered. This is done with the help of a "Day-Night" switch, which the same circuit also monitors.

Patents are pending on the device, and according to its developers, the Singer Military Products Division, two of the ideas are basic. The company states that the system has been approved by one of the services for a large surveillance program and that during evaluation it could not be jammed.

SWAMI intrusion detector (for Standing Wave Area Motion Indicator) consists of sensor (right, rear), Day-Night control box, (left, rear), and monitor unit. Uhf signals are used in radar-like fashion to keep an area under surveillance.

Nuvistor-Design Tetrode In Development at RCA

The unusual design principles of the Nuvistor small-signal triode tube are being applied in the design of a small-signal tetrode and a beam power tube, the Radio Corporation of America has announced. The company has just made triode Nuvistors available on a limited sampling basis.

BUILT-IN RELIABILITY

Low R_{cs} (0.05Ω) at high temperatures insured by large ring emitter-base area. Leakage currents minimized by all welded construction . . . no contaminating solders or fluxes used!

High current-carrying capacity and maximum safety against over-heating provided by heavy 90-mil emitter lead.

GERMANIUM TRANSISTOR APPLICATION NOTES

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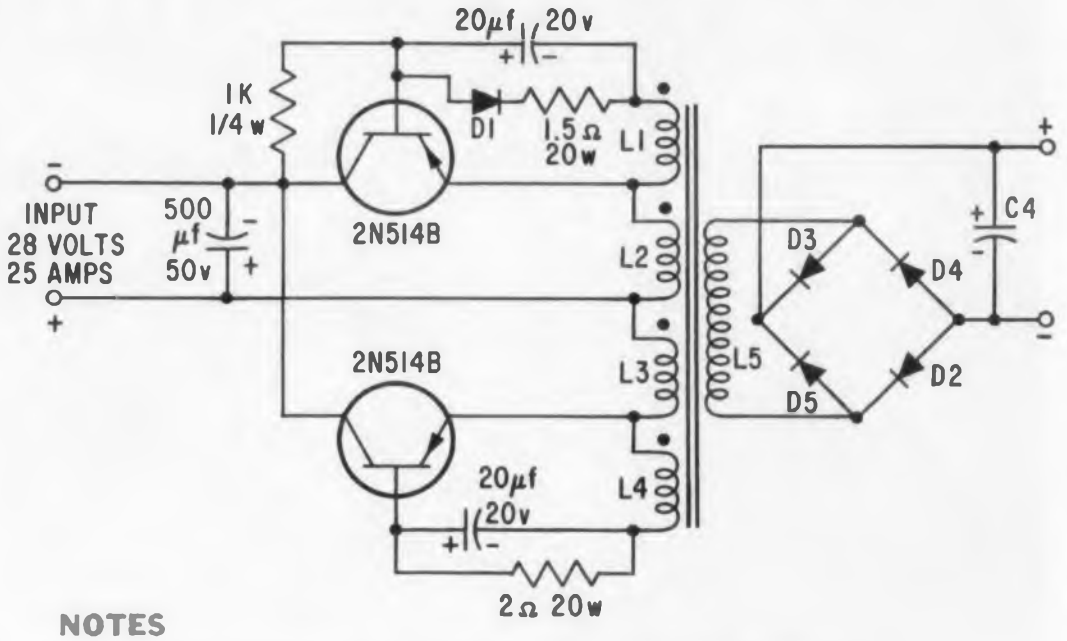

NOTES

L5 may be wound according to the output voltage desired, allowing about 0.639 turns per volt. The wire size should be large enough to allow one circular mil per millampere. The output current and load will then determine D2, D3, D4, D5, and C4.

L2, L3—17 turns each #10 bifilar wound

L1, L2—4 turns each #16

Core-type 50022-2A Magnetics, Inc.

Q1, Q2—2N514B 80 volt 25 amp each mounted on a minimum of 200 sq in. of ¼" aluminum for operation up to 50°C.

D1—1N1124 mounted on a minimum of 1 sq in. of exposed aluminum 1/16" thick. Operation to 50°C.

Frequency about 1 kc.

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Ranging from 10 to 25 amps in 40, 60, or 80 volt types, all units feature guaranteed gain at maximum rated currents and *1.5 volts* V_{CE}. For your high current switching applications, all types highlight typical switching times at 25°C of 12.0 usecs (t_{on}) and 7.0 usecs (t_{off}).

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maximum ratings at 25°C

		2N511	2N511A	2N511B	2N512	2N512A	2N512B	2N513	2N513A	2N513B	2N514	2N514A	2N514B	units
V_{CBO}	Collector-to-Base Voltage (I_C = −5ma, I_E = 0)	−40	−60	−80	−40	−60	−80	−40	−60	−80	−40	−60	−80	v
V_{CEK}	Collector-to-Emitter Voltage (V_{BE} = +0.2 v, I_C = −5ma)	−40	−60	−80	−40	−60	−80	−40	−60	−80	−40	−60	−80	v
V_{EBO}	Emitter-to-Base Voltage (I_E = −5ma, I_C = 0)	←	−30	→	←	−30	→	←	−30	→	←	−30	→	v
I_C	DC Collector Current	←	−10	→	←	−15	→	←	−20	→	←	−25	→	a
I_E	DC Emitter Current	←	10	→	←	15	→	←	20	→	←	25	→	a
I_B	Base Current	←					−5			→				a
	Total Dissipation	←					80			→				w
T_J	Junction Temperature	←					95			→				°C

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CIRCLE 18 ON READER-SERVICE CARD ➤

WASHINGTON REPORT

Ephraim Kahn

AMC to Deal More Directly With Its Subcontractors

Electronic firms may find that work on subcontracts that trace back to the Air Materiel Command will result in direct dealings with AMC officers, as well as with the prime contractor. AMC has decided that there can be too much lost motion in going through channels, through the prime contractor. So its logistics support managers and commodity class managers have been authorized to deal directly with subcontractors, provided notification of this is given to the prime contractor.

There are technical benefits to this "significant step forward" in supply management for the Air Force. AMC specialists can talk over their needs and requirements with subcontractor design engineers and technicians, for example.

AMC also sees this new freedom to communicate as an important step toward standardization of ground support equipment—and this is looked on as an especially significant achievement since a high proportion of money for weapons systems is spent on this type of equipment.

A side benefit of direct contact between AMC and subcontractor technical personnel is likely to be a tightening of procurement practice. Face-to-face discussion of problems will inevitably lead to greater familiarity with subcontractor problems and policies. AMC personnel will, no doubt, be alert to any information they may garner on pricing policies, for instance. It is well known that the House Armed Services Committee has expressed a degree of concern bordering upon irritation with the military's sometimes sketchy knowledge of subcontract terms.

Standardized Make-or-Buy Rules Might Be On Way From Services

Make-or-buy criteria in military contracting may soon be standardized for all of the Armed Services. A revision to the Armed Services Procurement Regulation is under consideration that would conform Defense Department practice with the system in current use by the Air Force.

It is believed certain that the new ASPR material will stick to the principle that the decision whether to make or to buy any single item must be made by management. But contracting officers working with companies would have to make

themselves aware of the possible consequences of the make-or-buy decision both in terms of economic impact and effect on the military program concerned.

The make-or-buy criteria will shed light, too, on the question of subcontracting. It is expected to provide what will be a virtual checklist of justifications for subcontracting—price reasonableness, aid to small business, quality, mobilization base maintenance, and other items.

A general policy on make-or-buy would probably be set in the original contract, which would also establish procedures to enable contracting officers to see to it that the prime contractor stuck to these general principles. A proviso calling for observance "to the greatest practicable extent" of the negotiated make-or-buy "structure" in contracts is already being inserted by the Air Force into those pacts which incorporate a policy statement on this point.

Air Force practice is to list the types of items, sometimes in quite general terms, which may be subject to a decision to make or to buy. Contractors must supply "an adequate justification" for any recommendation to buy, and—when feasible—they are expected to propose subcontractors by name. The contractor and government officials then attempt to reach mutual agreement on the proposals.

There Are Exemptions

The Air Force exempts certain types of contracts from this provision. Among the exempt pacts are those valued at less than $350,000; R & D for products that will not enter the Air Force inventory; and fixed-price contracts that (1) do not contemplate the use of government-owned facilities and (2) do not provide either for price incentives or for price redetermination.

Contractors for the military will also find that a forthcoming revision to the ASPR requires them to keep their cost data on a more current basis. The new requirement is an attempt to answer some of the pointed Congressional criticism that has been directed at the Defense Department in this regard.

Cost data supplied by contractors is used in negotiating prices. The General Accounting Office recently has held in a number of cases that overcharges by contractors could be traced to use of cost information that was out of date. At present, the Defense Department is considering requiring a certification from all major contractors. This would entail a statement that the contractor has reviewed the cost data under a contract, and a further commitment saying, in effect, either that the information is correct or that appropriate adjustments have been made to compensate for the fact that the cost data were not current.

MEETINGS

Calendar of Events

August

18-21 WESCON Show and Convention, Cow Palace, San Francisco, Calif.*

20-21 Symposium on Industrial Uses of Radioisotopes, U. S. Atomic Energy Commission, in cooperation with the Buffalo Chamber of Commerce, University of Buffalo, and Canisius College, Buffalo, N. Y.

23-26 AIEE, 6th Electrical Conference of the Petroleum Industry, Wilton Hotel, Long Beach, Calif.

31-2 Semiconductors Conference, Metallurgical Society of AIME, Statler Hotel, Boston, Mass.

September

1-2 Conference on Chemistry in Aerodynamic and Space Flight, Air Force Office of Scientific Research, General Electric Co., University of Pennsylvania, Philadelphia, Pa.

1-3 14th National Meeting, Association of Computing Machinery, MIT, Cambridge, Mass.*

6-12 International Conference for Standards on a Common Language for Machine Searching and Translation, Western Reserve University and Rand Development Corp., Tudor Arms Hotel, Cleveland, Ohio.

7-10 6th Annual International Meeting; The Institute of Management Sciences, (TIMS), Paris, France.

17-18 Engineering Writing and Speed Symposia, IRE, Boston, Mass. and Los Angeles, Calif.*

18-19 3rd Technical Symposium, Cedar Rapids section IRE, Sheraton-Montrose Hotel, Cedar Rapids, Iowa.

18-20 8th Annual High Fidelity Show, International Sight and Sound Exposition, Inc., Palmer House Chicago, Ill

20-25 14th Annual Conference and Exhibit, Instrument Society of America, Chicago, Ill.

21-22 Standard Engineers Society 8th Annual Meeting, Boston Section, Hotel Somerset, Boston, Mass.

23-25 4th Annual Special Technical Conference on Non-Linear Magnetics and Magnetic Amplifiers, AIEE, IRE, Shoreham Hotel, Washington, D.C.*

28-30 National Symposium on Telemetering, IRE, Civic Auditorium and Whitcomb Hotel, San Francisco, Calif.

* Includes meetings described herewith.

WESCON Show and Convention, August 18-21

The show will feature numerous exhibits which will fill the Cow Palace in San Francisco. Complementing the product lines will be papers covering all phases of professional group interests. A "new look" in the technical program is being planned this year which will limit each of the usual 40 daytime sessions to three full-length papers in each. A second innovation will be the introduction of a "panel of peers," a group of experts in the field, invited to comment on the group of papers at the completion of each session. Registrants will be able to obtain and review all papers prior to their presentation through the Convention Record.

14th ACM National Conference, September 1-3

Conference of the Association of Computing Machinery will be held at the Massachusetts Institute of Technology, Cambridge, Mass. Technical papers to be presented will cover numerical analysis, data processing, automatic programming, language translation, digital and analog devices, and various applications of computers. Chairman of Local Arrangements is: Frank M. Verzuh, Computation Center, MIT, Cambridge, Mass.

Engineering Writing and Speech Symposia, September 17-18

To be held simultaneously on the East and West Coast, the IRE Symposia will be devoted to "More Effective Communication of Scientific and Engineering Information." The West Coast session will be held at the Ambassador Hotel, Los Angeles, Calif., and will feature motivations that make the engineer want to improve his writing ability, what he can do to improve himself and how to go about it, and educational steps for further improvement. The East Coast session will meet at the Sheraton-Plaza Hotel, Copley Square, Boston, Mass. Four sessions will cover: "Communication in Modern Society," "Problems in Communications Facing the Professional Man," "How To-Do-It Topics for Engineers and Scientists," and "Writing and Editing." National Symposia Chairman: T. T. Patterson, Jr., Radio Corporation of America, Bldg. 13-2, Camden, N.J.

4th Annual Special Technical Conference on Non-Linear Magnetics and Magnetic Amplifiers, Sept. 23-25.

To be sponsored by the AIEE and IRE and will be held at the Shoreham Hotel, Washington, D.C. The technical program will consist of sessions devoted to the theory, design, and application of: (1) magnetic amplifiers and similar saturating core devices, (2) magnetic amplifiers and semiconductor devices in circuit combinations, (3) magnetic components for switching circuits and digital computers.

Paper Deadlines

October 23: Deadline date for papers for the **1960 IRE Convention** to be held **March 21-24,** Waldorf-Astoria Hotel and New York Coliseum, New York. Send a 100-word abstract in triplicate, including title of paper, name and address, and a 500-word summary in triplicate, including title of paper, name and address to: *Gordon K. Teal, Chairman, 1960 Technical Program Committee, The Institute of Radio Engineers, Inc., 1 E. 79 St., New York 21, N.Y.*

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DATA INSTRUMENTS Pioneers in equipments for fast and accurate analysis of test data, with automatic recording of punched cards, tapes, or printed lists—for aircraft and missile flight tests, industrial and scientific applications.

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SIDE MOUNTED RELAY
0.200 grid / maximum module height 0.400 inches / 25 G vibration to 2000 cycles / integral part of printed circuit—ideal for dip soldering

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thermal shockproof—temperature range —55 C to 150 C / up to 2200 uuf—200 WVDC / 0.0590 inches maximum height / 0.155 inches mounting diameter

CIRCLE 41 ON READER-SERVICE CARD

CIRCLE 42 ON READER-SERVICE CARD

EDITORIAL

Bravo For The New Look at WESCON

Three cheers for the men behind the scenes—the men who planned the WESCON show. What they have done will make this gathering one of the most useful ever held—a model for future shows.

It won't draw the record crowds that the national Radio Engineering Show does in New York. It won't have as many exhibitors. It won't have the massive volume of technical papers.

Its theme will be value, not volume—especially at the technical sessions. Just note the new look at the sessions:

- No more than three papers at each technical session.
- Advance publication of each paper in the WESCON Convention Record.
- A "panel of peers" at each session, to comment authoritatively, on each paper.
- At least an hour of open discussion at each two-and-a-half hour session.

This streamlined format is a tribute to its planners, Bernard M. Oliver, chairman of WESCON's executive committee; Albert J. Morris, this year's convention director; and Karl R. Spangenberg, chairman of the 1959 technical program.

Value-packed technical sessions are only half of what San Francisco will offer this month. The exhibits, too, will have a face-lifting.

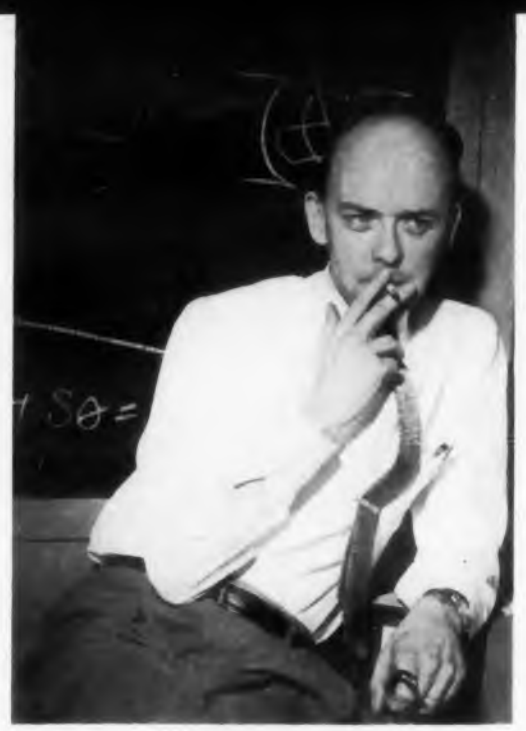
Most obvious will be the prominent display, in the Cow Palace's central auditorium, of 30 commercial electronic systems, instruments, or components, which have won WESCON's industrial design awards. Of these, 10 will receive Awards of Excellence; 20 will receive Awards of Merit.

Awards will be presented on August 18th, at the opening ceremony of the four-day gathering. A panel of leading professional industrial designers and industrial design educators will have judged more than 150 competition entries for visual clarity of function, ease and safety of operation, and appropriateness of appearance.

That's quite a bill of fare. Congratulations, WESCON.

George D. Rostky

What Electronic Designers Should Know About Meter-Relays



George J. Crowdes
Chief Engineer, Assembly Products, Inc.
Chesterland, Ohio

George J. Crowdes believes meter-relays have a broad untapped potential. In this article he provides some theoretical background on the units, discusses some of their applications and corrects some misconceptions about them.

CONTACT meter-relays are being used more and more because they stabilize and simplify electronic circuits. And meter-relays easily do certain things that are difficult to achieve by electronic means. Knowing the types available, their characteristics and applications will help engineers understand the electronic potentialities of meter-relays.

Basic Background

A meter-relay is the most sensitive of all electromagnetic relays: it can be actuated directly by a signal as small as 0.2 μa. It is more sensitive than other relays because it is also a moving coil D'Arsonval meter, which operates on much smaller signals than other electromechanical relay movements. Since it has a dial, a meter-relay continuously indicates a signal from any variable that can be measured electrically through a suitable transducer. Finally, a meter-relay is a monitoring device with easily adjustable signal set points that trigger control action.

The basic idea of a meter-relay involves mounting a contact on the pointer carried by the meter's moving coil, with a mating contact positioned inside the meter. The second contact is usually fastened to another adjustable pointer, or to a fixed stud or pin. When the signal current rises or falls to the point marked by a fixed contact, a circuit closes across the contacts. This circuit usually works, through slave relays, into one that carries much greater current, and useful work is done.

The Contact Types Available

There are two general types of contacts in meter-relays: locking and non-locking. Locking contacts are split into locking coil and magnetic types. It is generally agreed that the locking coil type is the most reliable and assures the most positive control action. See Fig. 1. The locking type has some limitations, but these are small compared to the added reliability. The restrictions imposed by the locking circuit, moreover, may be easily surmounted with a few simple tricks. Another important advantage of the locking coil is longer contact life.

By itself, the moving coil of a meter-relay exerts only a few milligrams pressure between the contacts. Such a non-locking arrangement is unreliable because it often leads to sticking contacts when the signal is removed. Reasons for sticking include arcing, mechanical wear and natural adhesion between two pieces of metal.

In general, non-locking meter-relays are usually limited to uses where (1) the signal abruptly rises above and falls below the point-of-contact; (2) contact load is less than 10 μa; (3) open-circuit voltage is less than 10 v; and (4) a high torque (1 ma or better) meter movement is used. Even under these conditions, non-locking contacts usually have a limited life of not much more than 100,000 operations.

But locking contacts may last between 10 and 20 million cycles, if properly rated. The best design for locking action involves an extra coil of about 100 turns of fine wire, separately connected, but wound on the moving coil. This locking coil is connected to the contact carried on the moving pointer and to a dc (or rectified ac) source in series with the load. Thus, when the contacts close, current flows through the locking coil. Even though there may be high contact resistance at the instant of contact, the small current in the locking coil increases contact pressure, and starts to reduce this resistance. As the resistance decreases the current increases until the full current in the locking coil gives high locking torque and positive contact. This process is almost instantaneous. Without the locking coil, pressure is no more than 5 mg; with the locking coil, pressure is from 1 to 3 g.

The locking torque, in the design discussed, also loads the spring holding the adjustable contact. When the current stops flowing through the locking coil the loaded spring snaps the contacts apart and prevents sticking. This action has a unique wiping and self-cleaning quality that is not achieved by any other design of meter-relay.

In the magnetic type of locking meter-relay, small permanent magnets are the fixed contacts. After being locked magnetically, contacts are separated mechanically by scissor-like arms actuated by a pushbutton or solenoid. This type of meter-relay has the advantage of carrying either ac or dc through the contacts. Magnetic type units will also stay locked until reset even after current stops flowing. This can be advantageous sometimes. On the other hand, the scale arc of the magnetic locking meter-relay is limited, usually to about 20 deg (compared to about 95 deg of other types). The point of contact is also determined by the magnetic field rather than physical contact.

Ranges Vary

Meter-relays are furnished in ranges from 0 to 5 μa to 0 to 50 amp, or 0 to 5 mv to 0 to 500 v. Ranges below 75 mv come in dc only because of rectifier limitations. Otherwise, all ranges are available in ac or dc. Higher voltage or current ranges may be made with external multipliers, shunts or transformers.

Contact ratings are anywhere from 1 to 150 ma and from 6 to 125 v dc. Dc is best for the contacts, but half-wave or full-wave rectified ac is suitable. Unrectified ac causes arcing and welding. For proper operation, meter-relay contacts should never be overrated. The locking

coils of standard meter-relays operate on currents ranging between 5 and 25 ma.

Units are Stable and Accurate

One of the best characteristics of meter-relays is their inherent stability. Once calibrated they offer a scale of values that remains set. All the positions on the meter-relay dial may then be used as stable reference points, and the limit pointers may be adjusted anywhere along the scale arc. In circuits having meter-relays for stability, electronic components may be used at either the signal or control ends. Signals are checked to make sure they do not exceed preset limits. If they do, the meter-relays trigger other signals to controlling apparatus that might otherwise tend to hunt and drift.

Meter-relays also have a good operating accuracy. Normal calibrating accuracy is 2 per cent, but repeatability of the set point is 0.25 per cent or better. In all cases, point-of-contact accuracy—the differential between the signal that will leave the contacts open and the signal that will close them—is less than 1 per cent of full scale. Greatest accuracy at the working point can be achieved with meter-relays having up to two-thirds of the maximum value suppressed. Dial indicating accuracy is about ±2 per cent of full scale. Therefore, with a 10 μa meter-relay having point of contact accuracy of 1 per cent, a change of 0.1 μa will actuate the contacts. With a 0 to 5 mv scale, the differential can be as small as 0.05 mv.

Because they only require power in the lower microwatt range while working into high wattage circuits, meter-relays are highly efficient, simple amplifiers. In certain circuits the power gain accomplished by a meter-relay with a full-scale range of 1 ma can be as high as 1×10^6. This gain is conservative—it can be much greater. A 1 ma meter-relay may be used, for example, to switch a circuit of 300 ma at 100 v, or 30 w. Even at half-scale, of 500 ma, the meter-relay requires only 50 mv and thus needs only 25 μw of power. When the trip point is below half-scale, which is quite common, the power gain is much larger.

The standard 1 ma meter-relay, moreover, has a relatively high torque movement. When lower torque meter-relays are used, the power gain jumps again. A meter-relay used as a 300 deg pyrometer, with coil power at full scale of only 2.5 μw can switch 30 w and thus realize a power gain of more than 10×10^6.

Response Time Limited

Compared with the almost instanteous speeds of many electronic devices, meter-relays are limited in response time. Response time of a meter-relay may be defined as the interval required for the pointer to reach 99 per cent of its deflection for a given applied torque. This time will vary with three factors: torque, inertia and damping.

The fastest practical response time of meter-relays, in general, is about the same as that of panel meters (roughly 100 msec). When the response times of other units in a circuit especially relays, are added to the response time of meter-relays, however, the designer may be dealing with a minimum total interval of 250 msec. The total time required for ultimate control action is often as much as 500 msec.

Response times can be improved in various ways, especially by using more power. One method is overdriving, as when the contact is set at 40 μa and the signal reaches 80 μa. In a recent case, a practical 75 msec speed was developed in a 1 ma meter-relay by using 670 μw of power (for a 670 ohm coil). This compares with the standard consumption of 100 μw for such a meter-relay.

Another method of improving response time for a given meter movement is to literally move the low pointer stop upscale from its normal position without changing the meter's calibration.

If response times are important in a given application, the designer should specify (1) tolerance on response time, (2) tolerance on calibration, (3) external signal circuit impedance, (4) allowable overshoot, and (5) internal resistance limitations, if any.

Units Sensitive to Shock, Vibration

Like any moving coil instrument, a meter-relay is sensitive to shock and vibration. When they are subjected to rapid horizontal or vertical accelerations, standard meter-relays may show inaccuracies because of the unbalanced moments in their coil mechanisms.

One type that overcomes these problems fairly well is the VHS non-indicating meter-relay. It functions internally like a conventional unit, but it has no meter or indicating pointer. It will withstand shock of 20 g without permanent damage, although the moving coil assembly may be displaced temporarily.

Magnetic locking meter-relays also may be obtained with shock resistance much greater than that of standard types. One magnetic contact model will withstand more than 500 g.

Comparatively New Uses

A potentially broad and still comparatively new field of application for meter-relays, is their use in vacuum tube voltmeter circuits. In almost all cases, a meter-relay can be inserted simply in these circuits in place of any indicating meter. The circuits then have control or alarm features along with the unique ability (because of high input impedance) to measure voltage without loading the circuit. Automatic ground-testing of missiles is among the prime applications of vtvm circuits having meter-relays.

Occasionally design problems arise in connection with "isolated" meter-relays. Such problems can almost always be avoided by consultation with meter-relay manufacturers. An isolated meter-relay is one whose signal and locking coil leads are brought to separate LUGS. (Usually, there is a common connection.)

If there are other instruments in a signal circuit, an isolated meter-relay is generally specified. With an unisolated unit, the locking coil may push the readings of other instruments past their limits.

Various other unusual circuit requirements may

Fig. 1. Contacts in meter-relays can be either non-locking or locking. It is generally agreed that the locking type is the most reliable.

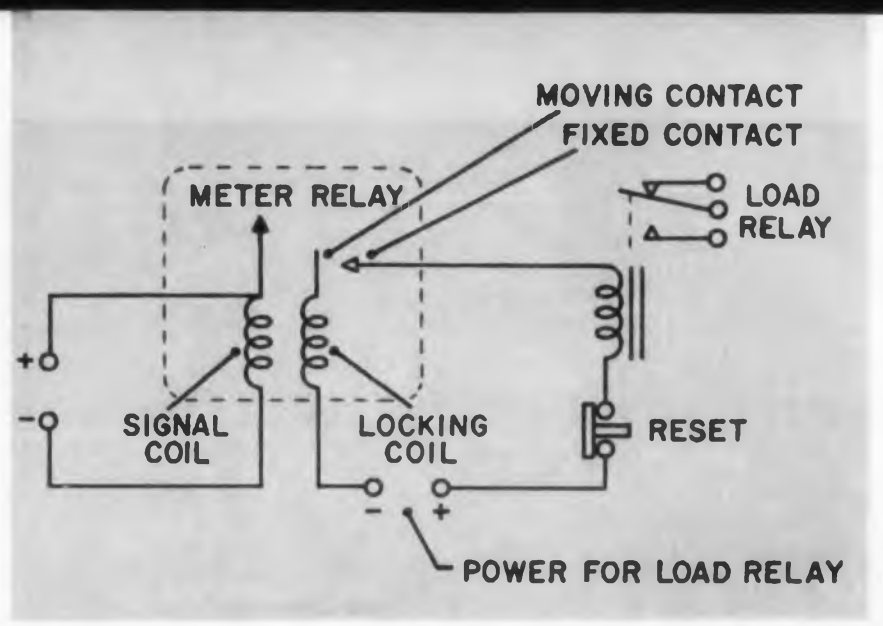
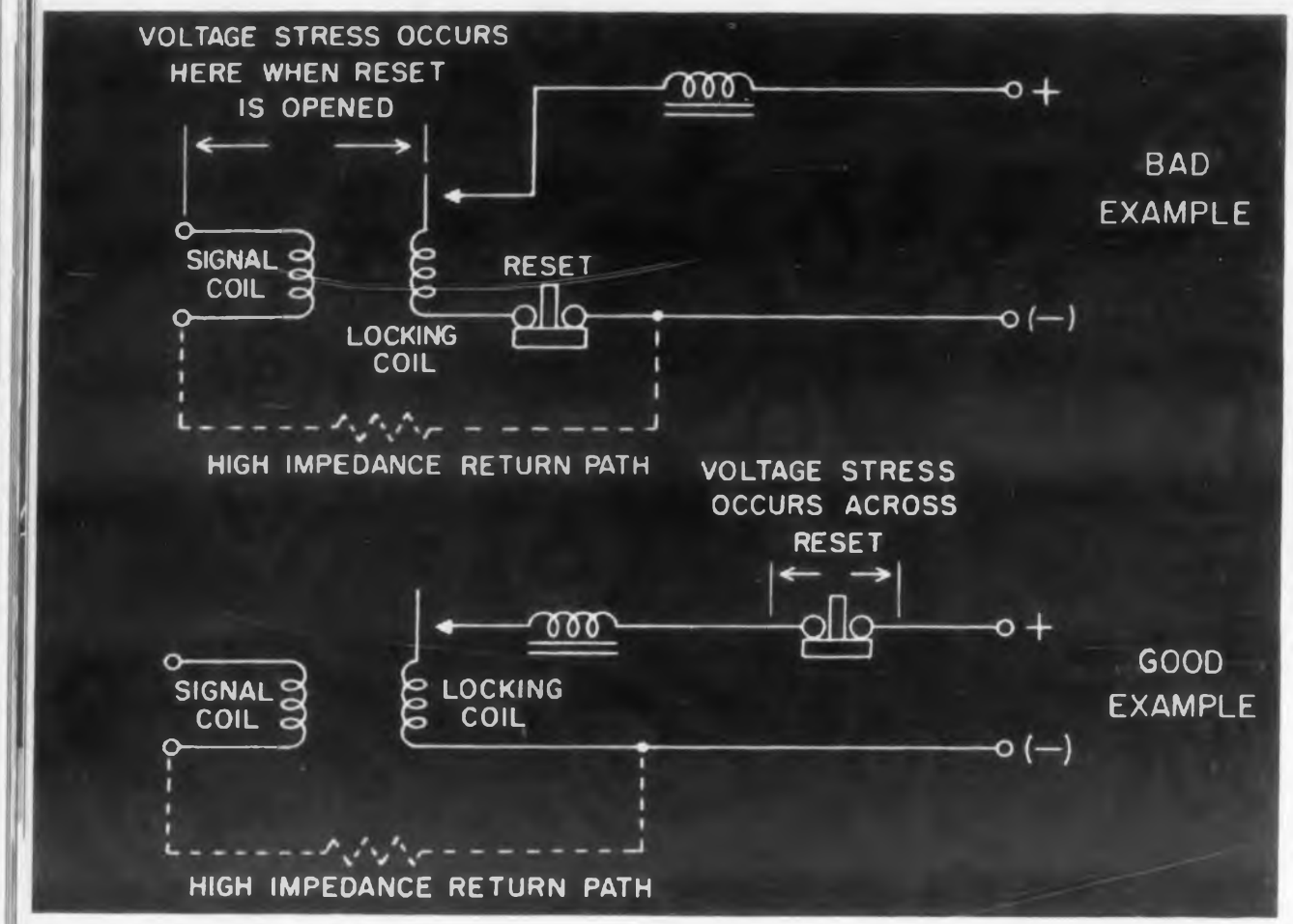


Fig. 2. Basic circuit for locking coil meter-relay. The best design for locking action involves an extra coil of about 100 turns of fine wire separately connected, but wound on the moving coil.



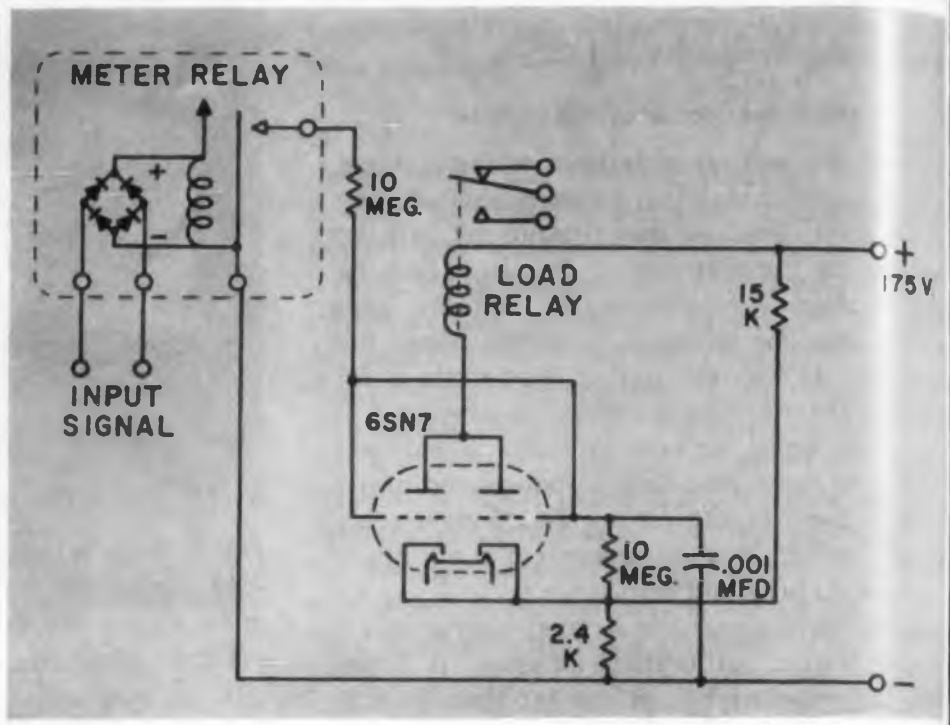


Fig. 4. (above) A highly successful application involving a non-locking, meter-relay and an electronic relay.

Fig. 3. (left) By properly locating the reset button, damage to coils can be prevented.

call for isolated meter-relays. For example, a load circuit may have a negative ground connection, the signal circuit a positive ground connection, and a high-limit meter-relay is desired. In this case, an isolated meter-relay would be used with connections jumpered.

Isolated meter-relays must not be used as an easy method of preventing voltage breakdown between the signal and locking circuits. Instead, an isolating transformer should be used in the locking circuit.

Sometimes the isolation is broken when discharge voltage peaks are developed by collapsing inductive loads in relay coils. If the load relay is large enough, this force can run to several kilovolts. This inductive kickback can be prevented by making sure it occurs across the interrupter switch and not between isolated coils. See Fig. 3.

Remember, too, that burning of meter-relay contacts may occur if voltage is discharged from the collapsing field of an inductor in series with the contacts. The cure: place a diode across the inductor and one in series with the contacts.

Designers should not wait until the last stages of circuit design before specifying a meter-relay. A low-torque movement may then be all that can be used. This sluggish movement is ofen expected to operate at faster-than-average response time. If meter-relays are considered early, practical sensitivities and speeds can be used to best advantage.

Typical Circuits Using Meter-Relays

A highly successful application involving a non-locking meter-relay and an electronic relay is shown in Fig. 4. This is a case where a simple high limit control is needed to monitor motor current, but a straight meter-relay circuit is too slow for the application. An all-electronic circuit, however, would be too complex, particularly for applying the signal from the motor. Also, the all-electronic hook-up would not provide the continuous signal indication and the easy adjustment of limit points.

Several special features of the meter-relay permit successful operation of the non-locking contacts in this case. Custom-made gold contacts are used to keep resistance and sticking to a minimum. The current through the contacts is held to a maximum of 2 ma. The circuit has a very high speed on-off control action. Finally, a high torque meter is used for positive pointer movement and clean separation of contacts.

The load relay used with the meter-relay is normally energized and is connected in series with the vacuum tube. The meter-relay switches the tube's grid potential. When the motor current input reaches the set point the meter-relay contacts close and the tube's grid becomes negative. The load relay is thus de-energized. When the input signal falls below the limit, the contacts separate, grid voltage becomes normal and the load relay is energized again.

Despite the seeming simplicity of such circuits, however, designers should be aware of all aspects of meter-relays before they place too much responsibility on non-locking contacts.

Another recent circuit is a good example of using a meter-relay with a differential amplifier to compare two signals and then to simplify the control problems connected with this comparison. The meter-relay is a zero-center, double-contact unit. Its scale is blank and the range between center-scale and either limit is only 5 μa, thus insuring precise control.

The meter-relay monitors the output of a differential amplifier, and it maintains an electrical analog voltage equal to a reference voltage. Ultimately a servo motor is actuated to maintain proper pressure in a hydraulic system. No correction to the servo is needed as long as the variable signal from the amplifier remains approximately the same as the fixed voltage from a potentiometer. The variable signal is fed to the left grid of a vacuum tube in the amplifier, while the fixed voltage feeds the right grid. When the voltages remain the same the indicating pointer of the meter-relay stays at zero center. Too much or too little voltage to the left grid unbalances the signal

from the tube to the meter-relay. The indicating pointer of the meter-relay then swings up or down and makes contact with a fixed pointer. "Raise" and "lower" relays then actuate the servo motor as required.

The same general procedure is also used to transmit corrective pulses to the motor driving the potentiometer.

Sometimes the usual meter-relay situation is reversed and electronic means, instead of electromechanical, are used to unlock a meter-relay—during automatic temperature controlling, for example. In one such circuit, a vacuum tube and relaxation oscillator do the job sometimes left to electromechanical interrupters.

The tube is normally conducting and thereby energizing a load relay in series with it. When the meter-relay contacts "make" at set point, the tube grid is made less positive, de-energizing the load relay. The meter-relay is locked by the current discharging from the 2 μf capacitor. The frequency of sampling may be varied according to what is thought best. If the signal falls below the limit the tube is again able to conduct and re-energizes the load relay because the locking circuit is open. As long as the signal remains at set point the tube is held out until the next pulse.

Improved Timing Circuits

Many improved types of timing circuits can be devised electronically with meter-relays. One circuit requires the high and low limit action of a meter-relay. But the problem is to avoid a starting surge that would drive the meter-relay to its limit and shut off the motor being controlled before it can perform its desired function. Therefore the time delay interval must begin, not when the meter-relay contacts meet, but when the signal is applied.

Initially, the signal pointer of the meter-relay rests against the contact of the low pointer, which is set slightly above zero. The low contact is connected to the grid of a vacuum tube and a current slight enough to energize the tube flows. The locking circuit is open so that neither the high nor low contact is armed to lock.

When the signal surges from the monitored motor the indicating pointer is free to move. Even if it reaches the high set point it will not energize the load relay because the high contact is temporarily disconnected. The movement of the indicating pointer from the low contact acts as a switch, and removes the tube grid from ground. As a timing capacitor slowly discharges, the tube's conduction decreases. A relay is then de-energized and circuits are closed that disconnect the low contact from the grid and arm both the high and low contacts. The meter-relay is then ready to proceed with its control function since locking will occur at both set points. ■ ■

Magnetic Memory Element Shrinks and Speeds Computers

FASTER, SMALLER computers can be built with this new magnetic memory element—the Biax. Used as both memory element and logic device, the Biax will work at speeds up to 20 mc. Memory access time is not a limiting speed of computers built with the device. Each Biax measures 50 x 50 x 85 mils and has two 20-mil square orthogonal holes.

Biaxes have been operated at 125 C (using a ferrite with a Curie temperature of 175 C) with no loss of performance; readout is completely nondestructive.

Applications for the elements will be found in high speed data processing equipment, industrial control computers, military airborne and space computers, logical processing devices and high speed instrumentation.

Biaxes are being mass produced by the Aeronutronic Div. of Ford Motor Co., Newport Beach, Calif. They can be made using soft ferrites with squareness ratios of as low as 0.75 with no detriment in performance.

Aeronutronic claims that computing equipment using the elements for both memory and logic should be significantly cheaper and more reliable than equipment using semiconductors. The number of solder connections in a typical computer, for example, can be reduced by one or two orders of magnitude.

With Biaxes, 200 flip-flops and 3000 gates (the equivalent of 15,000 to 20,000 semiconductors) can be packed into a tenth of a cubic foot.

Because small currents (200 to 300 ma-turns for 0.4 μsec for full write) are required to operate a Biax memory, the total power for a given computational speed is reduced.

Designers looking to throw-away logical subsystems will find the Biax attractive. If a subsystem malfunctions, Aeronutronic says, the cost of the Biax units is so low the user can afford to discard faulty units and replace them with fresh ones.

For further information on this multimegacycle computer element, turn to the Reader-Service Card and circle **101.**

DESIGN FORUM

Device Uses Orthogonal Magnetic Fields For Nondestructive Readout

Fig. 1. Computer memory has 256-bit, 64-word capacity, operates at cycling speeds as high as 20 mc.

A COMPLETELY new memory element, the Biax was invented by Cravens L. Wanlass, Director of Research for Aeronutronic's Computer Operation. While the use of orthogonal magnetic fields for nondestructive readout has been explored by other people in the past—notably Thorenson and Arsenault of Magnavox Corp. during 1954-1957—Mr. Wanlass' application is the first practical device.

Memories built with Biaxes will probably be faster, cheaper, smaller, more reliable and will work with less power and at higher temperatures than any built using cores, twistors and transfluxors. An example of the dense packing possible is given in Fig. 1.

How It Works

The basic Biax memory element, shown in Fig. 2(a), is ferrite material with two non-intersecting orthogonal holes in it. If separate conductors are run through each hole, there is no conventional magnetic coupling between them; the fields generated around the wires are at right angles to each other.

With the setup shown in Fig. 2, a dc bias current is applied through the secondary hole so the secondary winding is operating at point 1—Fig. 2(b)—and with an ac generator or pulse source connected to the primary, no signal will be recorded by the oscilloscope.

But if the bias current in the secondary is set

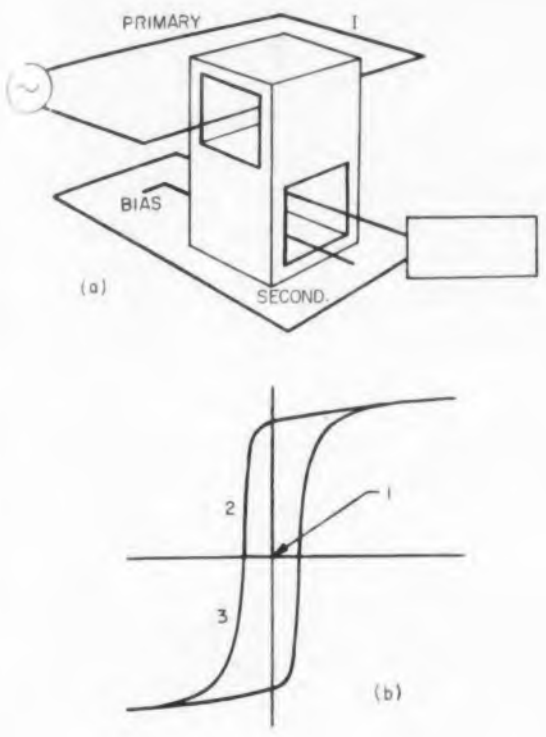


Fig. 2. No conventional magnetic coupling exists between upper and lower holes of basic two-axis Biax element in *(a)*. The Biax hysteresis loop is shown in *(b)*.

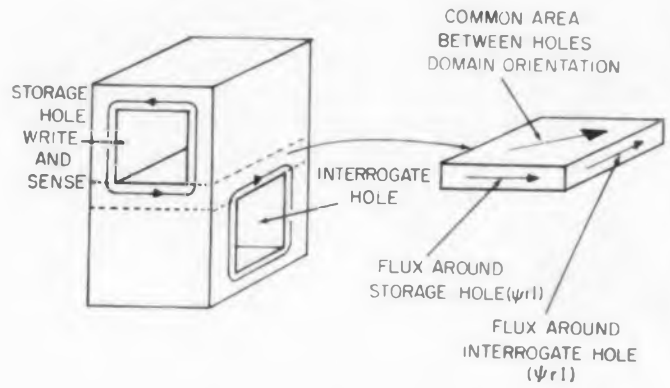


Fig. 3. Saturation of ferrite through one winding rotates shared magnetic domains, causes a decrease of secondary hole's magnetic induction. Rotation is elastic.

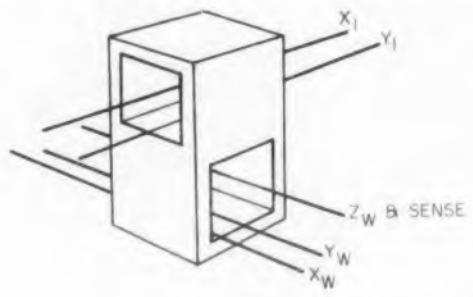


Fig. 4. Basis Biax memory element. Z winding is used for readout.

so the magnetic induction is positive or negative –regions 2 or 3 of Fig. 2(b)–there will be an output recorded on the scope. This is because the region between the primary and secondary holes is shared by both windings. See Fig. 3. As the primary current source tends to saturate the ferrite surrounding the primary winding, the magnetic induction of the secondary hole tends to decrease. Some of the magnetic domains are rotated more parallel to the primary field.

This domain rotation is temporary and elastic. It will persist only as long as the primary current is large enough so its mmf can affect the secondary winding's magnetic domains. The output from the secondary is independent of the direction of primary current; the output is always a decrease in the magnitude of magnetic induction. The output voltage is positive or negative depending on the direction of the flux originally stored around the storage hole.

In this way binary storage is possible. The bottom hole of Fig. 4 is the "information storage axis," therefore the "write" axis. The top axis, orthogonal to the bottom, is the "interrogation axis," which is used for the selective, nondestructive "read." Note the storage axis contains a Z, inhibit, winding–which can also be used as the sense winding of the particular system during a read cycle. It can be addressed by bit for X, Y selection type memory applications or used in a linear, word-oriented type of memory array.

Write It In

Aeronutronic calls the Biax write system the "oersted-second" system. This is to acknowledge its fundamental difference from the usual coincident-current select technique used in magnetic core arrays. A qualitative diagram of switching time as a function of applied field for a given volume of ferrite is shown in Fig. 5(a). The associated hysteresis loop is drawn in 5(b). It is assumed that the minimum field that can be applied to switch the ferrite is a field equal to the coercive force H_c.

Using the ordinary coincident current technique, half the total field–applied by the X or Y winding alone–must be less than H_c. When two fields (X and Y), each of strength less than H_c but greater than $H_c/2$, are applied at the same time the material will switch in the amount of time indicated (coincident current select) in Fig. 5(a).

Note that switching time decreases in proportion to the strength of the total field. The Biax "write" system makes use of this by using greater fields for both the X and Y windings. The X winding causes a field of H_B to be applied for a time T_B. The same H_B and T_B are applied on the Y winding used to select the particular Biax element of the array, to store information in it. As the diagram shows, the H_B applied to a given X line is not sufficient to switch the Biax elements–even though this field is considerably greater than the coercive force of the particular ferrite.

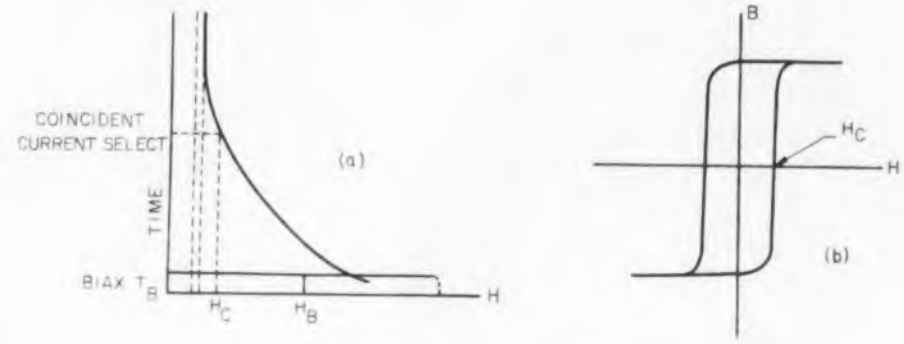


Fig. 5. Switching time vs applied field is shown in *(a)*; when applied H-field crosses curve, ferrite is switched. A ferrite square hysteresis loop is shown in *(b)*.

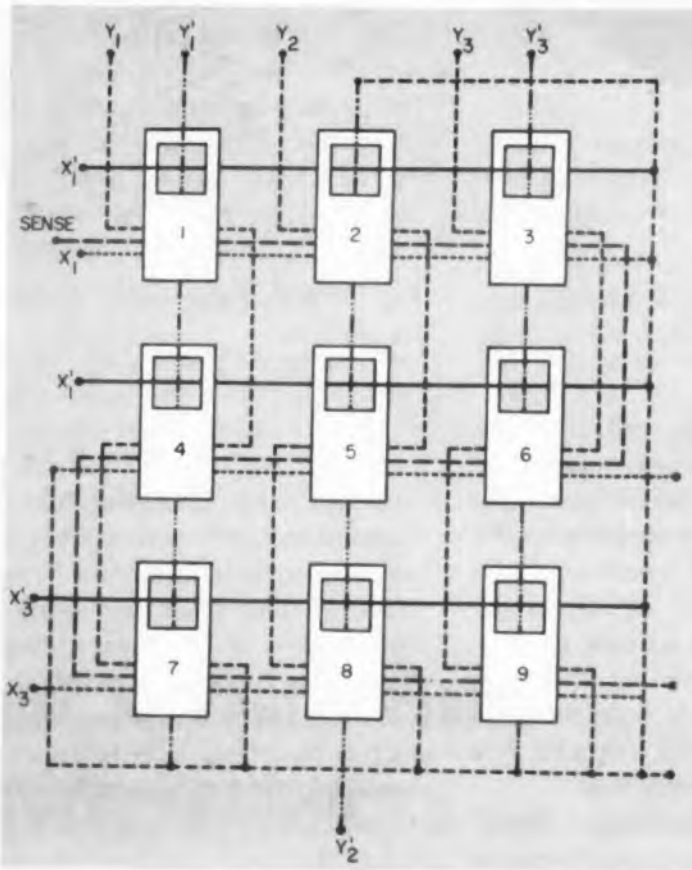


Fig. 6. A 3 x 3 Biax memory array.

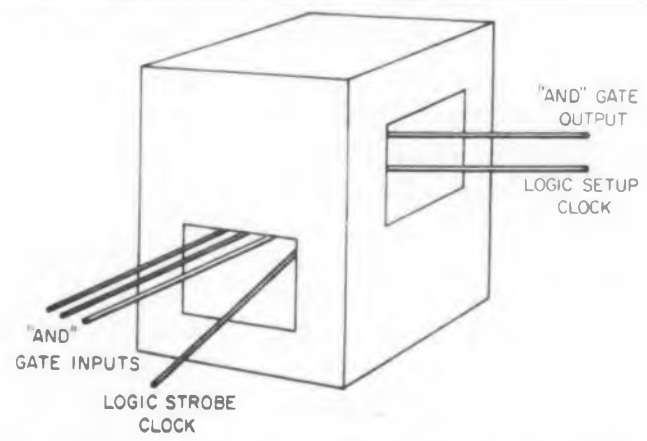


Fig. 7. Basic Biax gate element. There is no shared ferrite between orthogonal holes. As many as 15 AND inputs are possible: only limitation is size of 20 x 20 mil hole.

Switching does not occur because the field isn't on long enough to cause nonreversible movement of the magnetic domain boundaries. But where both the X and Y fields add, the switching time parameter intersects the applied field and the ferrite is switched. Both the applied fields and the duration of the fields are controlled in the oersted-second system. As can be seen from the diagram, switching time is much smaller than with the coincident current method.

Read It Out

The Biax readout system is selective, nondestructive, and does not require precise control of either amplitude or duration of the applied current pulses. The product of the current amplitude and the pulse duration only need to be equal to or greater than a certain minimum.

The two axes of the Biax are magnetically independent except for flux sharing of the common material between the holes. Temporary interaction in the shared ferrite it much accentuated when one axis is switched from one state of maximum magnetic induction to the other state of maximum induction. If information is stored in the bottom hole of the element sketched in Fig. 5(a), the voltage on the sense line is approximately 20 times greater when the upper hole is switched than when the same current is applied to drive the upper hole material into more saturation.

A 3 x 3 memory array is shown in Fig. 6. For the write axis: the unprimed X terms (X_n) are the axis windings used to write information; the unprimed Y terms (Y_n) are likewise used to write. The sense winding, which interlinks all information storage axes, is the output winding on which the stored information will be presented when interrogation takes place.

On the interrogation axis: the primed X terms (X_n') are the X axis interrogation windings, while the primed Y terms (Y_n') are similarly the Y axis interrogation windings. The common winding is used as a ground for the system.

Suppose Biax element No. 5 (X_2Y_2) is to be read and that at the beginning of any read cycle the interrogation axes of all elements are set at the positive saturation point of the hysteresis loop. Let's further assume Biax No. 5 is set to 1. A positive polarity output will occur when interference takes place between the interrogation flux and the storage axis flux.

Now the X_2' axis receives a current of such polarity as to switch all the interrogation axes so they are set on the lower portion of the hysteresis loop (negative magnetic induction). This is called "setting the axis for interrogation." Note that all other interrogation axes are still set positive. Next the Y_2' axis receives a current pulse such that its line of elements is switched to a positive state.

But all elements in the line, with the sole exception of No. 5, are already in this normal state of saturation. During this second pulse, therefore, only No. 5 has its interrogation axis switched from negative magnetic saturation to positive. This switching causes the elastic interference mentioned before and a pulse is presented to the sense winding. Since the sense amplifiers are unblocked during the Y_2' pulse, a positive pulse is presented to the sense amplifier indicating that No. 5 stored a 1.

If a 0 had been stored, a negative pulse would have appeared. The last operation of the read process is a current pulse applied to X_2' to reset all of the interrogation axes back into the normal (positive) state.

That this process is truly nondestructive is demonstrated by the fact that a particular element has been interrogated, by Mr. Wanlass, 10^{11} times at a rate of 10^7 interrogations per second with no loss in amplitude.

No coincident currents are needed: a current pulse that is not accurately controlled in shape or amplitude is adequate to the task. A fast rise time is helpful, however, since it speeds up the switching process and causes a larger output voltage to appear on the sense winding. At present, output voltages of ± 10 mv per turn for a 50 ma turn interrogate pulse are normal. This is less current by a factor of 10 than needed for conventional core techniques. The low drive currents result in completely transistorized drivers, since driver currents and resulting back voltages are extremely low.

Signal-to-noise ratio is good. This is due to the read pulse being negative or positive—much better than the signal or no-signal system used in present coincident current memories.

Heat It Up

The Biax performs satisfactorily up to temperatures in the vicinity of the Curie temperature of the material used in the element. One array (using a ferrite with a Curie temperature of 175 C) has been operated eight hours at 125 C with no degradation in output.

"It is conceivable," remarks Mr. Wanlass, "right now with an element having a Curie temperature of 300 C, a practical temperature for which the element would be usable might be 250 C."

Logic Switching, Too

A new Biax, drawn in Fig. 7, can be used when nondestructive readout is not necessary. This occurs in AND and OR gates that don't have to retain information once they have been used to set a flip-flop. It is pressed so as to have no ferrite between the orthogonal holes. In fact these could just as well be intersecting orthogonal holes.

A magnetic field around one hole will "destroy" the flux around the other hole and "reestablish" flux around the driven hole—regardless of the magnetized state of the driven hole.

The upper hole contains the sense (output) winding and a set clock in Fig. 7. The lower hole contains the AND input terms and a strobe (readout) clock. The set clock and AND input terms occur simultaneously, while the strobe clock follows the set clock in the gating cycle. For a "true" AND gate condition, no current (in the AND-gate windings) flows through the lower hole; the upper hole therefore has a flux established around it by the set clock.

Next, the strobe clock in the lower hole "destroys" the flux encircling the upper hole. This produces an output on the sense winding.

For a "false" AND condition, at least one AND input current exists in the lower hole at setup time. This inhibits the establishment of flux around the upper hole; hence no output signal is generated in the sense winding during the subsequent strobe clock time.

OR gating is achieved by running a single sense wire through the upper hole of all Biax elements which are to be ORed together.

Normal outputs are one volt per turn. As many inputs to an AND gate as the hole diameter allows can be used: namely 10 to 15. Space is the only limitation. The number of AND functions that may be ORed is related to the signal-to-noise ratio of the AND gates. At present, the normal signal-to-noise ratio is 100 or greater. This ratio will allow 15 OR terms with a large safety factor.

Since the element operates on a flux or no-flux transfer from the output hole to the input hole, ferrites with large squareness ratios are unnecessary. The signal-to-noise ratio described was obtained using soft ferrites with squareness ratios of 0.75 or less.

Multicircuit Elements are Possible

Aeronutronic has already given consideration to making multiaperture plates to save space and wiring effort. Chunks of ferrite containing 16 holes through one axis and four through the other have been built. These plates are equivalent to 16 Biax elements and are, in fact, working memory units having 16 bits of storage.

A Triax element is in the works. This is a configuration in which there are three orthogonal sets of holes. It gives promise of providing logical complexities not readily furnished by a combination of two-axis units.

Thin Films Will Be Used

When the production of thin films is rendered practicable, Biax elements will use them. The Biax effect is obviously basic and not a function of the ferrites now used. Any increase in switching speed provided by a better magnetic material will make the Biax faster, too. ■ ■

Problems in Selecting Ferrite Modulators

1. Operation and Design

Peter A. Rizzi*
Raytheon Manufacturing Co.
Bedford, Mass.

MICROWAVE ferrite modulators offer obvious advantages over active circuit elements. Because they do not obey the law of reciprocity, simple yet stable microwave devices can be built. There are many ways of achieving modulation with ferrite, each with its own design problems and solutions. Here are several common ferrite modulators and how they operate:

Rectangular Guide Amplitude Modulator

Loss vs magnetic field characteristics of a typical rectangular guide ferrite structure are shown in Fig. 1. The ferrite is placed where the transverse and longitudinal components of rf magnetic field are equal and 90 deg out of phase. To an observer looking along the direction of applied magnetic field, the rf magnetic field appears circularly polarized; consequently the structure exhibits the familiar ferromagnetic resonance absorption characteristic.

To use this device as an amplitude modulator, a bias field of about 2700 oersteds is needed at X band. This, of course, requires a very large electromagnet, which is impractical for many applications. Since the magnetic field required for resonance is proportional to the microwave frequency ($f = 2.8H$ megacycles, where H is the applied magnetic field in oersteds), the bias field required is less at the lower frequencies. A bias field of only 600 oersteds is necessary at S band.

A disadvantage of this type of amplitude modulator is that the insertion loss is by necessity very high at the quiescent or bias field value. More practical methods of amplitude modulating with ferrites will be discussed later.

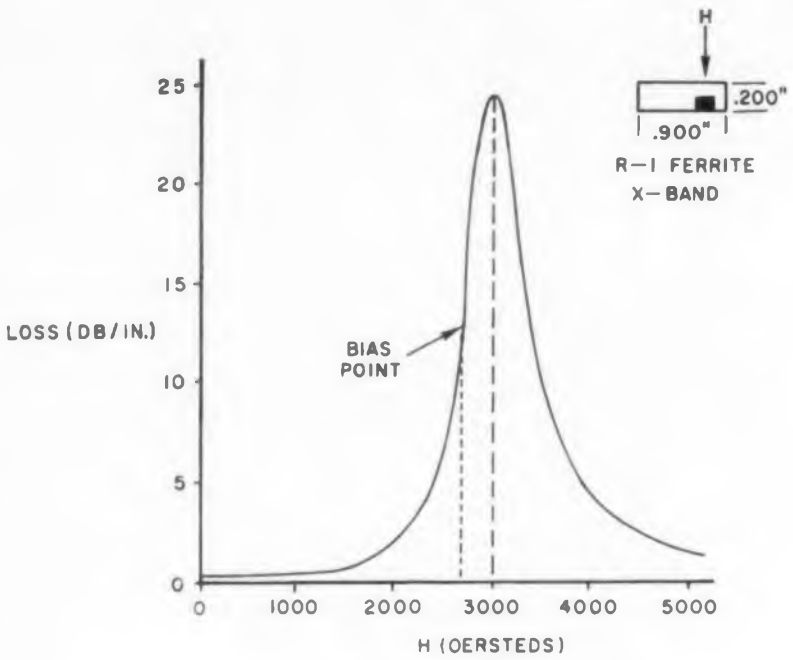


Fig. 1. (left) Loss characteristic of a ferrite-loaded circular guide.

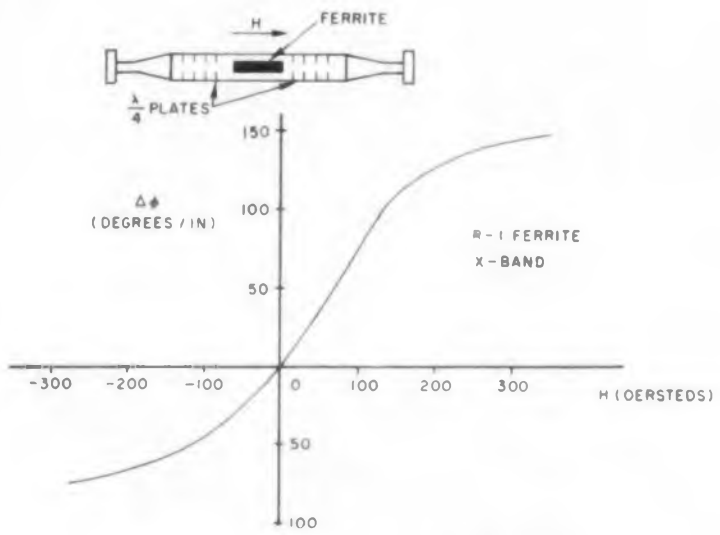


Fig. 2. (right) Phase characteristic of a ferrite-loaded circular guide.

Circular Guide Phase Modulator

Phase shift vs magnetic field characteristics of a typical ferrite phase shifter are shown in Fig. 2. In this device, the input linear wave is converted to circular polarization by the quarter-wave plate. Circularly polarized energy passes through the ferrite section, which consists of a ferrite rod located at the center of a circular guide. Phase shift through the ferrite is a function of magnetic field. The ouput quarter-wave plate reconverts the wave to linear polarization.

This type of ferrite phase shifter is very useful as a phase modulator. First of all the curve is quite linear for a considerable range of magnetic field. Second, the amount of phase change that can be obtained for a reasonable length is quite large. Finally, the direction of the magnetic field is axial, so a solenoid can be used to generate the field. This should be reasonably efficient at high modulating frequency, since an electromagnet is not required to obtain the magnetic field.

Since in phase modulation the modulation index is equal to the maximum phase deviation in radians, modulation indices of as high as *ten* can be realized at low modulating frequencies. As the frequency increases, the problem becomes more difficult. In fact, at frequencies greater than 200 kc, a modulation index of better than *one* requires modulation power in excess of 1 w.

*At present with the Ewen Knight Corp. of Needham, Mass.

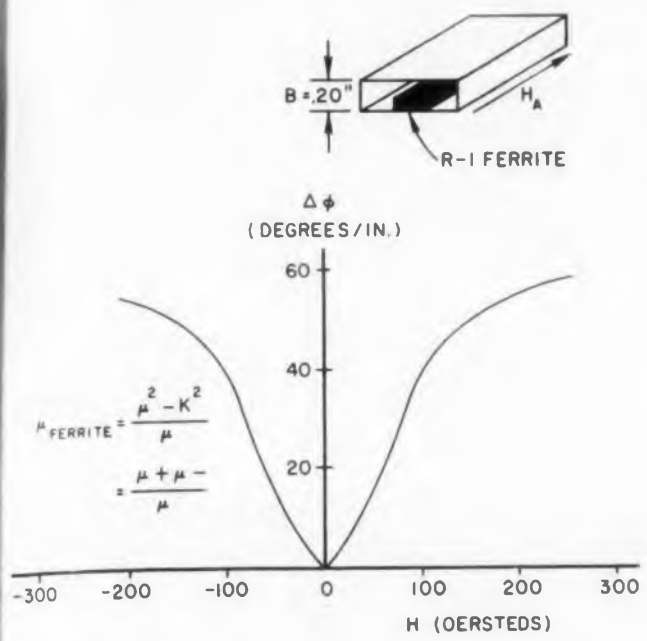


Fig. 3. Phase characteristic of a ferrite-loaded rectangular guide.

Rectangular Guide Phase Modulator

Another method of obtaining phase modulation is shown in Fig. 3. In this case, the input wave is linearly polarized and at right angles to the applied magnetic field. If we choose the wave guide *B* so that a horizontally polarized wave cannot propagate, the wave cannot rotate and the effect of the magnetic field on the ferrite guide is a change in the output wave phase. Note that the phase change per inch is not as great as in the previous case.

This device, however, does not require transitions or quarter-wave plates. If a compact phase modulator for moderate modulation indices is desired, the rectangular guide modulator is definitely superior. It should also be noted that in this device a bias field is needed to obtain a sinusoidal phase variation in response to the application of a sinusoidal current. This is because the phase shift is independent of the polarity of the magnetic field.

Rotation-Type Amplitude Modulator

The third microwave property which can be varied by means of an external magnetic field is the plane of polarization. A typical curve of rotation vs magnetic field is shown in Fig. 4. Earlier, a method of amplitude modulation which employed the ferromagnetic resonance effect was mentioned. Since the device needed a large electromagnet and had a high insertion loss, it was considered impractical for many applications. The variable rotation property of the ferrite in conjunction with a two-mode transducer now afford

(Continued on p. 34)

2. Comparison of Types

Most ferrite modulators are custom-designed for a specific application. But often the electronics designer's power, frequency and other requirements will force him to use one particular kind of modulator.

Some of the questions that must be asked, to pin down a particular kind:

- **Is phase or amplitude modulation desired?**
- **Is it a high or low power application?**
- **How much modulator power is available?**
- **How much insertion loss can be tolerated?**
- **How much harmonic distortion can be tolerated?**

In general a low insertion-loss type can only be used at relatively low modulation frequencies (below one kc). For frequencies up to 50 mc, the engineer must expect relatively high insertion loss.

Some modulators don't have any harmonic distortion—the rotating H-field type, mentioned in Mr. Rizzi's article, for example. But they take perhaps 100 w modulator power at one kc. Others have varying degrees of distortion. A rule of thumb for medium-distortion modulators is that 1 to 10 w driving power is needed for a relatively low harmonic distortion.

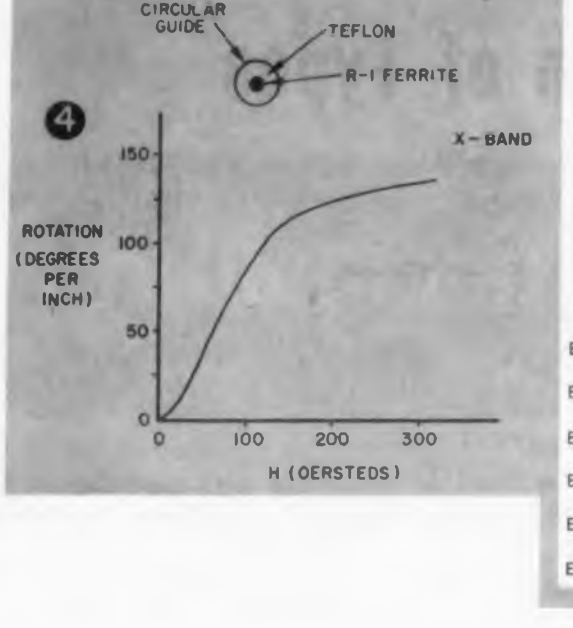
With the help of Herman Chait of Cascade Research Div. of Monogram Industries, Glendale, Calif., ELECTRONIC DESIGN has compiled a tabular comparison between modulator types to supplement Mr. Rizzi's article. The modulators listed do not represent all modulator types—just the most common.

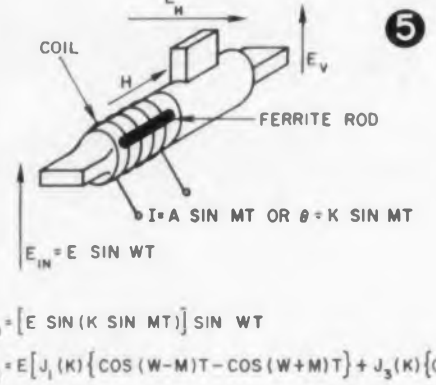
The first table compares the principal uses, advantages and disadvantages of ferrite modulators; the second should help the engineer decide which kind he needs to do a job.

Table 1. Qualitative comparison of eight ferrite modulator types.

Type of Modulator	Main Functions	Disadvantages	Advantages
Rectangular Waveguide Amplitude Modulator	Amplitude modulation of cw klystrons or magnetrons. Control signal output of generator (AGC).	Requires a relatively high magnetic field. More driving power needed. Harmonic distortion.	No transitions from rectangular to circular waveguide. Ferrite can be bonded directly to the waveguide, thereby allowing higher power dissipation.
Circular Waveguide Phase Modulator	Electronic scanning of arrays.	Requires quarter - wave plates and transitions from rectangular to circular waveguide. Becomes non-linear at higher powers. Usually non - reciprocal. Harmonic distortion.	Requires low driving power.
Rectangular Waveguide Phase Modulator	Electronic scanning of arrays.	Some designs are non-linear at high powers. Harmonic distortion.	No transitions required. Can be reciprocal.
Rotation Type Amplitude Modulator	Amplitude modulation of cw signals, AGC.	Non-linear at high powers. Harmonic distortion.	Can be modulated at high frequencies (up to 50mc).
Rotation Type Single Sideband generator	SSB applications, superheterodyne receiver (local oscillator).	High insertion loss.	High stability of frequency separation.
Rotating Magnetic Field Phase Modulator	SSB applications.	Requires high modulating powers.	No harmonic distortion. Infinite phase shift.
Cascaded Rotators (Phase Modulation)	Phase modulation of elements in scanning arrays.	Requires two rotators. Must be well-matched.	Does not require quarter-wave plates.
Coaxial Amplitude Modulator	Amplitude modulation of cw signals, AGC.	Relatively low power handling.	Requires low driving power. High modulation frequency.

(Continued on p. 35)





$$E_H = [E \sin(K \sin MT)] \sin WT$$

$$E_H = E[J_1(K)\{\cos(W-M)T - \cos(W+M)T\} + J_3(K)\{\cos(W-3M)T - \cos(W+3M)T\} + \cdots]$$

$$E_H \approx E\frac{K}{2}[\cos(W-M)T - \cos(W+M)T] \text{ FOR SMALL VALUES OF K}$$

$$E_V = [E \cos(K \sin MT)] \sin WT$$

$$E_V = E[J_0(K)\sin WT + J_2(K)\{\sin(W+2M)T + \sin(W-2M)T\} + J_4(K)\{\sin(W+4M)T + \sin(W-4M)T\} + \cdots]$$

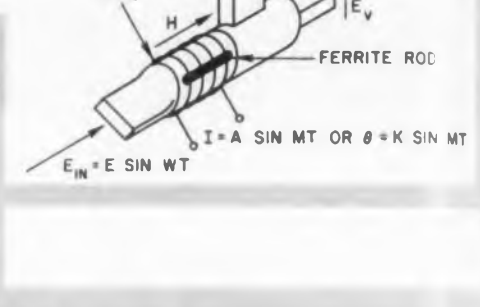
$$E_V = E\left[\left(1-\frac{K^2}{4}\right)\sin WT + \frac{K^2}{8}\{\sin(W+2M)T + \sin(W-2M)T\}\right] \text{ FOR SMALL VALUES OF K}$$

$$E_H = .707E[\cos(K \sin MT) + \sin(K \sin MT)] \sin WT$$

$$E_H = .707E\left[\left(1-\frac{K^2}{4}\right)\sin WT + \frac{K}{2}\{\cos(W-M)T - \cos(W+M)T\}\right] \text{ FOR SMALL VALUES OF K}$$

$$E_V = .707E[\cos(K \sin MT) - \sin(K \sin MT)] \sin WT$$

$$E_V = .707E\left[\left(1-\frac{K^2}{4}\right)\sin WT - \frac{K}{2}\{\cos(W-M)T - \cos(W+M)T\}\right] \text{ FOR SMALL VALUES OF K}$$



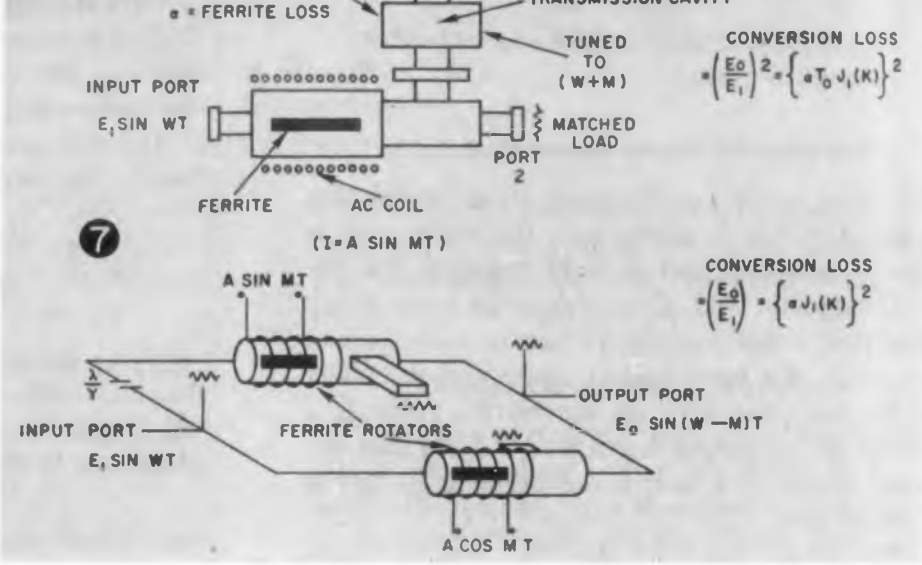


Fig. 4. Rotation characteristics of a ferrite-loaded circular guide.

Fig. 5. A rotation type of amplitude modulator.

Fig. 6. A rotation type of amplitude modulator with the input port at 45 deg with respect to the two output ports.

Fig. 7. Two types of single sideband generators.

1. Operation and Design *(continued from page 33)*

a practical way of obtaining am. Fig. 5 shows one method of doing this.

As the vertically polarized wave propagates through the ferrite section, it is rotated an amount proportional to the solenoid current. The voltage at the horizontally polarized port of the two-mode transducer will thus be E_{in} *sin* θ, while the voltage at the vertically polarized port will be E_{in} *cos* θ. If the current in the coil is varied at a modulating frequency m, the rotation will vary in the same manner. Therefore e_h and e_v will be given by the equations in Fig. 5.

It is interesting to note that the application of a pure sine wave to the ferrite rotator produces not two sidebands, but an infinite set of sidebands whose amplitudes are related to the Bessel functions of the first kind. Fig. 5 also shows what the equations reduce to for small values of rotation (i.e., where sin $\theta = \theta$). For small values of K, e_h reduces to an ordinary suppressed am wave, while the equation for e_v has the same form as a normal am wave. There is one difference, however—the envelope of e_v is at twice the frequency of the modulating signal.

If we wish to keep a one-to-one frequency correspondence between the modulating signal and the envelope of the am wave, the arrangement shown in Fig. 6 can be used. In this case, the input polarization is at 45 deg with respect to either the vertically or horizontally polarized output ports. In this way the horizontal component of the E-vector is sin $(45 + \theta)$. For small modulation, the envelope of the am wave is at the same frequency as the modulating frequency.

Another important fact is that the insertion loss in the quiescent condition is only 3 db. This arrangement has been used in many of the commercially available ferrite amplitude modulators.

Rotation-Type SSB Generators

The arrangement in Fig. 5 has also proved very useful in the design of high frequency single sideband generators. Fig. 7 shows two methods of single sideband generation using ferrite rotators. The first operates as follows: a signal at the microwave frequency W enters the input port, vertically polarized. Due to the current in the solenoid the ferrite rotates the plane of polarization at an angular frequency M. According to the previous equations, the carrier and all even-order sidebands will appear at port 2 and will consequently be absorbed by the load.

Odd-order sidebands will appear at the input of the cavity filter. Proper tuning of the cavity allows the selection of the desired sideband while rejecting all others.

Conversion loss, defined as the ratio of wanted sideband power to input power, is given by the equation in Fig. 7. T_o is the on-resonance transmission loss in the cavity and is usually from 1 to 6 db, depending on the ratio of W to M. Loss in the ferrite-loaded guide is α (usually from 1 to 2 db, depending on the length of the ferrite rod).

Third and most important quantity in the equation loss is $J_1(K)$. This is the first-order Bessel function of K, where K is the rotation at the peak

of the rf current swing. K depends on the rotation sensitivity of the ferrite, the power available at the modulating frequency, and other factors which will be discussed shortly. Due to the limitation in cavity selectivity, this type of single sideband generator is practical only at high modulating frequencies, say above 2 mc at S band or 7 mc at X band.

The second device shown in Fig. 7 avoids this difficulty. It uses two hybrid tees and two ferrite rotators. A signal at the microwave frequency enters the input tee and is split equally between the two coplanar arms. One signal is delayed 90 deg before entering the ferrite rotator. If the ferrites are modulated 90 deg out of phase, one sideband (in this case $W + M$) will appear at the E arm of the output magic tee, while the other sideband will appear at the H arm.

By choosing one arm as the output and loading the other arm, we have a single sideband generator. Conversion efficiency is a function of ferrite loss and the maximum rotation angle. Maximum efficiency is -4.70 db for a rotator-type.

Two other methods of single sideband generation which are capable of 100 per cent efficiency (0 db) have been described in the literature.[1,3] The device described by Cacheris[1] uses a rotating magnetic field, while the one described by O'Hara and Scharfman[3] utilizes a magnetic field that varies in a sawtooth manner. Although these devices are capable of greater efficiency than the rotator type, the modulating power required to drive the ferrite is quite large (approximately 50 w).

Shorted Turn Problem

A major problem with all modulators is the shorted turn problem. Since the rotator coil is wound on the circular waveguide, the guide behaves like a shorted secondary of a transformer. It tends to shield the ferrite from the alternating magnetic field of the primary.

At high modulating frequencies this shielding is very effective and methods of avoiding the shorted turn effect are necessary. One method is to evaporate a thin metallic layer on the dielectric holder and have it act as the waveguide. If the layer is thin enough the resistance of the secondary is increased and the shorted turn effect decreased. Another method is to put a longitudinal slot in the waveguide. This reduces the shorted turn effect but also leads to microwave leakage. There are other methods but these two prove quite satisfactory for most cases.

Ferrite Characteristics

An area in which there is considerable room for improvement is in the ferrite material. Desired ferrite characteristics are low microwave loss, high initial permeability at the modulating frequency and low magnetic losses at the modulating frequency.

The Q of nickel ferrite increases with frequency, which implies that the losses are independent of frequency up to 50 mc. In the case of nickel-cobalt and manganese-magnesium ferrites, losses are relatively constant up to about 5 mc, then increase rapidly thereafter.

At X band, the results with nickel ferrite have been poor. This is due to its high microwave loss at low fields and low permeability at the modulating frequency. The results at X band with a manganese-magnesium ferrite (R-1) have been fairly good. But the efficiency decreases as the modulating frequency increases, due to the shorted-turn effect and ferrite losses. In fact, at high modulating frequencies the efficiency is quite low.

A good microwave ferrite with high initial permeability and high Q at the modulating frequency would improve matters considerably. ■ ■

2. Comparison of Types *(continued from page 33)*

Table 2. Electrical characteristics of eight ferrite modulator types.

Type	Frequency Band; Power Range	Modulator Range	Per Cent Modulation	Modulator Drive Power	Phase Shift; Ampl Modulation	Insertion Loss	Harmonic Distortion
Rect w-g Ampl Mod	1-70 kmc; up to 100 kw at 10 kmc with cooling.	less than 1 kc	100 per cent	High: from 1 w to 1 kw.	High ϕ shift in addition to a.m.: possibly 180 deg, at least 90 deg.	About 0.5 db	Medium
Circ w-g ϕ Mod	1-70 kmc; up to 1kw at 10 kmc. Can't cool.	less than 100 kc	Appr 100 per cent ϕ mod.	High: from 1 w to 1 kw.	ϕ shift depends on length of ferrite; some a.m.	Typically 0.5 db for 360 deg.	Medium
Rect w-g ϕ Mod	1-70 kmc; up to 50 kw at 10 kmc. Can be cooled.	up to 2 kc.	Appr 100 per cent ϕ mod.	High: 1-100 w	Some a.m., but less than with circ ϕ mod.	Less than 0.5 db.	Medium
Rot. Type Ampl Mod	1-70 kmc; 1 kw at 10 kmc.	up to 100 kc	Appr 100 per cent	High: 1-100 w	Some a.m., but less than with circ ϕ mod.	About 0.5 db	Medium
Rot. Type SSB Gen	1-70 kmc; up to 1 kw at 10 kmc.	less than 10 mc	Very small: typically 10 per cent. At high freq. possibly only one per cent.	High: depends on frequency and per cent modulation.	Some a.m.	Very high: over 6.0 db.	Low
Rot. H-Field Type	1-70 kmc; up to 1 kw peak at 10 kmc.	up to 1 kc.	Appr 100 per cent	High: up to 1 kw.	Infinite ϕ shift. No a.m.	Less than 0.5 db.	None
Cascaded Rotators	1-70 kmc; up to 1 kw at 10 kmc.	less than 100 kc	Appr 100 per cent	High: from 1 w to 1 kw	ϕ shift depends on length of ferrite; some a.m.	Typically 1 db for 360 deg.	Medium
Coaxial Ampl Mod	1 mc-10 kmc; about 10 kw pk, 10 w average.	up to 1 mc	Appr 100 per cent	Very low: on order of 1 w	High: perhaps 90 deg.	About 1 db	Medium

Acknowledgment

I would like to thank Irving Goldstein for suggesting the subject of this paper. In addition I would like to thank Walter Beust, Max Mohr and other members of the ferrite section at the Missile Systems Division of Raytheon for their help.

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1. J. C. Cacheris, Microwave Single-Sideband Modulators Using Ferrites. *Proc. IRE*, vol 42, pp 1242-1247, Aug 1954.
2. G. R. Jones, J. C. Cacheris and C. A. Morrison, Magnetic Tuning of Resonant Cavities and Wideband Frequency Modulation of Klystrons. *Proc. IRE*, vol 44, pp 1431-1438, Oct 1956.
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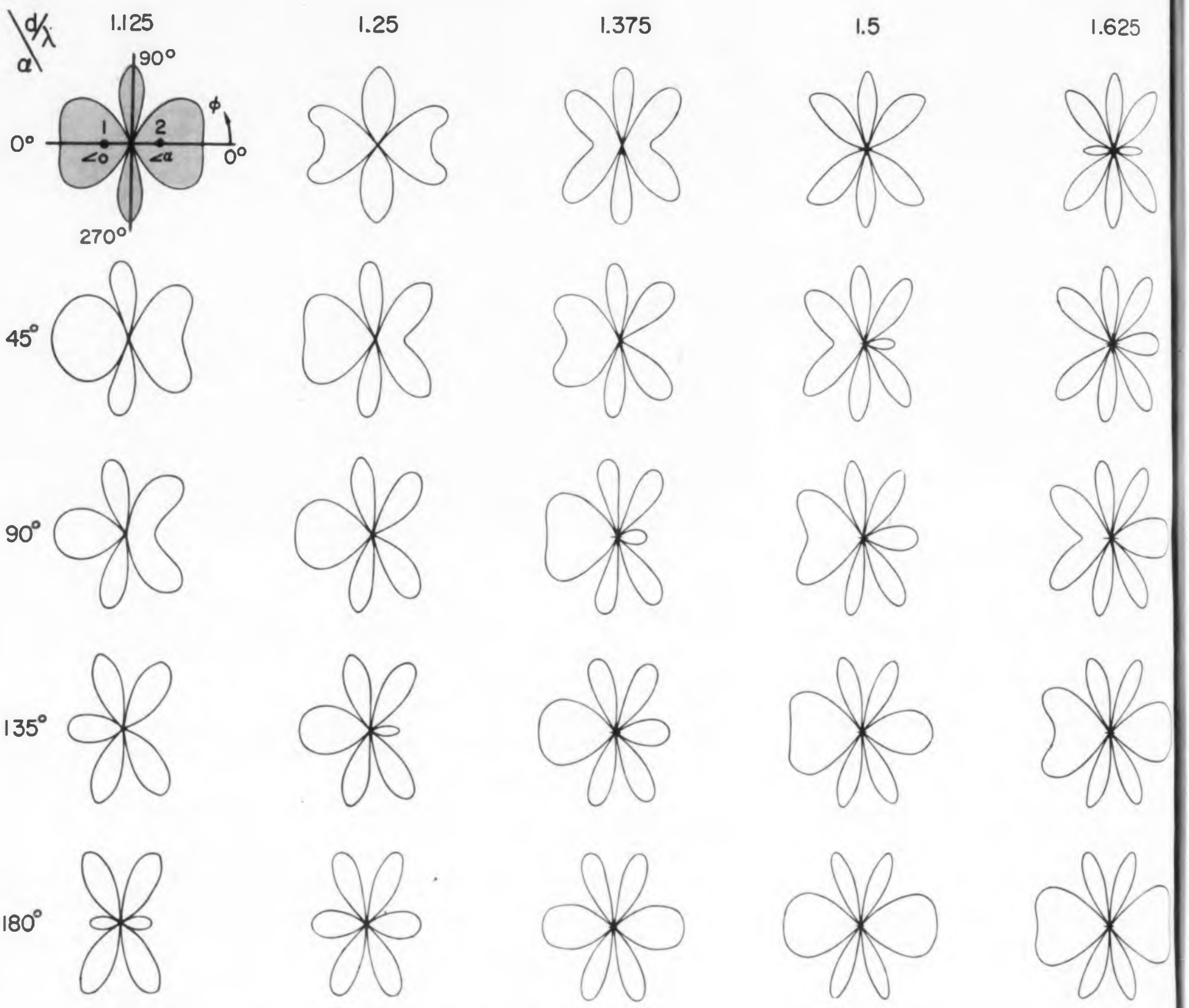
5. B. Vafiades and B. J. Duncan, An L-Band Ferrite Coaxial Modulator. 1957 IRE Convention Record, Part 1, pp 235-241.

Antenna Array Patterns for Many Beams

Paul Safran*

Airborne Instruments Laboratory

Mineola, N. Y.



Horizontal Radiation Patterns for Two Antennas Up To One Wavelength Apart

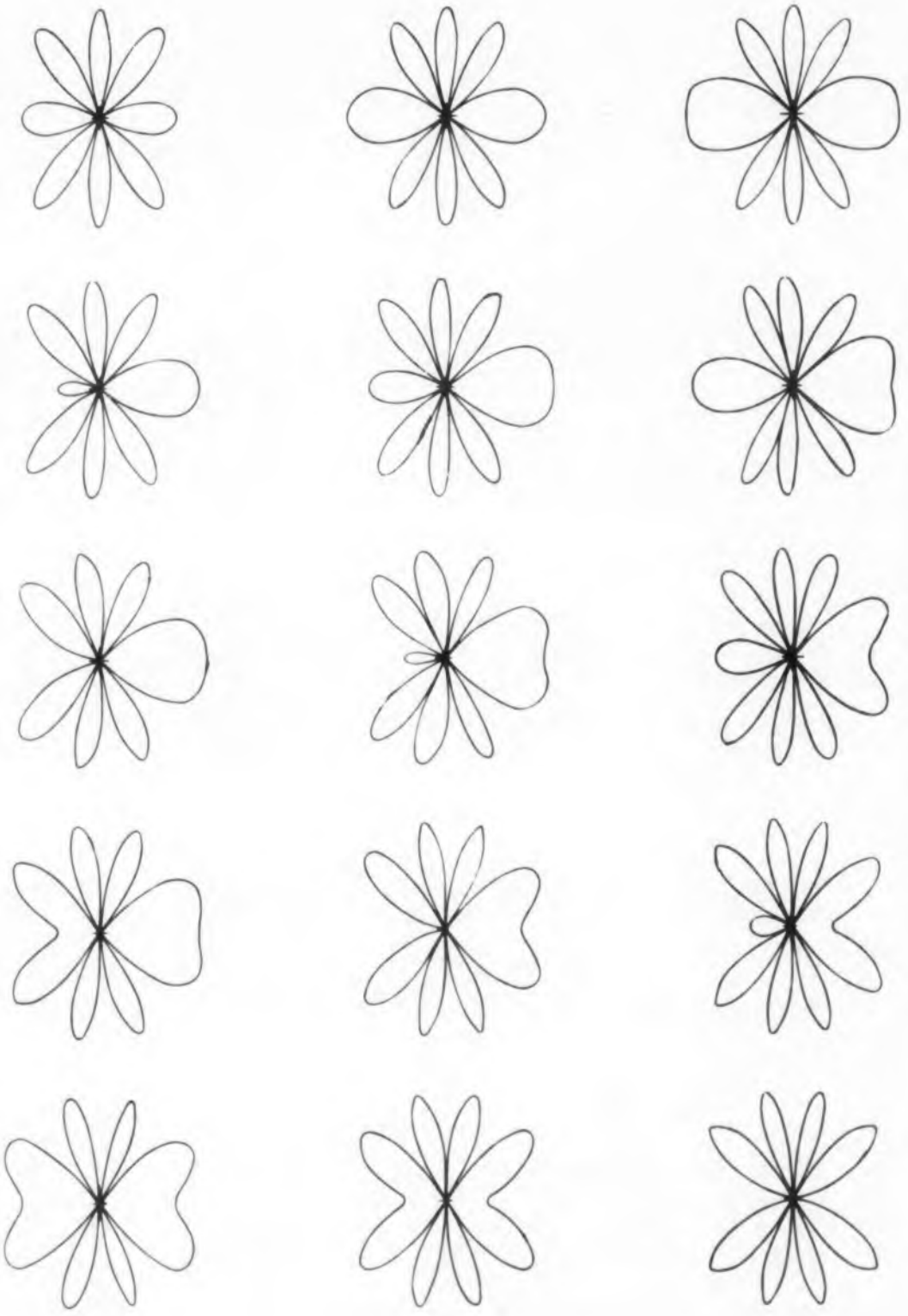
Paul Safran's chart of antenna array patterns can save hours of drudgery for the engineer who uses antenna array techniques. The use of his chart eliminates most of the time normally spent in calculating antenna or interferometer radiation patterns where multiple beams are required.

*Mr. Safran is now with The W. L. Maxson Corp., N.Y.C.

A CHART of array patterns can be extremely useful to the antenna designer. If he is concerned with quasi-optical interferometers, multiple-lobed radars, star tracking, or other multi-beam applications, he will find the chart on this page particularly useful.

It shows patterns with as many as eight beams for antenna point-source spacings from 1.125 to 2.0 free space wavelengths.

The chart on the next page was prepared by G. H. Brown for spacings of up to one wavelength, and for four beams at most. Brown's chart was included in his



article "Directional Antennas," which appeared in the January 1937 issue of *Proceedings of the IRE*.

Both charts give array patterns as a function of the spacing $d\lambda$ between two isotropic point sources and of the phase of the currents delivered to each source.

The normalized formula for the field patterns from which these charts were derived is

$$E = \cos\frac{\Psi}{2}$$

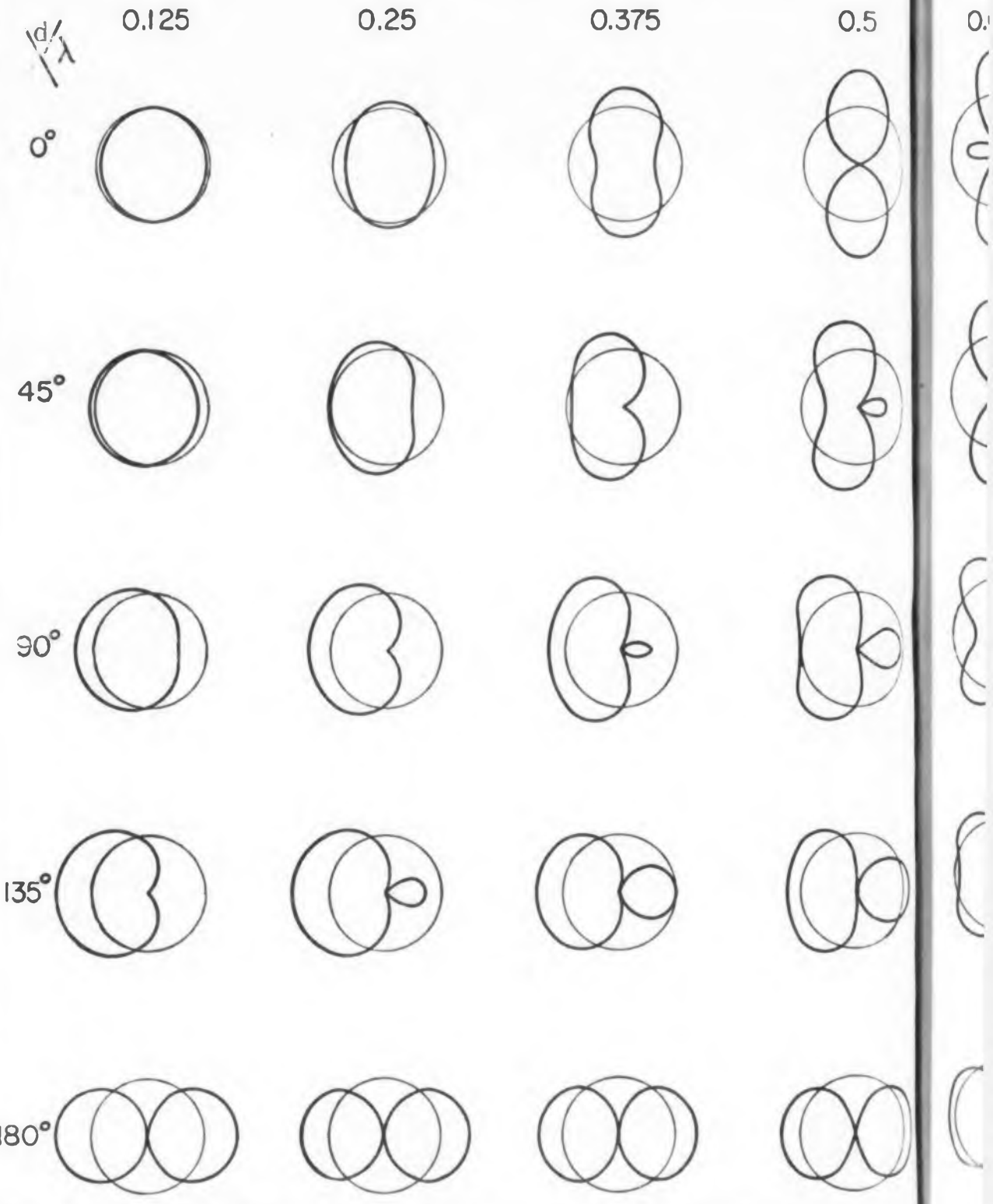
where

$$\Psi = 2\pi\,\frac{d}{\lambda}\cos\phi + \alpha$$

Here, Ψ is defined as the total phase difference between equal amplitude fields of two isotropic point sources with arbitrary phase difference α, at a distant point in the ϕ direction.

The angle ϕ is between the axis of the array and the distant point. The distance d/λ between the sources is in free space wavelengths.

Brown's chart gives array patterns for phasings up to 180 deg for d/λ up to 1.0. For many applications it is necessary to know the pattern shapes for larger spacings. This is particularly true where multiple beam patterns are required.



Horizontal Radiation Patterns for Two Antennas Up To Two Wavelengths Apart

Spacings up to d/λ of 1.0 yield, at most, only four beams. Patterns with as many as eight beams can be obtained with spacings up to two wavelengths.

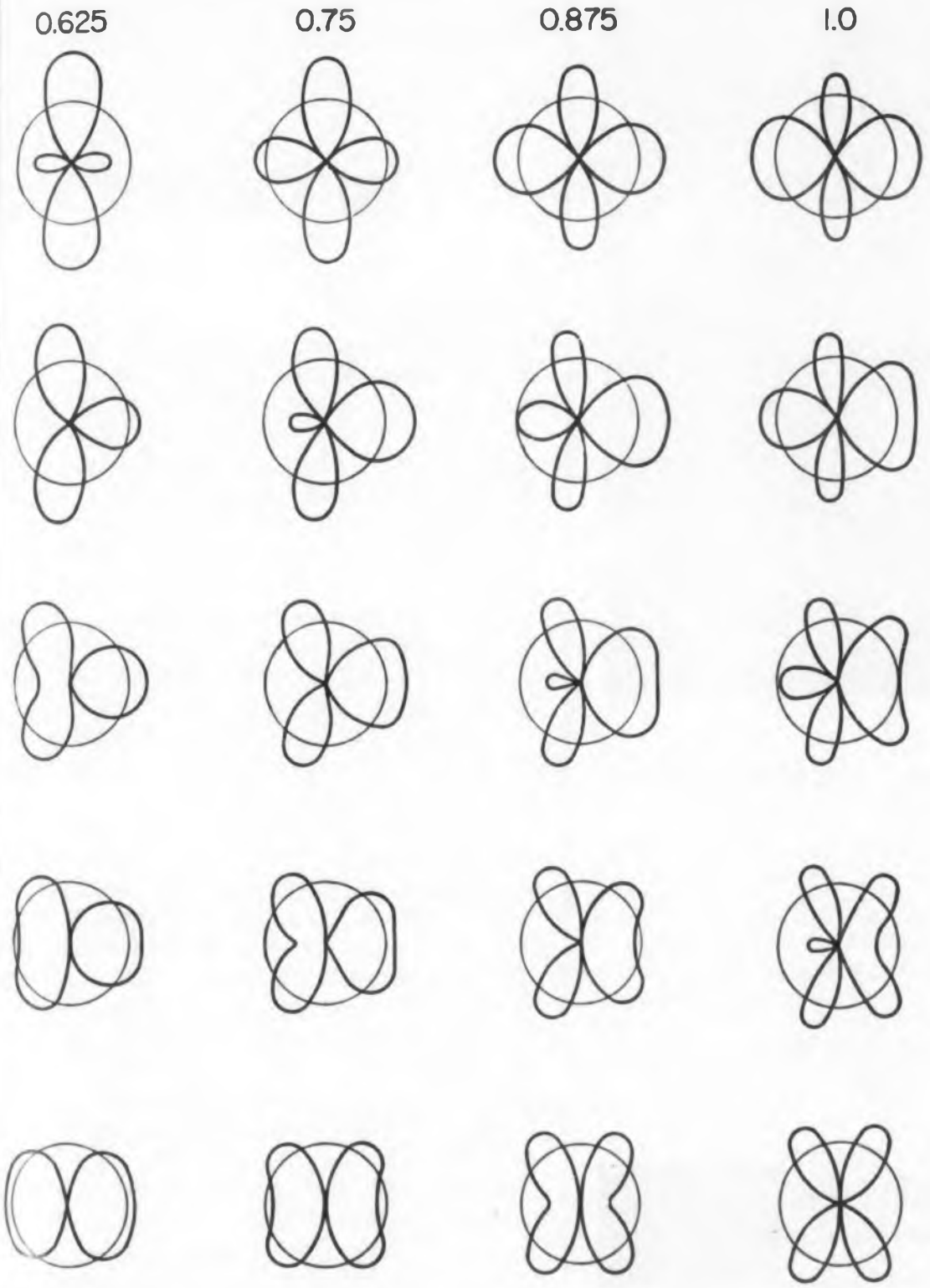
The chart on the previous page gives patterns which were calculated and drawn for $1.0 < d/\lambda \leqslant 2.0$ in increments of $d/\lambda = 0.125$. This was done for phasings of zero to 180 deg in 45 deg steps.

Phasings from 180 to 360 deg give the 180 to zero deg patterns, respectively, rotated about the vertical axis in the plane of the page.

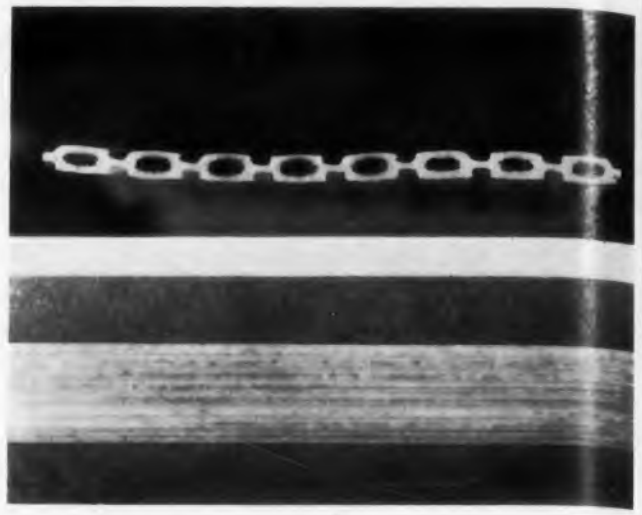
The charts show that the patterns follow definite trends. The pattern shapes can be predicted in most cases from the previous patterns. For instance, on any horizontal line on the chart (constant phase difference between sources), the number of beams increases (increasing d/λ).

If it is desired to obtain broad beam patterns, specific diagonal lines on the chart may be followed. For example, the diagonal line from $d/\lambda = 1.125$, $\alpha = 0$ downward and to the right may be used. If rabbit-ear patterns are desired, different diagonal lines would be followed.

All the patterns are symmetrical about the axis of the array. ■ ■



This chart originally appeared in the **Proceedings of the IRE**, January, 1937.



Made of rectangular braided conductors, this cable has a maximum of flexibility. Conductors are 0.012 in. thick and 0.065 in. wide.

Flat Cable Made In

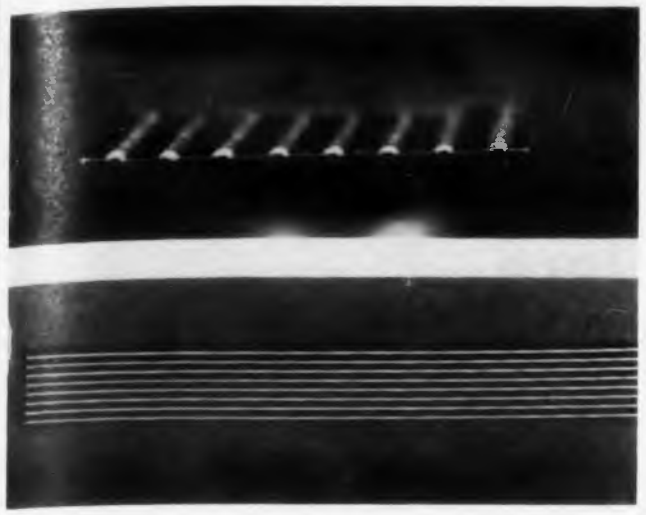
TO SUIT a variety of needs, these flat cables are designed with different kinds of conductors. The cables' conductors are embedded in a web of Teflon by an extrusion process that prevents the Teflon from either shrinking or elongating as a result of age or exposure to high temperature.

For uses where it is desirable to have controlled and low capacitance between conductors, one cable has its conductors separated by 0.15 in. This gives a measured capacitance of 3.5 μμf per ft between conductors and 2.5 μμf between every other conductor. The cable is now available with 18 conductors of No. 24 AWG and 0.006 in. of insulation: any conductor spacing can be furnished.

Another cable is designed for a maximum of flexibility. It is made with rectangular, braided conductors that are 0.012 in. thick and 0.065 in. wide. Each conductor is made up of 48 wires 0.003 in. in diam which is equivalent to No. 22 AWG. Nearly any equivalent AWG wire size can be braided thin and wide and encapsulated in Teflon. The cable is adaptable to standard connectors.

A cable for medical research is constructed of tungsten wires 0.0005 in. in diam on 0.005 in. centers. This cable has five wires and a 0.0025 in. thick insulation. Spacing between the wires can be held within a variation of 0.25 mil.

Where weight saving or miniaturization is important, a cable with served shields is available. The light and compact shield is made by serving



For use where controlled and low capacitance between conductors is desirable, this cable has a spacing between conductors of 0.15 in.

In Many Styles

a silver-plated flat copper wire 0.002 to 0.003 in. thick around the individual conductors and then encapsulating them in Teflon to form a ribbon. This construction adds 3 to 6 mils to the diameter of the wire instead of the 20 mils obtained with conventional braided shield. Shielding coverage is from 95 to 100% and the shield can be easily grounded by unwrapping enough flat wire from the end of the conductor to reach the ground terminal. The capacitance of the served-shield construction is somewhat higher than the braided shield. This cable is available with: all shielded wires; both shielded and unshielded wires; color coded wires; or just two colors.

Bondable Cable Available

Multi-Tet cables, which were announced last year, can now be had for bonding with adhesives. Strengths of 20 to 35 lb per in. are obtained from cables bonded to aluminum sheets with Epoxy cements. The cables can be supplied treated on one side only. The user then coats the treated side with a silicone pressure-sensitive adhesive. Or the cables can be supplied in a roll. The cable is removed from the roll and then stuck to a surface to which the adhesive holds the cable indefinitely.

All these cables are made by W. L. Gore & Associates, Inc., 487 Papermill Rd., Newark, Del.

For more information on these cables, turn to the Reader-Service card and circle number 102. *Booth 3713*

Microphotography Solves

The Case of Eyelet Failure

Fig. 1. Under the microscope an eyelet magnified at 20X shows no flaw.

Fig. 2. A microphotograph of the same eyelet as shown in Fig. 1. reveals a fracture of the solder fillet.

Fig. 3. Excessive pressures of normal riveting practices cause distortion of the eyelet (left).

MICROPHOTOGRAPHY can be used to analyze the causes of eyelet failure in subminiaturized printed circuitry. And close examination of the photos can also point the way to a design solution.

Using microphotography, H. Goldman, F. Harkov and W. M. Jung (all of the Sperry Gyroscope Co., Great Neck, N.Y.) did analyze and did correct a case of high eyelet failure rate in subminiaturized circuitry. The printed circuitry was used in a flight director computer.

Their initial tests showed that cold solder joints were the cause of the failure in production runs, and field service reports said the same thing. Although the defects showed all the characteristics

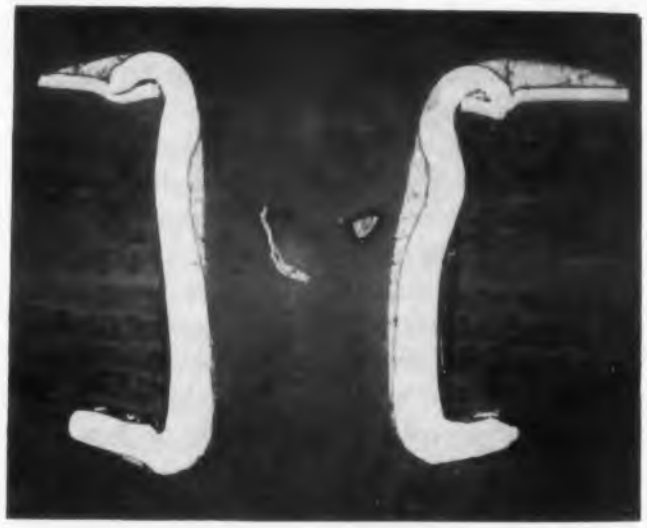


Fig. 4. Excessive pressures can also cause shearing of the conductor.

How Microphotos Were Taken

The eyelet to be photographed was cut rectangularly from the printed circuit board, leaving approximately 1/16 in. of phenolic under the portion of the eyelet to be photographed. The specimen was then squared off and the material under the eyelet reduced to 1/64 in. This side was placed face down in a mold, and a clear plastic was poured in. No pressure was used during the encapsulation period to minimize distortion and preserve the actual conditions existing between the eyelet and the surrounding circuitry. The specimen was sanded to the approximate center of the eyelet. In succeeding steps it was sanded until the visible scratches were removed. Then it was placed on a lapping machine and a fine-polishing wheel was applied. The resulting cross section had a mirror finish which permitted photography at magnifications in excess of 100X.

of cold solder joints (crystallization, dull finish, poor flow, etc.) they did not respond permanently to resoldering, which was the first solution. Lack of failure during environmental testing in accordance with military specifications clouded the issue.

It was then that a mechanical method was chosen for analysis of the failures. It was thought that once the type of failure could be seen, corrective measures could be more readily applied.

Electrical Analysis Rejected

Electrical analysis, another approach, was discarded. Among the reasons was that it provided a poor means of detection, since the failures were intermittent and rapid detection would have been impossible. Also, electrical analysis would not get to the heart of the problem.

Under microscopic analysis at a magnification of 20X the joints appeared satisfactory, as shown in Fig. 1. But microphotographic analysis, which provided a magnification of 100X, revealed fine cracks in the solder joint. This is shown in Fig. 2, an enlarged picture of Fig. 1.

It was seen that the original concept of using a standard eyelet and normal eyeletting techniques in the setting of printed circuit board eyelets was inadequate. Excessive distortion of the eyelet in the drilled hole had taken place and the peened-over portion of the eyelet had not been embedded in the phenolic, as shown in Fig. 3.

Since the eyelet was not being used to bond two materials together, but only as an electrical through connection, that condition was neither desirable nor necessary. The eyelet cutting through the phenolic may not be considered serious. But the eyelet did shear the copper conductor as shown in Fig. 4. This was serious.

Sleuths Study Solder

About twenty photographs were studied and it was found that the greatest thickness of solder fillet (measured across the widest portion) was 0.005 in. In general the thickness of solder fillet averaged 0.003 to 0.004 in.

The soldering method was also studied. Dip soldering temperatures ranged from 470 to 490 F. In this range of temperature the rate of expansion of phenolic is ten times greater than that of the brass eyelet.

After dip soldering, the solder solidified before the other components (phenolic and the eyelet) reached their normal condition. Since the phenolic cooled at a greater rate than the eyelet, severe stresses into tension were set up in the solder joint. They normally showed themselves in two ways: the more serious of the two was the formation of cracks around the eyelet and solder joint; the sec-

Fig. 5. This shows an experimental eyelet of insufficient length, which caused delamination of the conductor.

ond was delamination of the copper pad surrounding the eyelet from the phenolic.

Design Solution

The problem was solved through the use of a solder joint that could stand the thermal stresses induced. A flared type eyelet, set 0.001 to 0.002 in. loose, was decided upon to increase the thickness of the solder fillet. This eyelet offered the dual advantage of an increased solder joint fillet, plus the ability of the eyelet to take advantage of the plasticity of the solder alloy.

Setting the eyelet too tightly to the printed circuit board caused the copper pad to delaminate. This was because in the setting process the flared portion of the eyelet captured the circuitry between the phenolic and the force exerted in the setting caused delamination. See Figs. 5 and 6.

It was therefore decided to make the eyelet longer so that upon setting of the eyelet, approximately 0.002 in. movement in the vertical direction was possible. The relative diameters of the eyelet and its clearance hole remained the same. An increase in the size of the solder fillet is shown in Fig. 6. The abundant solder fillet with a component lead in the eyelet is shown in Fig. 7. Solder fillets obtained with the new eyelet varied in thickness from 0.013 to 0.017 in.

Tests of about 5000 eyelets, assembled into production board with required components showed no failures. ■ ■

Fig. 6. Pictured here is an improved eyelet with greater length and larger fillet.

Fig. 7. This shows another sample of an experimental eyelet, showing large solder area and the component lead.

In this article F. R. MacDonald gives equations and curves for calculating the transient temperature rise of electronic components dissipating heat.

How To Keep Electronic Equipment Cool At High Transient Temperatures

Fred R. MacDonald
Design Engineer
Bendix Aviation Corp.
North Hollywood, Calif.

WHEN ELECTRONIC equipment is used in small missiles or in aircraft at high Mach numbers, it is often subjected to high temperatures for short periods of time. The design engineer must take these non-steady temperature conditions into account if the equipment is to operate reliably.

During periods of high temperature, heat given off by electronic components is "stored" in the structure of the unit. This heat storage increases the structure's temperature. The length of time this process goes on will determine the maximum temperature the components will attain.

Design Considerations

A good design for steady state heat transfer conditions may be poor for a transient temperature environment. This can be illustrated by looking at two identical components dissipating a certain wattage, but packaged in different ways. See Fig. 1. Configuration *1* provides a good conduction path from the component to the environmental temperature. Configuration *2* places an insulator between the components and the environmental temperature.

The time temperature profiles T_1 and T_2 of the components packaged in configurations *1* and *2* are superimposed on the time temperature profile of the environmental temperature, T_e, in Fig. 2. This would approximate the short duration, high Mach number burst of an aircraft, or, with a different scale, the short duration missile flight where the environmental temperature increase is caused by aerodynamic heating of the skin. T_{max} is the maximum recommended temperature for the component. Enough time has elapsed so that before time *B*, the unit is in thermal equilibrium. Both T_1 and T_2 are below T_{max} and acceptable.

At *B* the environmental temperature rises in a step function to T_{e_2}. The component in configuration *1* now receives heat from the environmental temperature. The good conduction path accounts for the rapid increase in temperature. The temperature of the component exceeds T_{max} at *D* and unreliable performance results.

Temperature of the component in configuration *2* is less affected by the environmental temperature. This temperature will not exceed the maximum recommended temperature, T_{max}, until time *E*, when unreliable performance begins.

The temperatures of the components of configuration *2* do not exceed those of configuration *1* until time *F*. Thus, configuration *1* is most desirable for a particular transient temperature environment.

If the length of time at the maximum environmental temperature is short, the maximum recommended temperature for the components may be less than this temperature and reliable operation will still result.

Basic Equation

Neglecting thermal gradients in the mass, the basic equation for transient heat problems is:

$$Q = MC_p \frac{dT_C}{d\theta} + \psi (T_A - T_C) \qquad (I)$$

$$\psi = hA$$

See the table for a definition of the symbols.

Forced Convection. For steady state conditions, the equation for the component temperature is:

$$t_i = t_{A_i} + Q'/hA \qquad (1)$$

The final steady state temperature is:

$$t_f = t_{A_f} + Q'/hA \qquad (2)$$

The convective heat transfer coefficient, h is a function of the type of fluid, temperature, dimensions of passage and velocity of the fluid. For air, the thermal conductivity viscosity, and prandtl number are functions of temperature only for the normal range of pressures. The temperature functions for computing the heat transfer coefficients for three cases is shown in Fig. 4.

For a step increase in the air temperature from t_{A_i} to t_{A_f} the component temperature is obtained from the equation:

$$t = t_f - (t_f - t_i)\,\eta_f \quad \eta_f = e^{\frac{-hA}{MC_p}\theta} \qquad (3)$$

The factor η_f is given in Fig. 3 as a function of the mass, heat transfer area, convective coefficient specific heat and time.

Insulated. For the case of a well insulated component dissipating a wattage for a short length of time, the conductance $\psi \approx 0$ and, equation I becomes:

$$t_c = t_i + \frac{3.41\,Q}{MC_p}\theta \qquad (4)$$

and t_c increases without bounds with time. This equation is for short time intervals where the maximum temperature rise in time θ is needed.

Natural Convection. For natural convection, the buoyant force caused by the less dense air at the higher temperature affects an air movement. Therefore, the air velocity and thus the convective heat transfer coefficient are a function of the temperature difference between the air and the unit. The natural conduction breaks up into two regimes, laminer and turbulent.

Almost all cases of cooling electronic equipment in air lie within the laminer region of natural convection.

For laminer convection in the normal range of pressures:

$$h = \frac{C}{L^{0.25}} [K\,(a)^n]\,\Delta\,T^{0.25} \qquad (5)$$

and for a perfect gas:

$$C' = \frac{C}{L^{0.25}} \left(\frac{P}{P_{S.L.}}\right)^{0.5} K\,(a)^n$$

(Continued on page 48)

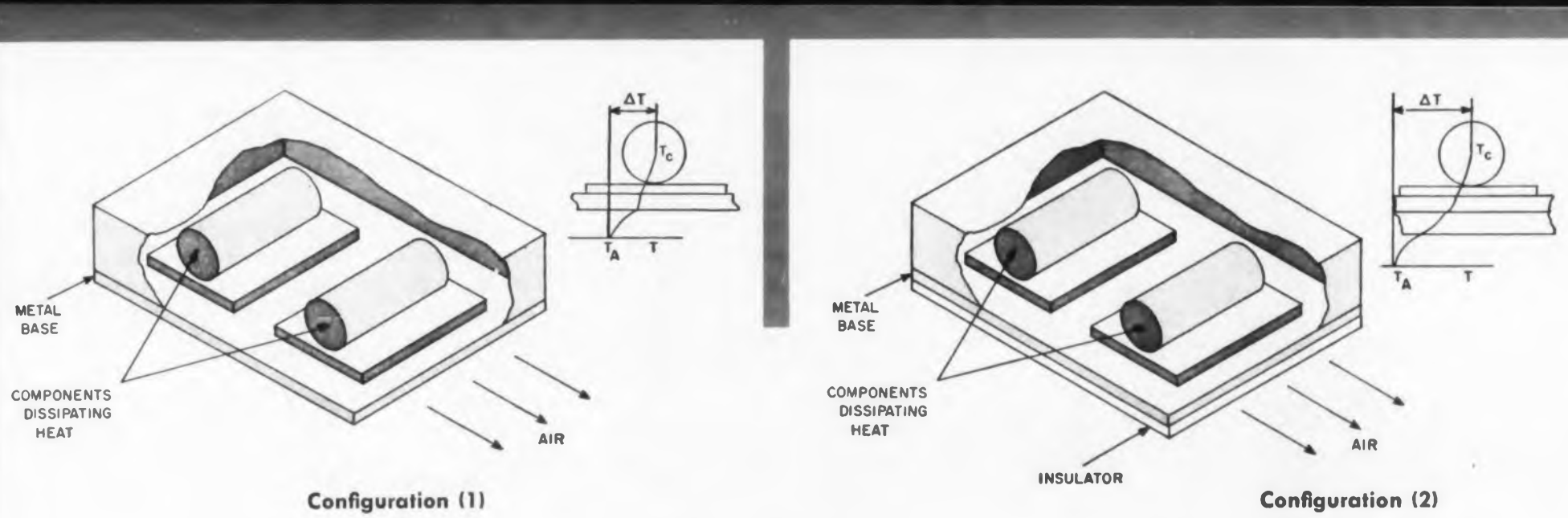


Fig. 1. Temperature gradients at steady state.

Nomenclature:

η_t = Transient coefficient for forced convection, $\eta_t = (t_t - t)/(t_t - t_i)$
Q = Heat (watts)
Q′ = Heat, Btu/hr. Q′ = 3.41Q
M = Weight in pounds
C_p = Specific heat, Btu/lb
T = Temperature in F
Θ = Time in hours
ψ = Conductance, Btu/(hr F)
h = Convective heat transfer coefficient, Btu/ft² F hr
A = Area in square feet
k = Thermal conductivity, Btu/(ft F hr)
B = Coefficient of thermal expansion
P = Density, lb/ft³
η_{ci} = Initial natural coefficient, $\eta_{ci} = (t_t - t_A)/t_t - t_i)$
n = viscosity
R = Gas constant
P = Pressure
η_c = Transient coefficient for natural convection, $\eta_c = (t_t - t)/(t_t - t_A)$
C = Configuration factor. See Fig. 5.
v = Velocity, ft/sec
l = Length or diameter, ft

Subscripts:

e, A = Environmental temperature
c = component
i = Initial component temperature
f = Final steady state temperature

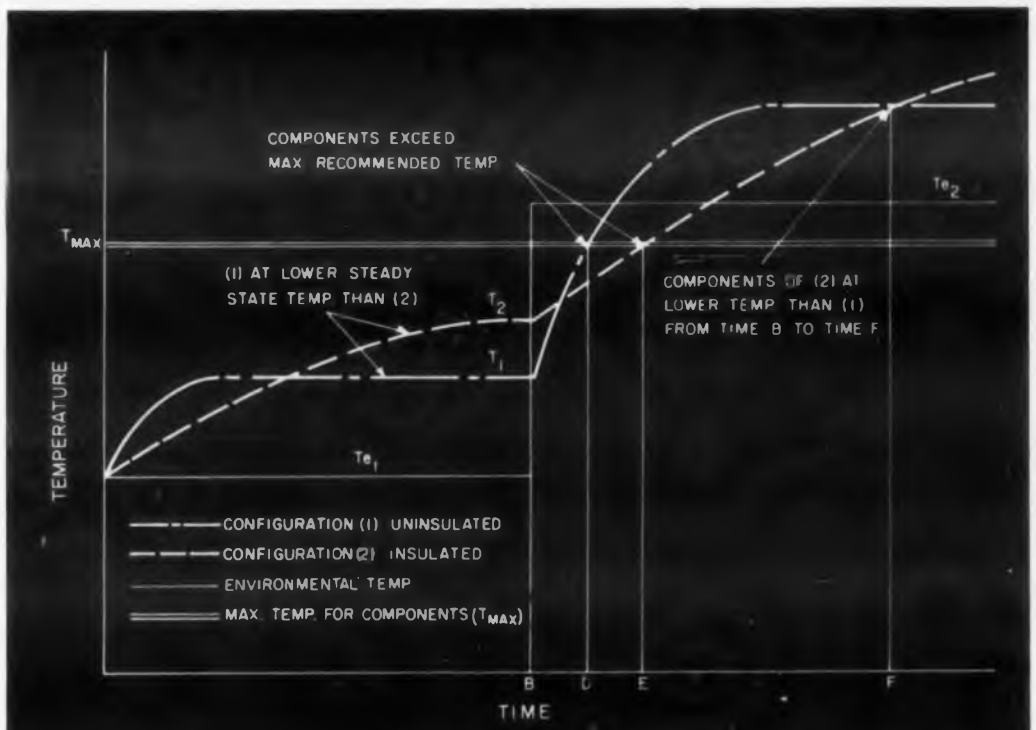


Fig. 2. Comparison of component temperatures for two packaging methods.

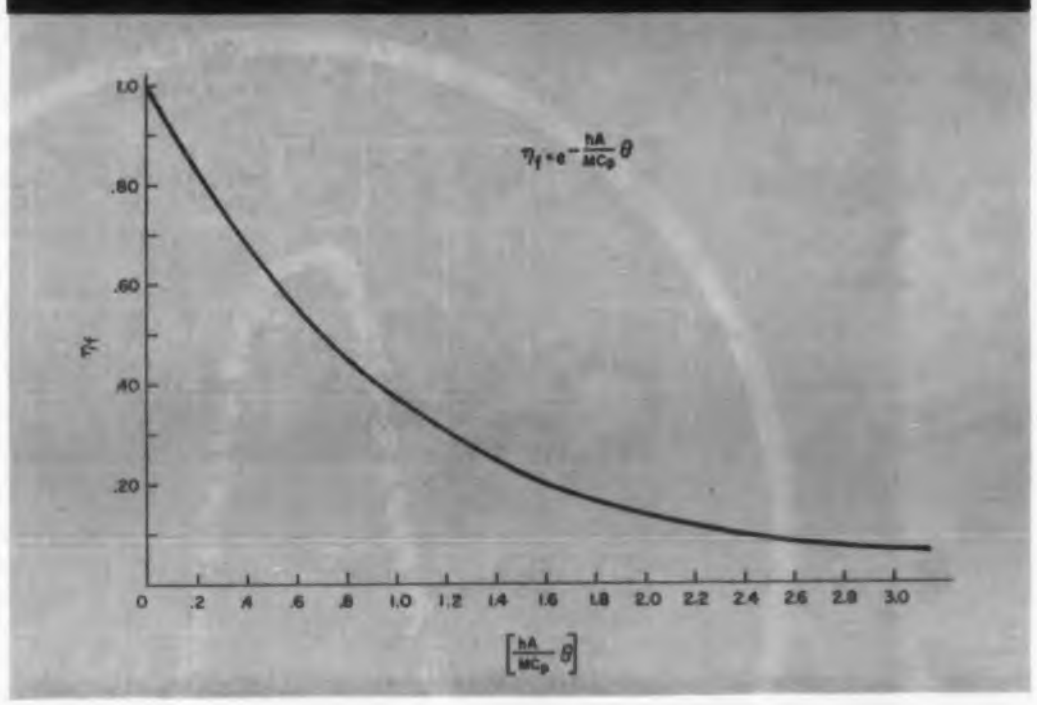


Fig. 3. Correction factor η_t for transient temperature rise with forced convection.

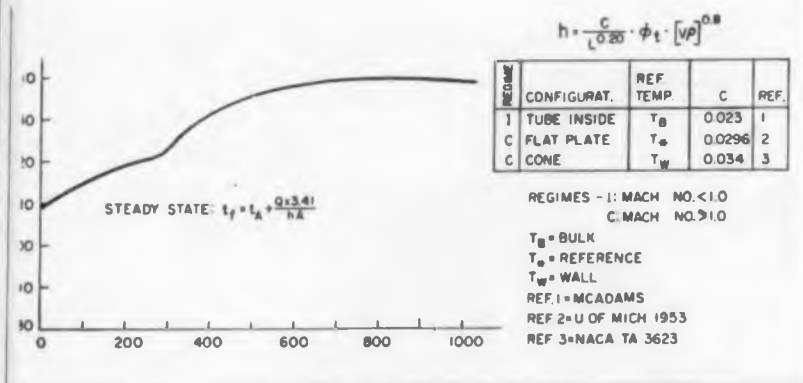


Fig. 4. Temperature function for convective heat transfer coefficient.

Fig. 5 gives $K(a)^n$ vs. evaluation temperature (mean temperature) for air for both laminer and turbulent cases. For the initial steady state value for the laminer case:

$$t_{ci} = t_{Ai} + \left(\frac{3.41\ Q}{C'\ A}\right)^{0.8} \tag{6}$$

The final steady state value:

$$t_{cf} = t_{Af} + \left(\frac{3.41\ Q}{C'\ A}\right)^{0.8} \tag{7}$$

For a step increase in the air temperature from t_{Ai} to t_{Af} the component temperature is obtained from the equation:

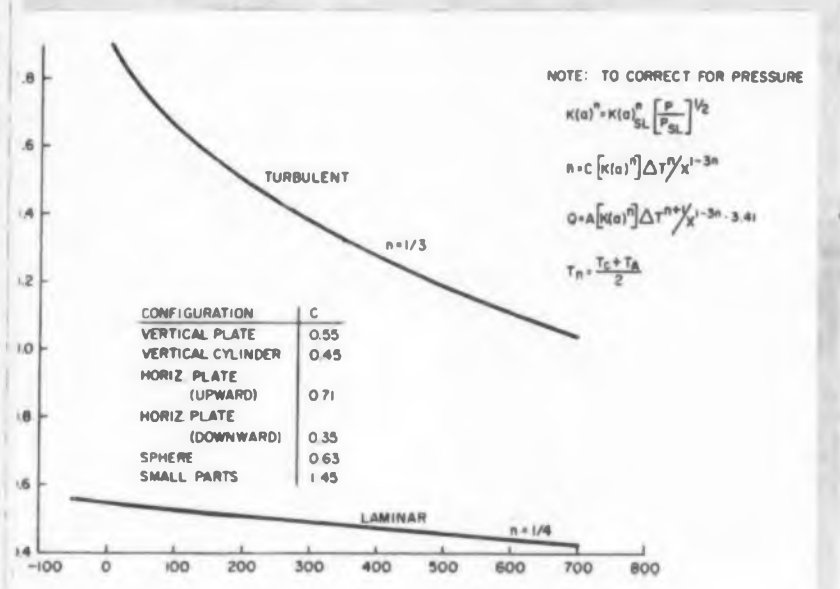
$$t = t_f - (t_f - t_A)\ \eta_c$$

$$\eta_c = 1 \Big/ \left[\frac{0.25\ Q'\theta}{(t_f - t_A)} + \left(\frac{t_f - t_A}{t_f - t_i}\right)^{1/4}\right]^4$$

Fig. 6 gives ηc as a function of heat dissipated, mass of unit, specific heat of unit, and the initial condition:

$$\eta_{ci} = \frac{t_f - t_A}{t_f - t_i}$$

Fig. 5. Temperature function for natural convection.



Typical Problem

A package containing electronic components dissipates 300 w. The unit has cooling air that is taken from the airstream of the aircraft during cruise. The air temperature is 160 F maximum and the density is 0.085 lb/ft². The velocity in the air passage is 400 ft/sec. The aircraft can fly Mach 1 for five minutes at sea level with a corresponding air temperature of 212 F and a density of 0.1 lb/ft², causing velocity in the air passage of 600 ft/sec. The diameter of the air passage is 0.5 ft. The area for convective heat transfer is 0.5 ft². The components are aluminum, steel and phenolic etc., with an average specific heat 0.25 Btu/(lb F). The mass of the unit is 8 lb. The maximum recommended temperature for the components is 200 F. The problem is to adjust the parameters in order that this temperature is not exceeded. A typical procedure is:

1. Determine if cooling is by natural convection or forced convection and calculate heat transfer coefficient.

Initially the air is taken in at a velocity of 400 ft/sec. Thus, Fig. 4 can be used to calculate the heat transfer coefficient. From the table at the initial condition:

$$h = \frac{0.023}{L^{0.2}}\ \phi_t\ (V\rho)^{0.8}$$

$$= \frac{0.023\ (118)}{(0.5)^{0.2}}\ (400 \times 0.085)^{0.8}$$

$$= 5.48\ \text{Btu/ft}^2\ \text{hr F})$$

Similar calculations at the maximum temperature conditions show:

$$h = 84.5$$

2. Determine the initial and final steady state temperatures from equations (1) and (2).

$$t_{ci} = t_{Ai} + \frac{Q\ (3.41)}{hA}$$

$$= 160 + \frac{300\ (3.41)}{0.5\ (84.5)}$$

$$= 197\ \text{F}$$

$$t_{cf} = 212 + \frac{300\ (3.41)}{0.5\ (84.5)}$$

$$= 212 + 25$$

$$= 237\ \text{F}$$

3. Find the transient temperature rise by using equation 3 or 8.

For forced convection η_f can be obtained from Fig. 3.

$$\eta_f = 0.33$$

The correction factor, from Fig. 3, is:

$$\frac{hA}{MC_p}\ \theta = \frac{84.5\ (0.5)}{8\ (0.25)}\left[\frac{5}{60}\right] = 1.12$$

Thus, from equation 3:

$$t_c = t_f - \eta_f\ (t_f - t_i)$$

$$= 237 - 0.33\ (237 - 197) = 224\ \text{F}$$

4. Compare the resulting temperature with the maximum reliable temperature of the components. Adjust parameters, keeping in mind that lowering the steady state temperatures often increases the transient rise.

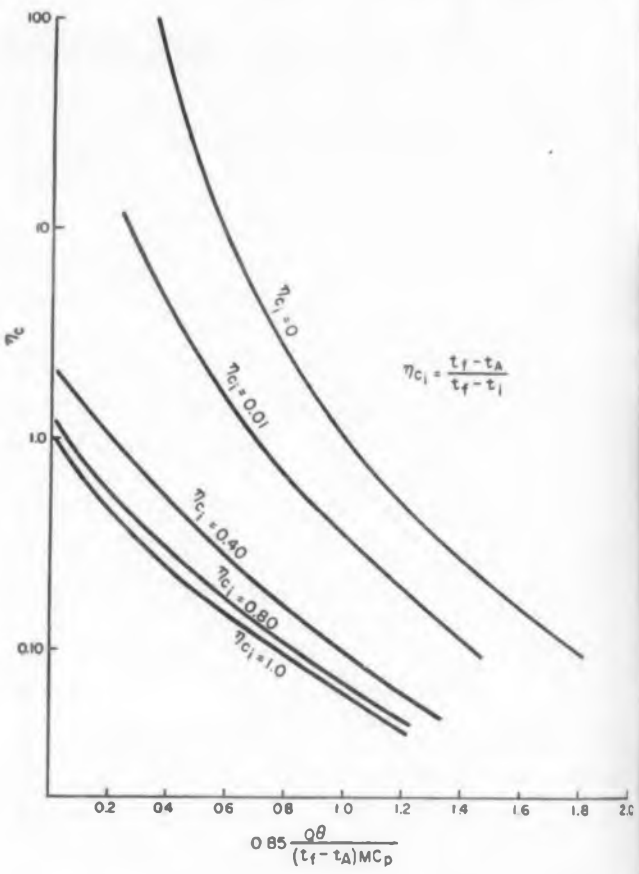


Fig. 6. Transient temperature correction factor, η_c, for laminar natural convection.

The maximum recommended temperature is 200 F, thus unreliable operation may result. If the area is increased by the use of fins, the steady state temperature will be lowered; however, the rate of temperature rise will be increased at the maximum temperature. If the inlet is closed when the air temperature increases to 212 F, the transfer will be by natural convection and the rate of increase greatly reduced. *(Cont. on page 49)*

10 millimicroseconds

◀ This is a
2 millimicrosecond
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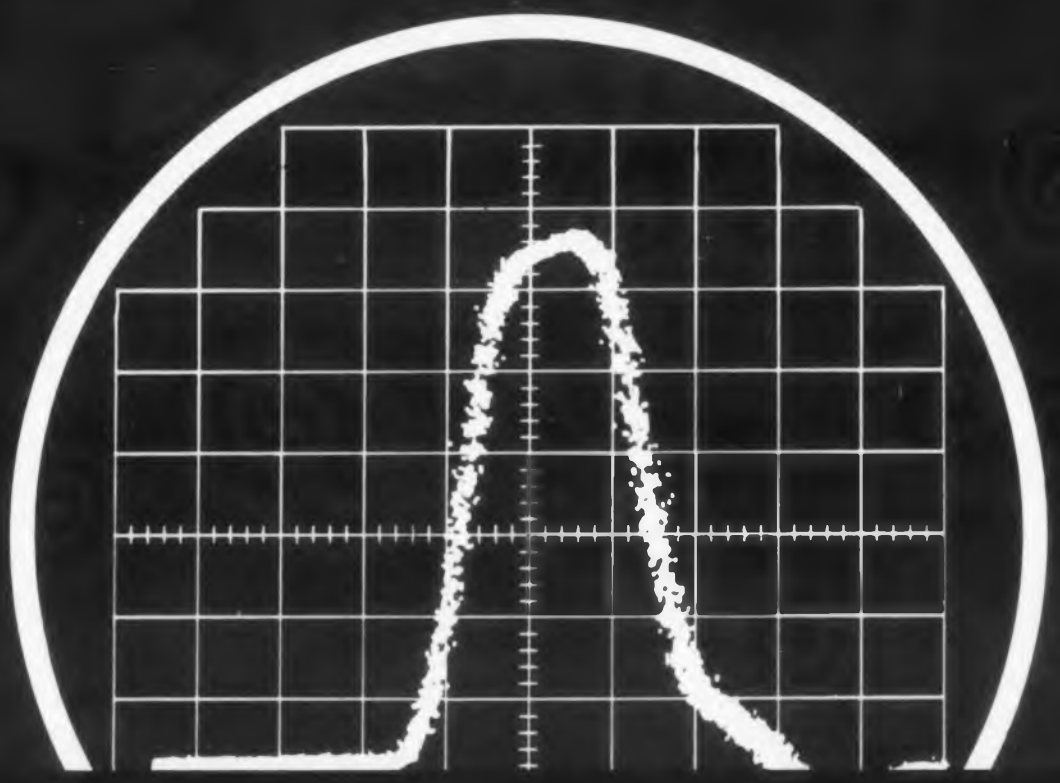

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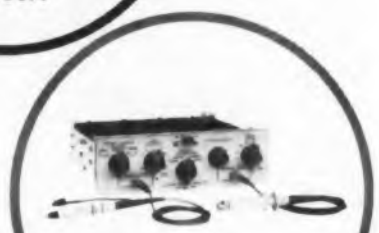

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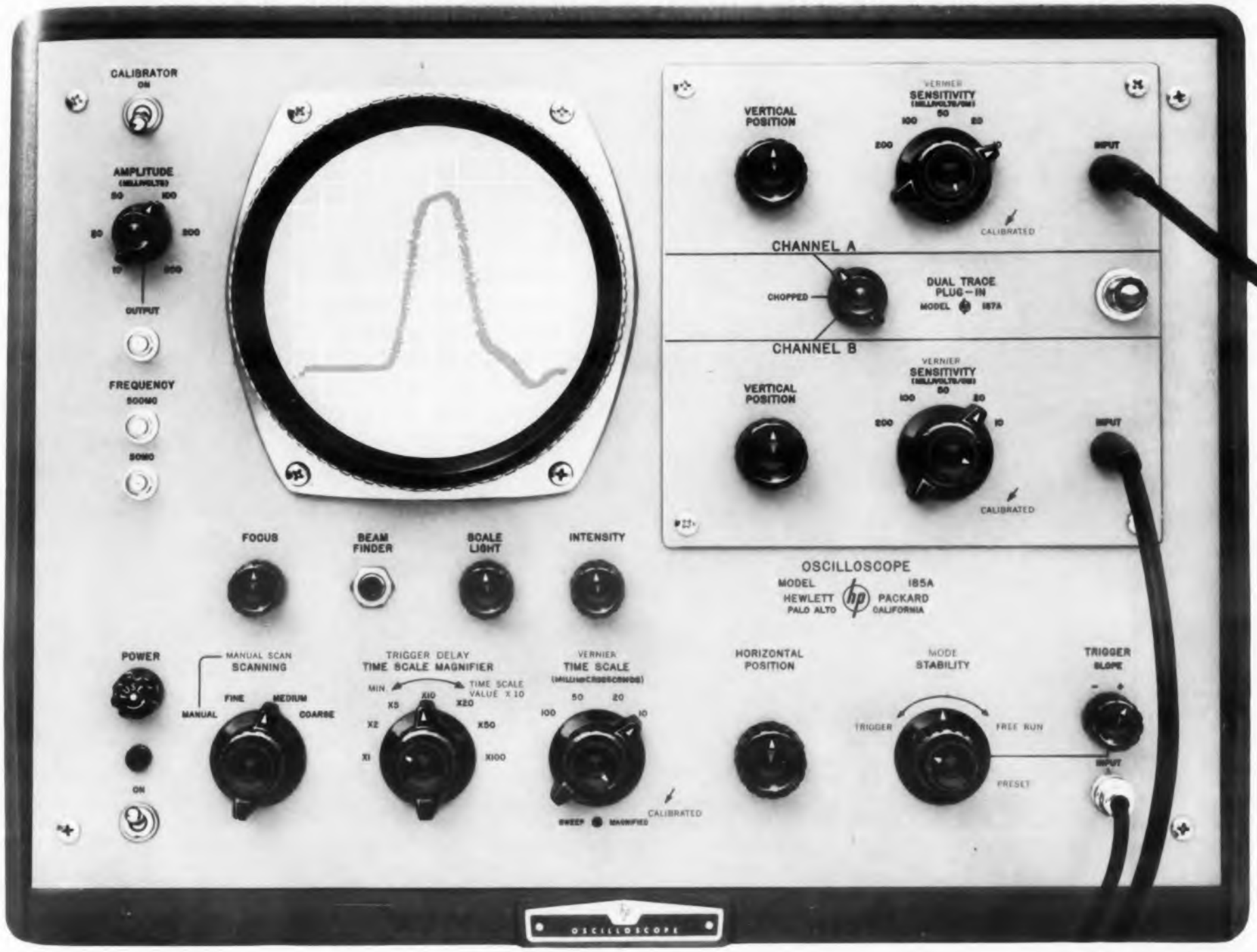

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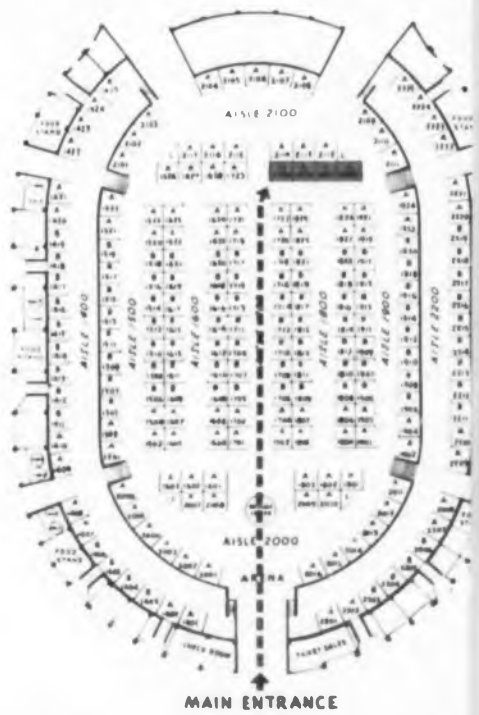

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Thus all parameters remain the same except the heat transfer area is increased to 5 ft² by the use of finned surfaces and the heat transfer is by natural convection for 5 min at maximum temperature.

For the cruise condition:

$$t_i = t_{A_i} = \frac{Q\ (3.41)}{hA}$$

$$= 160 + \frac{300\ (3.41)}{55\ (5)} = 164\ \text{F}$$

At the high Mach number, assuming the air remains at essentially 212 F, a pressure of $1.2(P_{S.L.})$ is assumed.

$$C' = \frac{C}{L^{0.25}} \left(\frac{P}{P_{S.\,L.}} \right)^{0.5} K\,(a)^n$$

From Fig. 5, assuming a vertical cylinder approximates the air passage:

$$C = 0.45 \qquad K(a)^n \text{ at } 212\ \text{F} = 0.5$$

$$C' = \frac{0.45}{(0.5)^{0.25}}\ (1.2)^{0.5}\quad (0.5) = 0.294$$

$$t_f = t_{Af} + \left(\frac{3.41\ Q}{C'\ A} \right)^{0.8}$$

$$= 212 + \left(\frac{3.41 \times 300}{5 \times 0.294} \right)^{0.8}$$

$$= 212 + 185 = 400\ \text{F}$$

However, this must be corrected for the small time increment.

Refer to Fig. 6:

$$\eta_{ci} = \frac{400 - 212}{400 - 164} = 0.8$$

and the abscissa equals:

$$0.85 \left[\frac{Q\,\theta}{(t_f - t_A)\ MC_p} \right] = 0.019$$

Using these results, and referring to Fig. 3, $\eta_c = 1.1$. Then:

$$t_c = t_f - \eta_i\ (t_f - t_A)$$

$$= 400 - 1.1\ (400 - 212)$$

$$= 400 - 209 = 196\ \text{F}$$

Temperature of components will not exceed 200 F; therefore, if the unit is supplied with fins to increase area from 0.5 to 5 ft² and the inlet air is shut off for the 5 min of maximum temperature conditions, the components should operate in a reliable temperature region. ■ ■

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2. W. H. McAdams, ibid, Chapter Seven.
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Detecting Thermal Run-away of Power Transistors

James Reese, W. W. Grannemann
University of New Mexico
Albuquerque, N. Mex.

A protection device detects the changes which occur as failure is approached in the magnitude of the collector current, and removes the power from the test transistor. Because the device prevents destruction of the unit, a large statistical sample can be obtained at a small cost.

COMPLETE failure can be approached closely and repeatedly without any damage to the power transistor by employing a protection device. Differences in failure points of the same unit then can be observed under various pulse conditions. Previously, the study of the maximum pulse power ratings of power transistors has been very expensive since many transistors may be destroyed if a large statistical sample is taken.

Failure Characteristics

The test transistor is connected with a common emitter and pulses are applied between emitter and collector (see Fig. 1). This method of pulsing removes any collector reverse-leakage current effects which might be present during "off" (no pulse input) periods. Complete failure is defined as an emitter to collector short-circuit. While small changes in transistor characteristics may occur during the first portion of testing, they are not cumulative and are not considered failures.

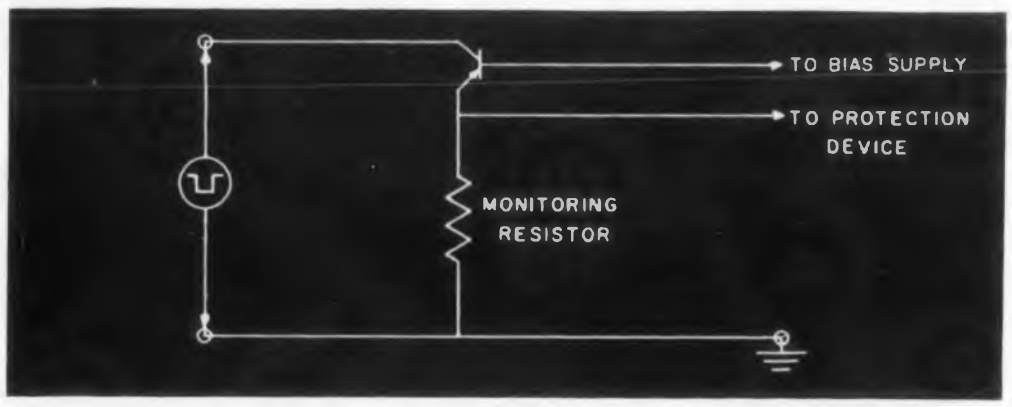
As complete failure is approached, each successive pulse of collector current is greater in amplitude than the preceding pulse. This phenomenon occurs even though the input power is constant, provided the input power is sufficient to cause complete failure. As junction temperature increases, the amplitude changes become more and more pronounced, culminating in a very large pulse at complete failure. A device which detects these amplitude changes and removes the input pulses when the changes occur, will prevent any permanent damage to the test transistor.

How The Protection Device Works

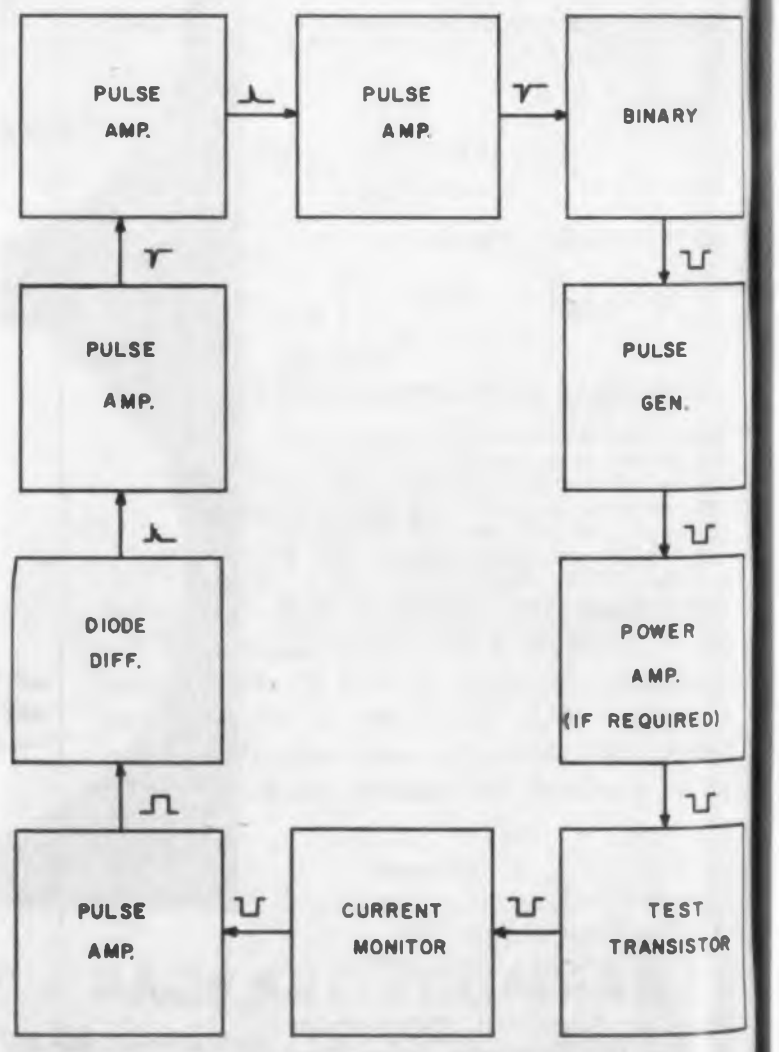
The block diagram of the protection device is shown in Fig. 2. The output of the pulse generator (or power amplifier if one is required) is applied to the test transistor. The output of the collector current monitor is applied to the first pulse amplifier and then to the diode differentiator. The output of the diode differentiator is amplified and applied to the binary. One plate of the binary is connected to a critical grid circuit in the pulse generator.

As failure is approached and collector current amplitude increases, the output of the diode differentiator (after amplification) becomes large enough to trigger the binary. When the binary is triggered, a negative pulse is applied to the critical grid in the pulse generator, cutting the pulse generator off and removing the power from the test transistor.

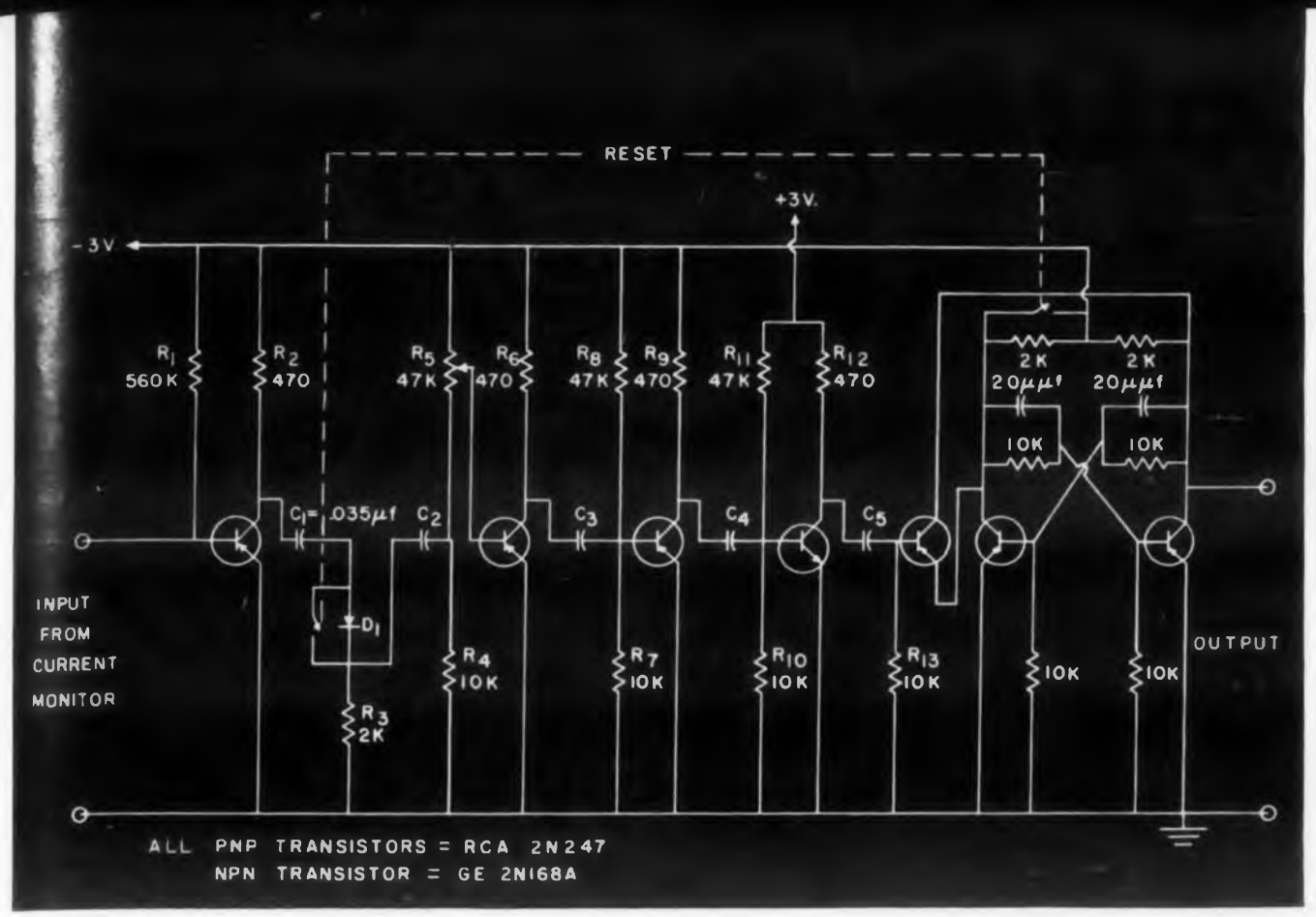
The schematic diagram of the protection device is shown in Fig. 3. The output of the current monitor (a negative pulse) is applied to the base of T_1, the first pulse amplifier transistor. The output of T_1 (a positive pulse) is applied to the plate of D_1 through C_1. The combination of D_1, C_1, and R_3 constitute the diode differentiator. Since D_1 offers a low impedance to a positive pulse, the differentiator time constant is approximately equal to the product of R_3 and C_1. Since the reset switch is normally open, there is only a high impedance discharge path for C_1. C_1 therefore charges to a peak value determined by the amplitude of the input to T_1. As the collector current in the test transistor is increased, C_1 charges to a new value. If the collector current is in-



1. (left) Test Transistor configuration.



2. (right) Block diagram of the protection device.



3. Schematic of the protection device. All pnp transistors used were RCA 26247 and npn transistor was GE 2N168A.

creased in small increments, with sufficient time between increments for C_1 to charge to the new value, only a small signal will appear across R_3.

As failure is approached the collector current increases by larger and larger amounts and the signal across R_3 increases correspondingly. The differentiated positive pulses appearing across R_3 are applied to the base of T_2. T_2, T_3, and T_4 are simple cascaded pulse amplifiers. The output of T_4 (a train of increasingly negative differentiated pulses) is applied to the base of T_5, the binary triggering transistor. When the signal on the base of T_5 becomes sufficiently negative, the binary is triggered, and its output cuts off the pulse generator.

The fraction of the signal appearing across R_3 which is applied to the base of T_5 is controlled by R_5. R_5 can be adjusted so that triggering will occur for any increase in input signal greater than a certain minimum. This minimum is determined by the overall amplification of the protection device and can be reduced, to some extent, by additional amplifier stages. In this type of testing, where thermal runaway is detected by the increase in collector current, damage to the transistor can occur if the protection device is set too low in sensitivity. To prevent damage, one must adjust R_5 so that the protection device is triggered immediately after thermal runaway begins. For the circuit shown in Fig. 3 (with R_5 set for maximum sensitivity), the input to T_1 must increase by an amount equal to or greater than 10 mv to trigger the protection device. This circuit is sufficiently sensitive to prevent damage for all of the various transistors tested at the University of New Mexico.[1, 2, 3, 4]

The setting of R_5 also determines the increments by which the test transistor collector current may be increased. If the collector current is increased too rapidly the protection device will trigger regardless of how near failure the test transistor is operating. By measuring the change in input amplitude necessary for triggering with a given setting of R_5, how large the increments of collector current should be determined.

Some of the tests of partial failure revealed damage to one junction while the other junction remained sound. When the test transistors were opened and the crystals examined under a microscope, one junction often appeared very rough and the other junction normal. Either junction could be the hot junction depending on operating conditions. ■ ■

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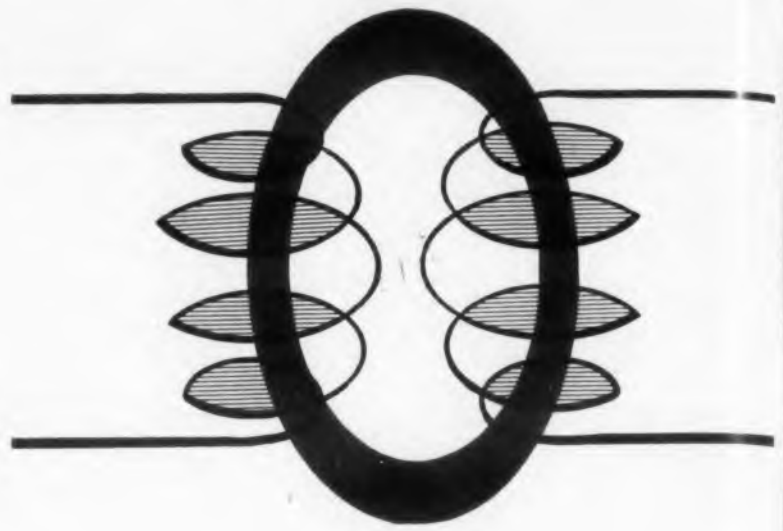
How To Measure Pulse Transformer Parameters



Edward J. Watt
Design Engineer
PCA Electronics, Inc.
Sepulveda, Calif.

MEASUREMENT of pulse transformer parameters is more accurately accomplished by pulse techniques than sine wave methods. One reason is that the pulse technique more closely approaches the actual circuit conditions. Another reason is that most, if not all, of the available sine wave test equipment for measuring inductance has outputs in the order of a few millivolts. However, most pulse transformers are operated at higher voltage levels.

The most important transformer parameter to measure is its inductance. All other parameters associated with a transformer, such as leakage inductance, winding resistance, inter and intra winding capacitances, are of a parasitic or undesirable nature.

From a standpoint of reliability, reproducibility, economy and time, the magnetization current test is the most ideal for measurement of inductance.

Magnetization Current Test

The test set up for the magnetization current test is shown in Fig. 1. The working equation for this approach is:

$$L = \frac{P_a - P_w}{I_m} \qquad (1)$$

where P_a is the driving pulse of amplitude E, P_w is the pulse width in seconds, and I_m is the peak magnetization current for any interval of time. The units are henry, volts, seconds, and amperes.

A sampling resistor R_s is placed in series with the winding under test and the voltage E_s across this resistor is observed on an oscilloscope. The current through the resistor, I_m, equals E_s/R_s.

The sampling resistor R_s does introduce an error into the reading and should be held to a value in which the voltage E_s across it does not exceed 2 per cent of the driving pulse E_p. The voltage E_s as observed on a calibrated oscilloscope is shown in Fig. 2.

Assume a driving pulse E_p of 100 v and 4 μsec wide. The scope should then be calibrated for 2 per cent of E_p or 2 v full scale. The resistor R_s is then chosen so that the voltage E_s across it does not exceed this 2 v. In Fig. 2, the voltage E_s at various 1 μsec time increments is 0.2 v, 0.5 v, 1.1 v, and 2.1 v. Table 1 shows the corresponding values of the excitation current and open circuit inductance for different increments of time during the 4 μsec pulse duration.

A given transformer winding exhibits quite a wide range of inductance variation as the driving excitation varies in pulse width and a fixed amplitude. See Table 1. A comparable variation would be had with a fixed pulse width and variation in pulse amplitude. A nonlinear magnetization curve is an indication that the transformer core is being driven into saturation. There is one good advantage in this type of testing for quality control inspection. If the winding is hit hard enough and driven into the saturation region beyond the so-called knee of the curve, the state of the previous magnetic "set" of the core becomes inconsequential. In other words a manufactured transformer will show the same test reading regardless of whether it is positively or negatively polarized or not polarized at all. All too often transformers are inspected in a polarized condition with consequent misleading measurements.

As seen from Fig. 3, if the transformer is driven beyond point C, then it will be immaterial whether the transformer is positively polarized and starts up from point A or negatively polarized and starts from point B. However, the inductance

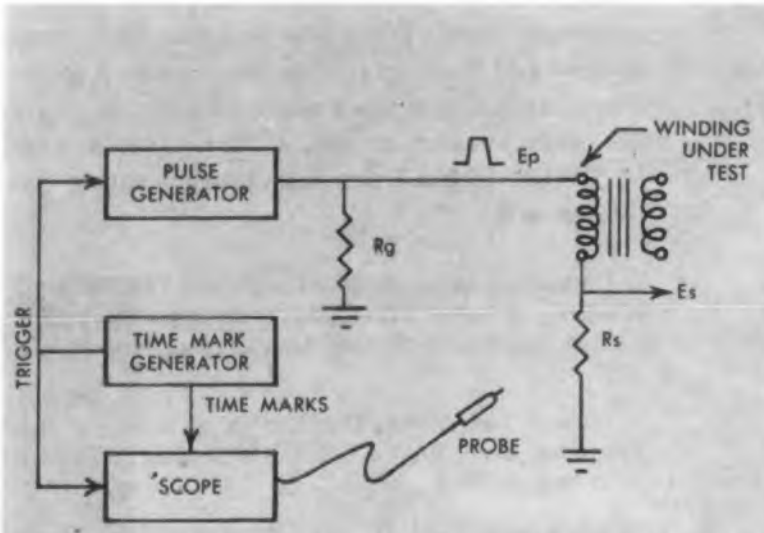


Fig. 1. Circuit for measuring inductance by the magnetization current method.

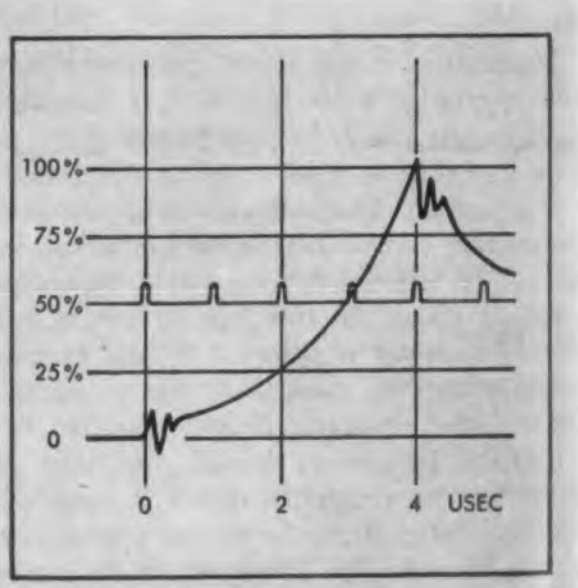


Fig. 2. Voltage E_s as seen on oscilloscope during magnetization current test.

Table 1. Inductance variation vs. excitation variation.

TIME in μsec	OCL in mh	I_m in amps	E_i in volts
1.0	5.00	0.02	0.2
2.0	4.00	0.05	0.5
3.0	2.73	0.11	1.1
4.0	1.90	0.21	2.1

Table 2. Values of 1n (E/e) for common droop measurements.

% Droop	e	E/e	1n (E/e)
0	1.0	1.0	zero
10	0.9	1.11	0.1044
20	0.8	1.25	0.2231
30	0.7	1.41	0.3577
40	0.6	1.67	0.5128
50	0.5	2.00	0.6931
60	0.4	2.50	0.9163
70	0.3	3.33	1.2030
80	0.2	5.00	1.6094
90	0.1	10.00	2.3026
100	zero	inf.	inf.

that the winding will exhibit in actual circuit operation will depend on its pulse excitation, and tests for that purpose should utilize the identical pulse that the circuit will operate with.

Drawbacks

There are some drawbacks in this type of testing. Readings measured on an oscilloscope will be of a diagonal line intersecting a vertical line. This is subject to the error of the nonlinearity of the particular oscilloscope and of the human operator making the readings. There is some scarcity of pulse generators on the market that can supply the necessary pulse excitation for saturation testing.

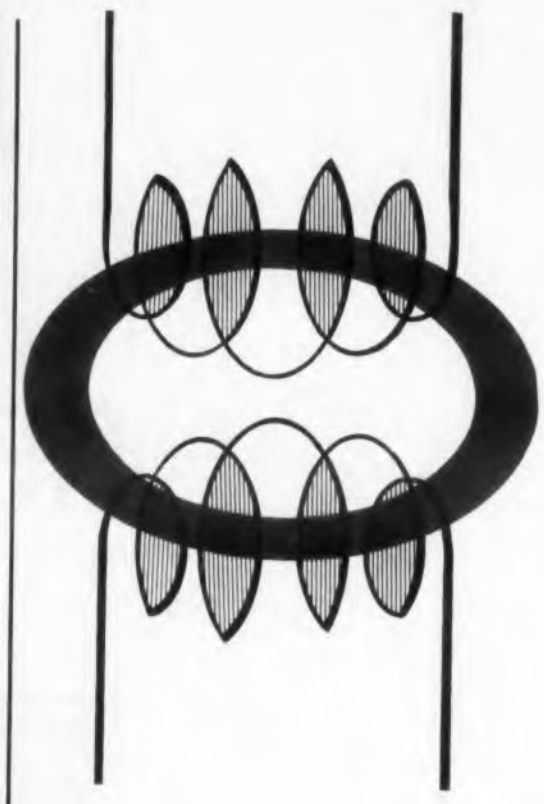
The Droop Test

The droop test is another method of measuring the inductance of a pulse transformer. While this test is simpler than the previous one, it does suffer from possible effects of core polarization. A set-up for this method is shown in Fig. 4. The working equation used is:

$$L = \frac{RT}{1n(E/e)} \qquad (2)$$

where R is the total effective resistance that the winding sees, E is the pulse amplitude 100 per cent point, e is the amplitude after a time T, and T is the pulse width time.

Whatever level of pulse amplitude is used (10, 40, or 200 v), it can be considered as 100 per cent



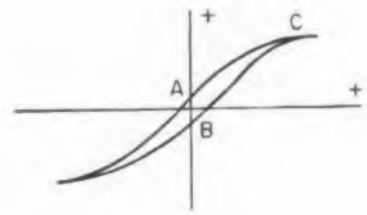


Fig. 3. A hysteresis loop.

or 1. Small e is the droop voltage after a given time T. At 90 per cent of E, the droop is 10 per cent, for 80 per cent of E, the droop is 20 per cent, and so on. Thus the value of the natural logarithm $1n(E/e)$ can be tabulated for all values of droop. Some convenient values of the expression $1n(E/e)$ for common droop measurements are shown in Table 2.

The effective resistance R that the winding sees is given analytically as:

$$R = R_o + R_w + \frac{R_g r_g}{R_g + r_g} \qquad (3)$$

where R_o is the inserted line resistance, R_w is the winding resistance, R_g is the generator terminating impedance, and r_g is the internal generator impedance.

Frequently, the latter two expressions of this equation can be neglected if R_o is sufficiently large, in which case the effective resistance R would be the inserted line resistance R_o.

Other transformer parameters such as turns ratio, rise time, etc., can be measured with only the addition of secondary loads.

Coupling Test

The coupling test is the most ideal for measurement of rise time, overshoot, and voltage ratio. A circuit for this type of testing is shown in Fig. 5 and further discussed in MIL-T-21038.

Inductance can still be calculated, except that now the effective resistance will be n^2R_L in parallel in R_o for use in equation 3. The measurement of rise time should be made on the secondary or tertiary windings, since these would be the slowest. If the observed rise time is satisfactory, no calculations are necessary beyond visual observation on the oscilloscope. Where rise time

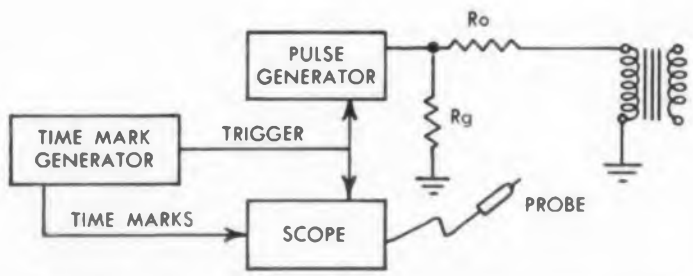


Fig. 4. Half-wave amplifier with closed current path around control winding.

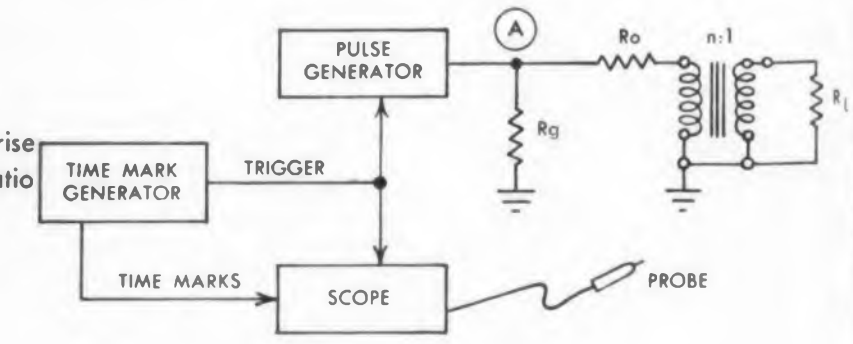


Fig. 5. Circuit for measuring rise time, overshoot and voltage ratio of a pulse transformer.

is critical or marginal, true rise time should be computed by equation 4. This equation carries many approximations and is only valid where there is negligible phase shift and distortion.

$$\text{True Rise Time} = \sqrt{T_o^2 - T_i^2} \qquad (4)$$

where T_o is output rise time measured on the secondary, and T_i is rise time measured at point A in Fig. 5.

An empirical equation for the calculation of rise time is given in equation 5:

$$\text{Rise Time} = 1.52\sqrt{L_L C_w} \qquad (5)$$

where L_L is the leakage inductance, and C_w is the interwinding capacitance of the transformer. While equation 5 shows the dependance of the rise time on the leakage inductance and interwinding capacitance, the difficulty found here is in measuring the leakage inductance and capacitance.

A transformer will not exhibit the same leakage and capacitance under pulse excitation as it will under sine wave frequency excitation. Hence, the measurements of L_L and C_w measured by the frequency method will not be correct. In pulse excitation, the capacitance leakage inductance have different values during the rise, the so-called steady state, and the fall intervals of the pulse. They are negligible during the steady state interval as compared to the rise and fall period.

The only other parameters necessary for electrical test are the winding resistances and some form of dielectric or insulation resistance test. (If the winding resistances are not critical, they should be omitted. This will allow the manufacturers more latitude in meeting the other parameters.)

The insulation resistance test is a measurement of the interwinding leakage current at a specified voltage. The dielectric test on the other hand does not measure any such current. MIL-T-27a and MIL-T-21038 (Ships) specify that the dielectric test will not cause any arcing corona, or insulation breakdown at a specified test potential. While arcing and corona can be detected by suitable means, the determination of any breakdown in the insulation, except for a direct short, is extremely difficult to determine. Frequently an incoming test department will perform this test with a piece of equipment which kicks out when a certain amount of interwinding leakage current flows through the insulation. But the fact that a certain amount of leakage current flows and opens up some relay in the test equipment is no indication that the insulation has broken down or become damaged in any way. This is particularly true with ac test voltages. For these reasons, the insulation resistance test is preferred over the dielectric test, inasmuch as the dielectric test proves little in the absence of a direct breakdown. ■ ■

Improving The Uniterm Filing System

Jack B. Meister
Research Director
Artisan Electronics Corp.
Morristown, N. J.

J. Meister is responsible for the development of commercial and special purpose electromagnetic devices. Since the logical starting point in any development project is a literature survey of past accomplishments, he developed a strong interest in an economical and efficient method of cataloging technical information. This leads to the system reported in this article.

AN ESSENTIAL tool of any modern engineering research organization is an efficient system for the retention and recall of scientific data published in periodicals, books and catalogs. In the April 16, 1958, issue of ELECTRONIC DESIGN an article by William D. Bell described the Uniterm System of filing, which offered many advantages over conventional methods. This article shows how further improvements can be made.

To point out the improvements of the proposed plan, it is necessary to review the operation of the original. It should be remembered that any information storing system includes four basic operations:

- Initial entry of data into the system.
- Withdrawing needed data from the system.
- Returning data to the system.
- Destroying obsolete information.

And the ease with which each of the above steps are accomplished is a measure of the effectiveness of the system.

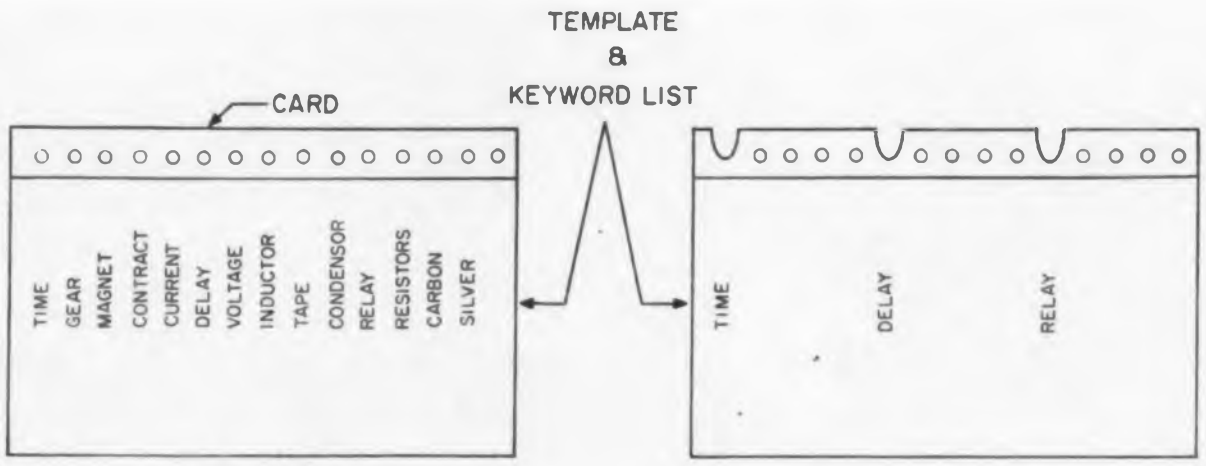


Fig. 1. Key words on the template show which holes in the cards must be notched.

Uniterm System Reviewed

In the Uniterm system a master list of key words or "uniterms" is prepared. A set of cards, each bearing one of the uniterms, serve as the index to the file. Incoming material is consecutively numbered, filed in a numerical file and the number listed on each of the cards representing a key word in the title.

In the proposed modification of the system the cards described above are replaced by cards of the McBee keysort type. These cards have holes placed either along one edge or the entire perimeter. An identical number of articles would possess the same master list of uniterms in the modified system. Assigned to each word is a specific hole location on the card. Incoming material is again consecutively numbered and filed in numerical order.

The master list is prepared in the form of a template that is placed above the card and identifies the uniterm assigned to each hole. The holes corresponding to the key words in the title are then punched in the manner shown in Fig. 1. The illustration assumes the item being filed is titled "time delay relays." The card is placed below the template and holes opposite the words *time*, *delay* and *relay* are notched out as shown in Fig. 2.

Probability of Entry Errors

In the original system the item received was consecutively numbered. The person filing consulted a master list and identified the key words in the title. Cards bearing each key word in the title are extracted from the card index. The number of the new article is entered in the proper location on each card.

The filing of the actual article has been simplified by substituting a numerical file for the

conventional alphabetic or subject file. Also, the system permits a person with little or no technical background to insert information into the system. The system does require, however, the extraction of a number of cards, alphabetically filed, and their return to a proper location.

As the system grows and the number of cards per word increases the number of entries necessary per insertion increases and, with it, the time required to make an entry and the probability of an error. The need to properly locate the numbers on the card increases the probability of an error.

In the proposed plan, as in the original, the document is filed numerically when received. The person takes a blank card, enters the number of the article on it and places a template containing the list of uniterms over the card. The holes corresponding to the key words in the title are notched and the card returned randomly to the file. Both the time necessary to make an entry and the probability of an error is greatly reduced.

Data Retrieval and Return

The second and third item on which the two plans can be compared is the retrieval and return of information from the file. Let us assume we are interested in obtaining all articles on time delay relays.

In the original system the card or cards marked *time*, *delay* and *relay* are pulled from the alphabetically filed card index. These cards are examined for numbers which appear on all three cards or groups of cards. And we obtain a list of numbers which correspond to articles in the numerical file on time delay relays. To simplify the scanning operation, the original cards were designed so that numbers would be listed in columns according to the lowest order digit. As the number of cards increases the scanning operation becomes cumbersome. The desired literature is extracted from the file and the cards must be properly refiled.

In the proposed plan the cards are placed in a selection tray. The same template used in punching is placed against the stack of cards and a rod is inserted through the holes corresponding to the words *time*, *delay* and *relay*. Since cards pertaining to this subject have been punched as shown in Fig. 1b, all cards relating to this subject will drop out as the stack is raised. This is shown in Fig. 3. The number of the articles in the file are immediately available by consulting each of these cards. If the related uniterms appear on opposite edges of the card two passes may be required. With some planning, however, this can be reduced to a minimum.

(Continued on following page)

The proposed system involves more cards, but the problems involved in the insertion and extraction of data is not proportional to the number of cards as in the original system. Once the desired articles are obtained from the file, the cards may be returned in any order.

Removing Obsolete Information

The last item on which the two systems can be compared is the ease with which obsolete information is removed from the files. Suppose the

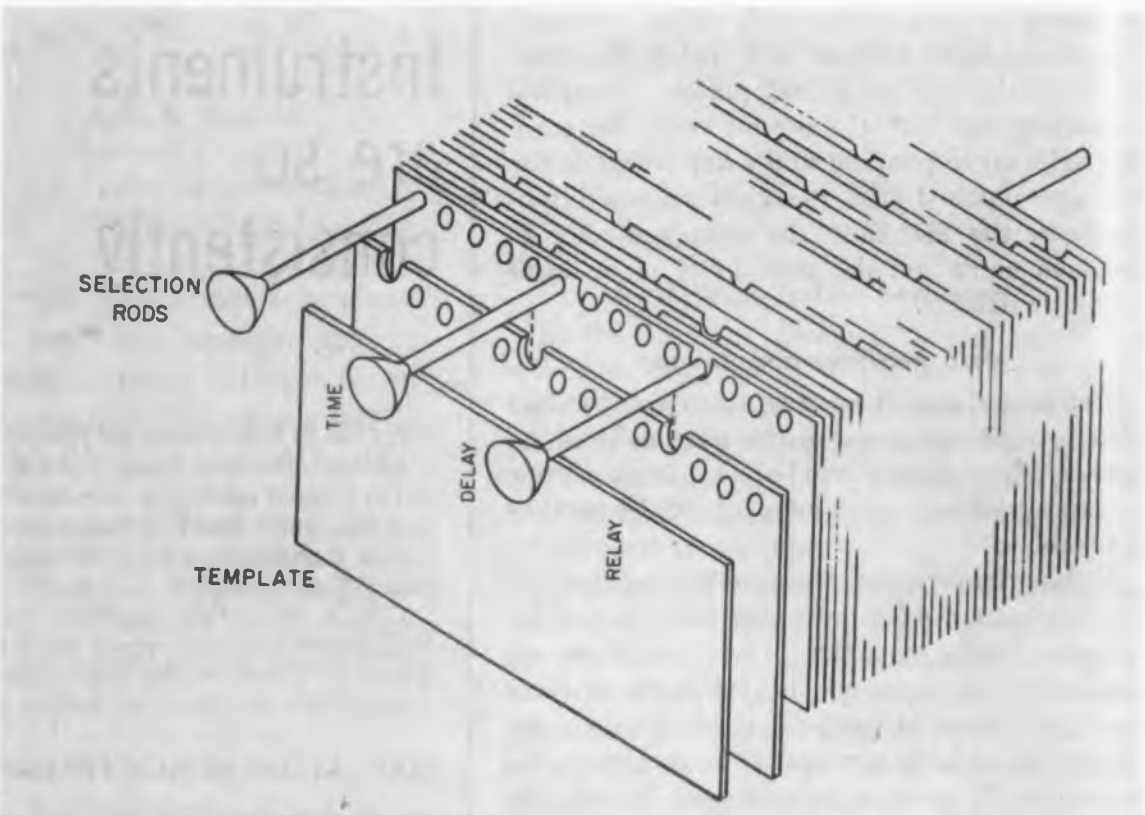


Fig. 3. Cards notched where rods are inserted drop from the stack. Article number appears on face of the card.

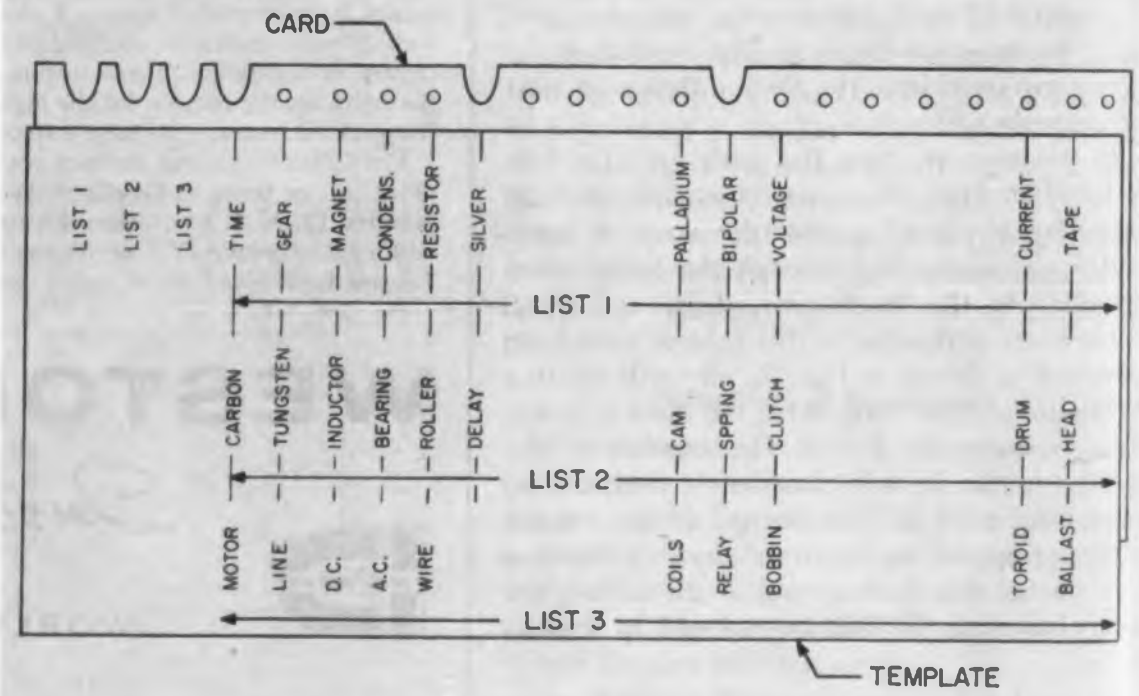


Fig. 4. Coding the template increases the number of items that can be cataloged.

article on time delay relays is now obsolete and must be removed from the file and the index.

In the original system all cards make *time*, *delay* and *relay* are removed from the file and the number of the obsolete articles located and obliterated. The cards must then be returned to their proper location in the file.

In the modified approach, rods are inserted as above into the holes marked *time*, *delay* and *relay*, releasing all cards relating to the subject. The single card with the obsolete number is destroyed and the remaining cards returned to the file in a random manner.

The only limitation of the proposed plan is the number of key words or uniterms which may be represented by holes placed around the circumference of a reasonably sized card. The capacity of the system may, however, be increased by a rather simple coding device.

Coding Increases Capacity

Assume that the number of items require a key word list of 180 uniterms and that the capacity of the long edge of the selected card size is 65 holes. The words would be divided into three lists of 60 each and the three left hand holes would be designated List 1, List 2 and List 3 as shown in Fig. 4. The template would be similar to that shown before, except that there would be three rows of uniterms one below the other. The first row would correspond to List 1, the second to List 2, and the third to List 3.

For an illustrative example, assume that a catalog entitled Time Delay Relays arrives. It is to be filed and each of the above words appears on a different list: *time* on List 1; *delay* on List 2; and *relay* on List 3. The catalog is assigned a number and a blank card is placed below the template. The person filing locates the word *time* and notches the hole which corresponds to it. Noting that *time* is on List 1, the person notches the hole corresponding to List 1. In the same manner the holes for the words *delay* and *relay* are notched. The card is then entered randomly into the file.

To extract information the operator must make a pass for each list involved. In the first pass a rod is inserted into each hole corresponding to a word in List 1 and the List 1 hole. In the second a rod is inserted into each hole corresponding to a word on List 2 and the List 2 hole, etc.

For the illustrative example, the rods would first be inserted into List 1 and *time*, next List 2 and *delay* and third, List 3 and *relay*. It should be noted that proper grouping of words could reduce the average number of passes required. Also, this method of expanding the file may be preferred to grouping holes along the entire perimeter of the cards. ■ ■

IDEAS FOR DESIGN

DE-SOLDERING TECHNIQUES

UNTIL THE advent of printed circuit assemblies, conventional methods of component removal were adequate, though inefficient and difficult. The conventional technique, use of a standard soldering iron and long nose pliers or screw driver as a pry, is, however, unsatisfactory for modern miniaturized components and printed circuit boards.

Semiconductor diodes, miniature resistors and capacitors, will not withstand the heat and prying action of the old removal methods. Additionally, the removal of more sturdy components, such as if cans and transistor or tube sockets, injures the printed circuit board.

Production line practice is to test the printed circuit board before its permanent placement into an assembly. Discovery of a faulty board then leads to removal of a component by one of three methods.

1. A stationary or fixed soldering iron (generally with a chisel point) is mounted tip down. The repairer holds the board against the iron, heating the connection. After it is sufficiently heated the iron is used as a wedge to pry a lug or component free. Sometimes a screw driver or pair of pliers is used for removal.

Multi-element leads are removed by heating each lug individually and working the part back and forth, reheating each lug as necessary. This method is time consuming; it generally breaks the part (which is sometimes repairable), and more often than not, it causes the soldering iron tip to become grooved and useless.

Slotted de-soldering tip is used to remove small components. It can also straighten folded or bent socket tabs.

2. Alternately a soldering pot is used for part removal. The pot is usually constructed as a round or square container (about 1-1/2 or 2 inches in diameter) mounted on a fixed vertical iron. The board is placed over the solder pot and the faulty component removed. A new part is immediately inserted while the solder is hot. This method is applicable only to boards with parts installed on one side.

Unfortunately, the heating area generally encompasses components other than those to be replaced. The high temperature and its wide coverage often result in damage to components or board. Sometimes this damage is not apparent even after re-testing.

3. The use of special de-soldering tools is by far the most practical approach to component removal. Only the component involved receives heat and thus other components are not rendered marginally satisfactory.

Do It Yourself . . . Or Buy

Many firms fabricate their own de-soldering iron tips to suit special requirements. Others buy commercially available irons and tips. Though no single tip will do every job, commercially available kits (like the Ungar 270) can satisfy most requirements.

Cup tips (available for 5, 7, and 9-pin tube sockets), can remove tube or transistor sockets in one operation, as well as certain i-f and rf coil assemblies. (Folded or bent tabs should first be straightened with a slotted tip).

The cups can be modified by inserting a copper tube into the cup. The modification can be used for blowing out or vacuum removal of excess solder.

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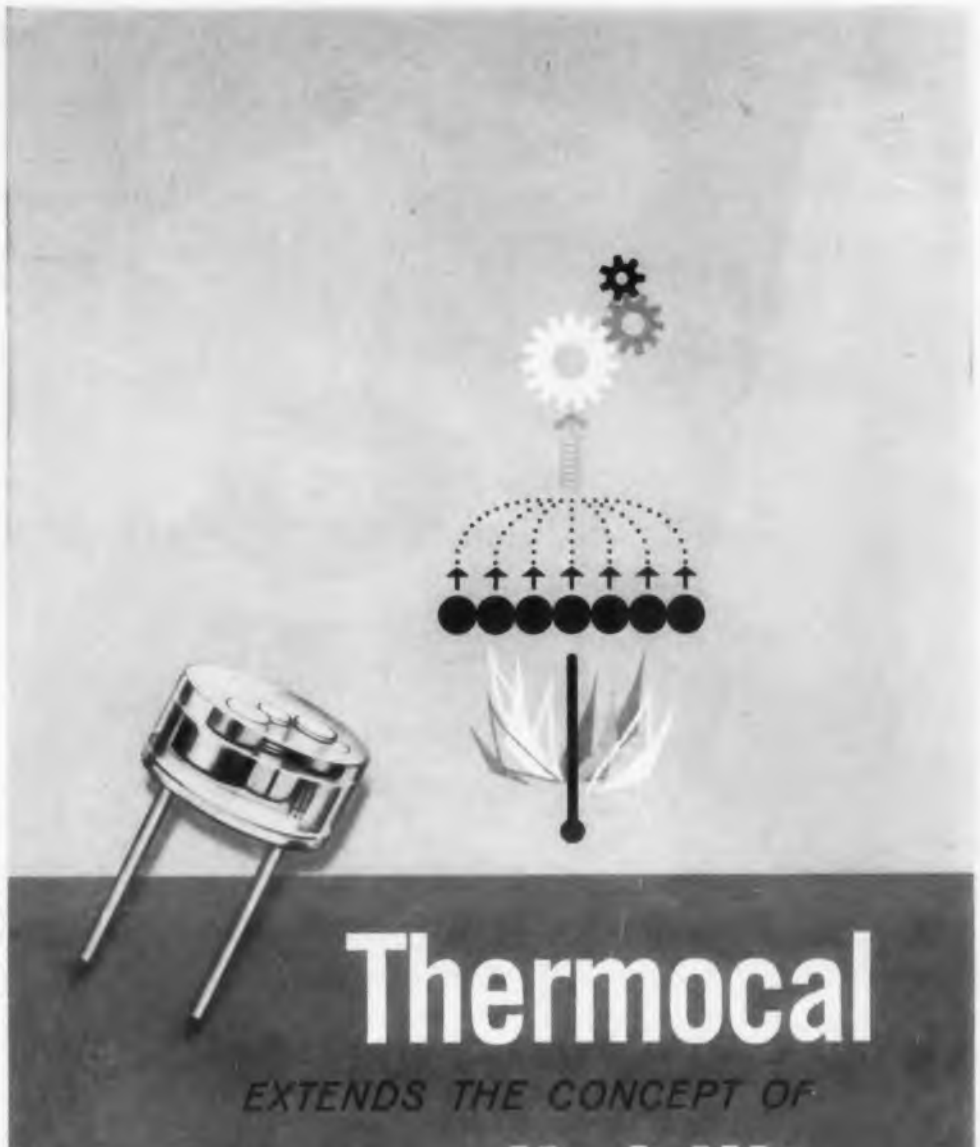

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IDEAS FOR DESIGN

Bar tips remove straight line components.

How To De-Solder

The technique for de-soldering is simple.

- The tip should be tinned and heated to soldering temperature before it is applied to a p-c board or to component wiring.
- The same tip used for de-soldering can also be used for soldering the replacement part. The edge of a cup or bar tip can be used for touch-up, while a slotted tip can be used like a conventional tip.
- Pliers should not be used when inserting a tip in the iron, as they can cause cross-thread damage.

Alvin B. Kaufman, Electronics Research Consultant Engineer, Ungar Electric Tools, Inc., Los Angeles, Calif.

Flow Solder Beats Dross, Icicles

Getting rid of the dross covering molten solder has plagued dipsolderers for some time. The GE Computer Dept. at Phoenix, Ariz. has licked the problem with an automatic flow-soldering process. There was never any slag on the solder that crossed the printed circuit boards. This was done

Manufacturing engineer checks flow solder device used in manufacture of computers in Phoenix, Ariz. A flowing river of molten solder gives a uniform, dross-free, quality connection. An advance beyond hand or dip soldering, this process eliminates touch-up and improves both productivity and quality.

by a drinking fountain sort of pump that took molten solder from well under the dross level, pumped it up as a standing wave of solder an inch deep. Finished boards had few icicles to trim. The flow soldering machine used is made by Electrovert, Inc. in New York, after an English design, Fry Metal Foundry.

One of the completely satisfactory working units in the U. S., GE Computer's set-up consists of an endless-chain conveyer with steel, teflon-coated pallets for the printed circuit boards. The conveyor was capable of zero to ten feet per min, though GE is presently sending it along at about three ft/min. Printed circuit cards are preheated in an infra-red oven at 135 F for about a minute as they pass through. Next stage is a flux spray, limit-switched so it will turn on only when a card is in the pallet.

The printed circuit card then floats across the solder fountain, is caught and passed to inspectors, who check for bridged connections and clip icicles. GE is currently using Kester 1571 flux and 63-37 eutectic solder, carefully controlled to 550 F.

Preheating and fluxing stages were designed by GE Computer people. GE is thinking of doing away with the fluxing operation altogether, which should increase the rate of production of printed circuits. It is available in three standard sizes: 8 in. width, 1/2 in. deep solder; 8 in. by 3/4 in.; 10 in. by 1/2 in.

Some of the benefits quoted by GE Computer engineers: the constant flow and the short exposure of the board to solder minimizes icicles and the tendency for solder to cross-connect circuits. Thermal shock for the board is reduced, too.

IDEAS FOR DESIGN

Short-Term Idea Protection Without a Patent

Because obtaining a patent can be time consuming and costly, situations often arise where it is not possible or practical for an inventor or designer to patent his new idea immediately. There may be no certainty that its commercial value warrants the expense of an application, or the idea may be scheduled for use before a patent can be secured.

In either case, the inventor wants to protect his idea and establish proof of its inception. Little, if any protection is afforded by the "Letter Patent," a registered letter sent to the originator with a description of the invention, since only the envelope and not the contents are registered. However, it is possible, in many states, for the inventor to gain a good deal more protection without revealing the idea, and for a very small investment.

The first step is to make a written record of the design or invention. A sheet of white 12 x 18 in. drawing paper is suitable. It should be folded in half once, so that there are four sides each 9 x 12 in. On one side, within the fold, fully labeled sketches of the invention should be made. On the opposite inside fold, all specifications and possible applications should be detailed. It is wise to list any remotely possible uses, since this increases the protection.

The drawings and description having been completed, the sheet should be sealed with all written matter hidden from view. This is accomplished by spreading a narrow border of glue along the inside edges and then folding the sheet closed. On the outside of the sealed sheet, the following information should be typed or printed:

> State of New York
> County of .....
> On this (date) day of (month), nineteen hundred and (year), before me came (inventor's name), to me known, and known to me to be the person who placed his signature on this sheet of paper in my presence. I am not witnessing the contents which he states he placed herein.

The document must be next presented to a Notary Public, signed in his presence, and notarized. Following this, a Certificate of Notary should be requested from the Office of the County Clerk. Upon presentation of the document and for a fee of 50 cents, a certificate is issued which authenticates the signature of the Notary.

It has a serial number which is permanently recorded, shows the date of issuance and is signed by the County Clerk. This certificate is affixed to the papers and both are impressed with the seal of the County Clerk. The record of the certificate, showing the date it was issued, is available at any future date.

Once the certificate and seal have been affixed, the papers are folded to letter size, placed in an envelope, and sealed. Wavy lines, drawn on the flap, can help prove that the contents have not been tampered with. Placing four penny postage stamps at intervals over the flap of the envelope, and sending it through the mails, adds the protection of four individually hand-stamped cancellations. The envelope should be addressed on the back, the side on which the stamps are placed.

When the envelope is returned in the mail, it should be left unopened, and filed safely away. It is proof of the existence of the invention on the date of notarization. The elaborate precautions taken show that nothing was added to the contents of the envelope after the date established. Thus, for a fee of 25 cents for notarization, 50 cents for the Certificate of Notary and four cents for stamps, a high degree of protection is afforded during the one year period in which the law permits use of a new invention without making patent application. Should it not prove worthwhile to patent the idea, a large expense has been avoided.

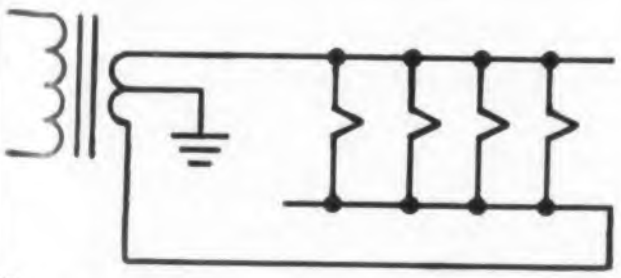
Harold J. Baron, Planning Engineer, Republic Aviation Corp., Missile Systems Div., Minneola, N. Y.

Equalize Parallel Filament Voltages

Voltage drops in filament wiring can lead to unequal filament voltages even with paralleled heaters.

By wiring the filaments as shown in the drawing, this can be averted. Notice that one lead from the filament transformer goes directly to the nearest tube, while the other lead goes to the farthest tube.

Reuben Wasserman, Technical Staff Member, Hermes Electronics Co., Cambridge, Mass.



Filament wiring to avoid unequal filament voltages due to line drops.

ACTUAL SIZE

This is the actual size of Heinemann's new sub-miniature circuit breaker, the SM3. Hermetic seal and all, it weighs no more than a bantam 2.1 ounces. It is magnetically actuated, therefore does not require de-rating for high ambient temperatures. In fact, under extensive environment-testing, the breaker has demonstrated excellent all-around operational stability. It will function properly on the tundra or in the tropics, will withstand the onslaughts of salt-sea atmosphere, sand, dust and high humidity. The SM3 is available to your specifications in any integral or fractional current rating from 0.050 to 10 amperes, at 110V, either 60 or 400 cycles AC, or 50V DC. And you have a choice of either fast or slow time delay, so that overload response can be matched closely to the operating characteristics of the protected equipment. If you have need of a rugged, compact circuit breaker "packaged" to go anywhere, you'd do well to give the SM3 some serious consideration. The facts and figures are presented for your review in Bulletin 3502. Write for a copy today.

HEINEMANN ELECTRIC COMPANY, 156 PLUM ST. TRENTON 2, N.J.

CIRCLE 47 ON READER-SERVICE CARD

IDEAS FOR DESIGN

High Voltage Output From Transistors

Occasionally it is necessary to develop a high output voltage from a transistor RC coupled amplifier. Most normal circuits are limited to a peak to peak output voltage less than the collector breakdown voltage. The circuit shown can deliver a peak to peak voltage of almost three times the collector breakdown voltage of each transistor to a resistive load. In addition, the circuit is applicable to dc amplifiers.

The basic circuit is shown in Fig. 1. It consists of a common emitter stage direct-coupled to cascaded common base amplifiers. With the proper base and collector loads, the signal voltage will divide equally among each of the three transistors. Likewise, with correct bias voltage, the quiescent voltages across each transistor will be equal.

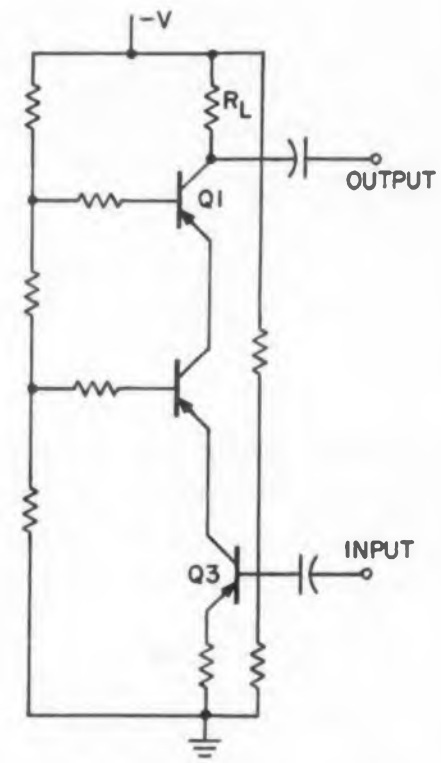


Fig. 1. Basic circuit for delivering high output signal voltages from transistors.

To design each stage, one selects an approximate collector current, and calculates a collector load resistance which will cause one half the supply voltage to be dropped across it. This resistor is the collector load of the third stage (common base).

The gain of this stage must be designed to equal 1.5 and its input impedance to equal the

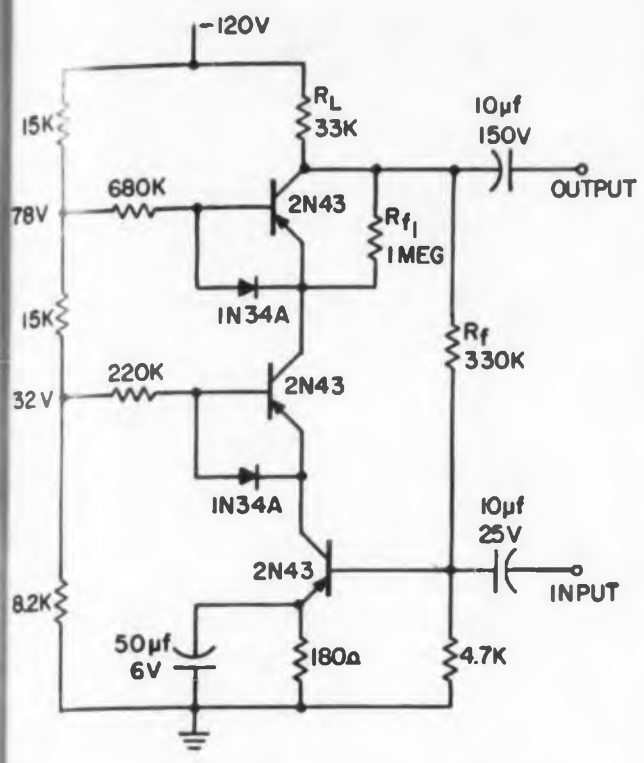


Fig. 2. This circuit provides a voltage gain of 10 and an output swing of 30 v rms. Its response is flat from 20 to 5000 cps.

load impedance. The base resistance is adjusted to meet these conditions. If the transistor characteristics are such that such a low gain cannot be obtained, local feedback from the emitter to the collector may be used.

The second stage (common base) is designed with the input impedance of the first stage as its collector load. The voltage gain of this stage must be two and the input impedance must equal the load impedance. The base resistance is adjusted to give this result.

The third stage or input stage (common emitter) is designed for maximum gain with the input impedance of the second stage as its collector load. Its bias voltage is derived from the emitter resistor.

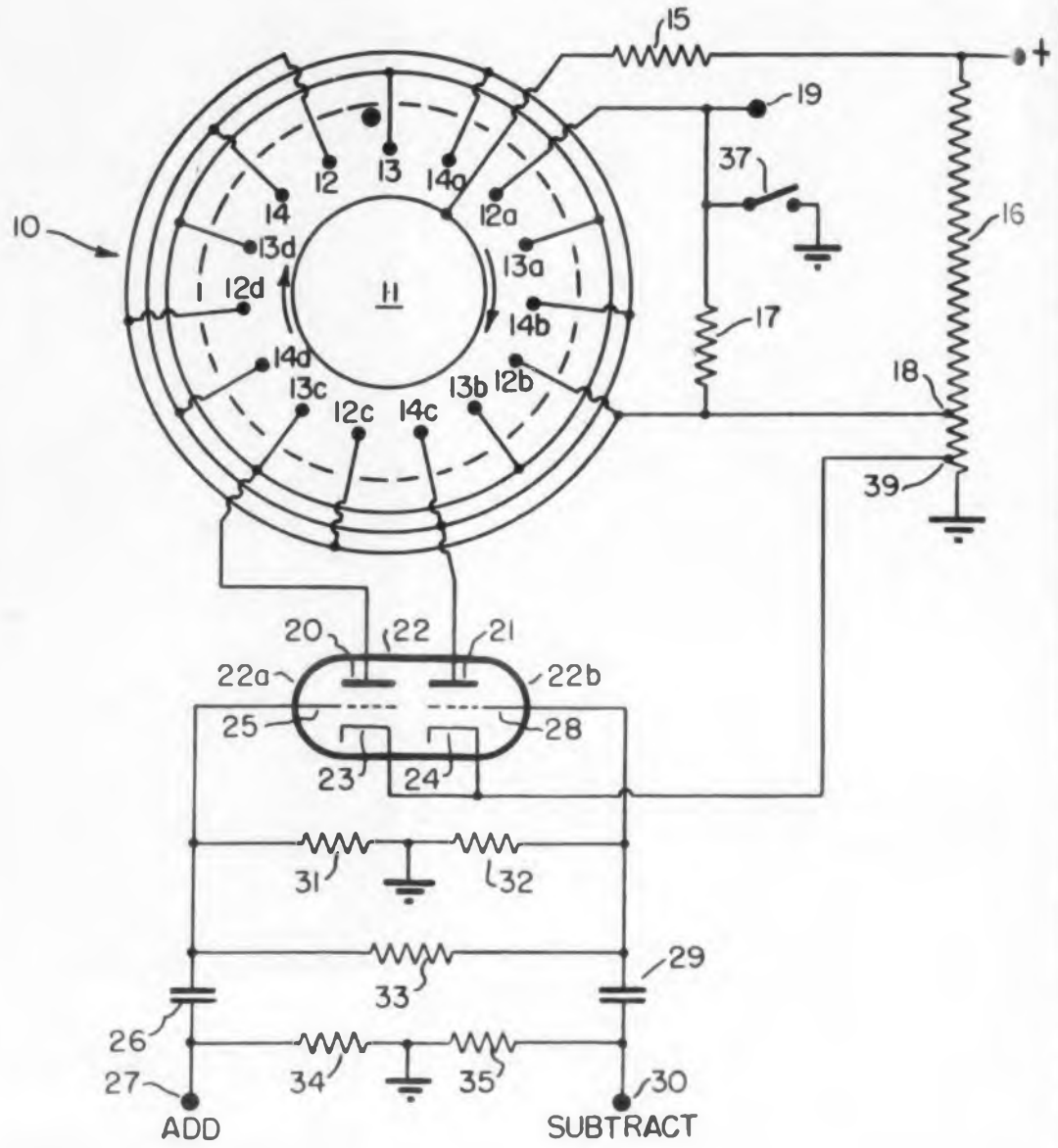
The stability of this circuit may be increased at the expense of gain by a large amount of degeneration in the emitter circuit of the input stage, and also by voltage feedback from the collector of the first stage to the base of the third or input stage.

Temperature stabilization of the first two stages may be accomplished by connecting reversed biased diodes from the base to the emitter of each stage. Additional stabilization may be accomplished with thermally sensitive elements in the feedback resistor.

The complete circuit with stabilization is given in Fig. 2.

H. L. Hardy, Circuit Group Leader, Electric Boat Div. of General Dynamics Corp., Groton, Conn.

PATENTS



Adding and Subtracting Drive Circuit for Counting Tubes

Patent No. 2,872,621. John E. Adams. (Assigned to Sylvania Electric Products Inc.)

Addition or subtraction is carried out by means of a gas-filled glow transfer counting tube by shifting the glow clockwise or counter-clockwise.

A 6802 tube *10* has a central anode *11*, cathodes *12* to *12d*, and two sets of guides *13* to *13d* and *14* to *14d* which are externally interconnected. One set of guides connects to anode *20* and the other set is tied to anode *21* of 6J6 dual triode *22*; cathode *12a* is separate for reset.

Initially triodes *22a* and *22b* are cut off. Microswitch *37* is closed to lower the voltage on cathode *12a* to which the glow transfers. A positive pulse to "Add" terminal *27* causes triode *22a* to conduct and the glow is directed to guide *13a*. Capacitor *29* and resistor *33* integrate the pulse and triode *22b* subsequently conducts. When the pulse terminates, triode *22a* cuts off but the change on capacitor *29* maintains triode *22b* conducting and the glow shifts to guide *14b*. After the capacitor has discharged, the triode cuts off and the glow shifts to the adjacent cathode *12b*. Successive "add" pulses sequentially shift the glow clockwise.

The symmetry of the dual triode circuitry results in counterclockwise shifts stepwise when "subtract" pulses connect to terminal *30*.

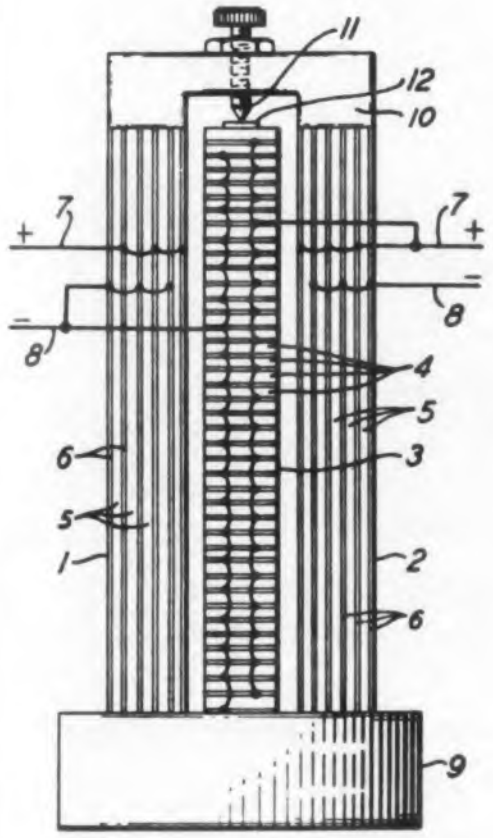
Piezoelectric Switching Device

Patent No. 2,883,486. Warren P. Mason. (Assigned to Bell Telephone Labs., Inc.)

A piezoelectric crystal will simultaneously elongate and contract in response to an electrical stress. Thus, when barium titanate crystals are stacked at right angles, the combined change dimensions is adequate to operate a high speed switch.

Outer stack *1-2* is composed of crystals 5 separated by electrodes *6* and mated by yoke *10* which carries contact *11*. Stack 3 has the individual crystals oriented normal to those in the outer stack. Each crystal is separated by the surface contacts and the stack ends in terminal *12*.

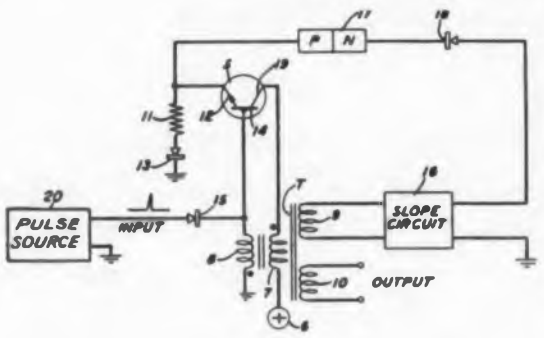
For full displacement in *10* μsec, the structure should resonate at 25 kc. In this instance, the length is approximately 4 cm and the aggregate relative travel of the stacks, the sum of the displacements, is 0.36 x 10^{-3} in.



Blocking Oscillator Pulse Width Control

Patent No. 2,886,706. Samuel C. Rogers. (Assigned to Bell Telephone Labs., Inc.)

The pulse width of the blocking oscillator may be set to less than the natural period of the transformer by means of a waveform generator which accelerates cut-off of the oscillation.



At quiescence, npn transistor 5 is cut off since the emitter leakage current sets the emitter positive with respect to the base. A positive input pulse raises the base voltage and the transistor conducts regeneratively by feedback from collector to base via the transformer windings. This triggers the slope circuit to generate a linearly increasing voltage waveform. When the amplitude of the sawtooth is high enough, diode *17* breaks down sharply to close the degenerative path back to the emitter. Current flows through resistor 11 to raise the emitter voltage to cut-off and the oscillation terminates.

The circuit is insensitive to temperature change and to individual transistor characteristics since the timing is determined exclusively by a temperature-compensated slope circuit.

Ferrite Microwave Devices for Use at High Signal Energy Levels

Patent No. 2,883,629. Harry Suhl. (Assigned to Bell Telephone Laboratories, Inc.)

At high signal energy levels a ferrite element located in a waveguide or cavity will absorb a substantial fraction of the input power. This is due to the interaction of the uniform precession wave with the spin waves produced by internal random agitation. It has likewise been determined that the wave length of the spin waves is of the order of microns.

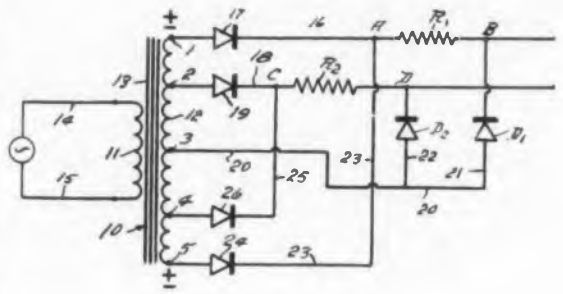
The invention lies in forming the ferrite element of particles which are no larger than 100 microns to inhibit the interaction of the signal and spin waves particularly when the applied magnetizing field does not produce ferromagnetic resonance. The particles may be obtained by ball grinding and centrifuge separation. A paste of low loss dielectric material such as polystyrene supports and insulates each ferrite particle. Pressing and baking produces the desired shape and size.

PATENTS

Absolute D.C. Voltage Reference

Patent No. 2,881,382. Gaetano T. Amato. (Assigned to Sperry Rand Corp.)

The difference in voltage across two Zener diodes in a full wave rectifier circuit establishes the absolute reference voltage. These diodes are selected with identical slopes but of different voltage



intercepts; the difference in voltage intercepts is the magnitude of the reference voltage.

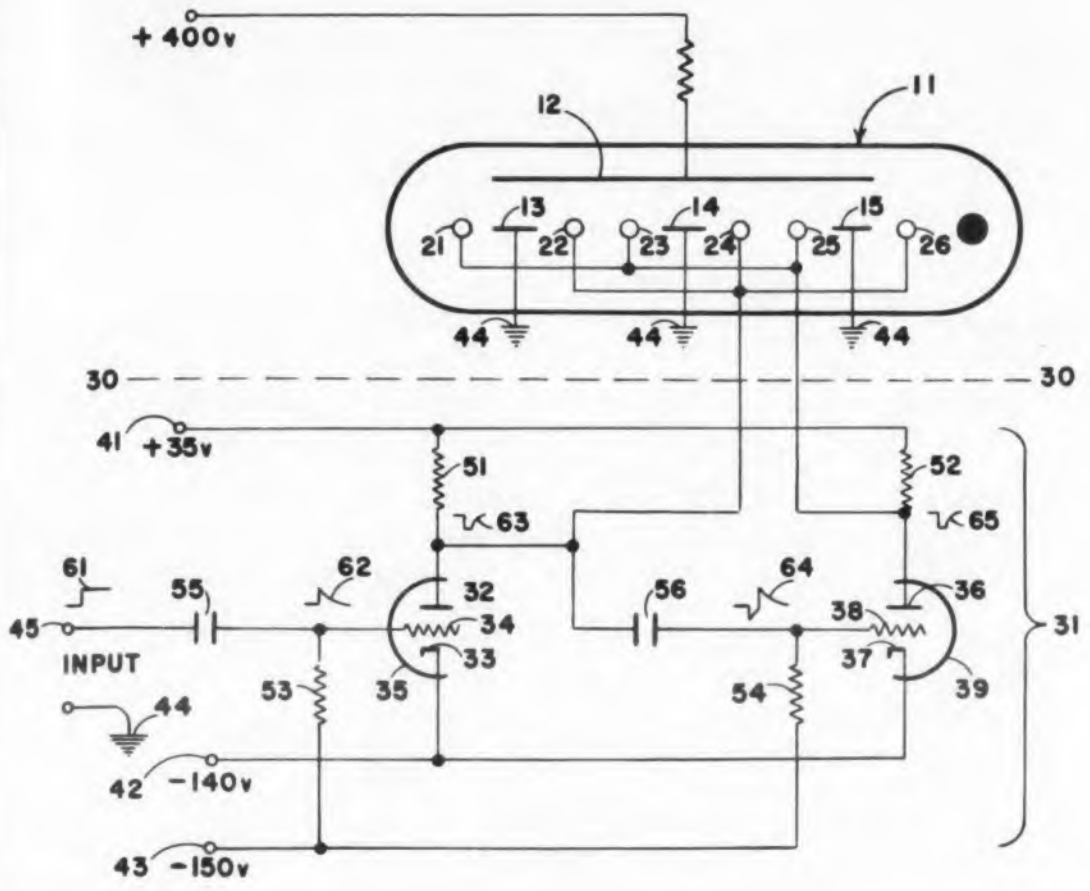
Zener diodes D_1 and D_2 are shown in series with the tapped secondary winding. The taps and series resistors R_1 and R_2 are selected to make the voltage variation in the diodes equal so that the ratio of diode currents is independent of line fluctuations.

Pulse Forming Networks

Patent No. 2,867,752. Hugh F. Stoddart, Theodore Voutselas (Assigned to Baird-Atomic Inc.)

The required delay to shift the glow in a G C10B decade counting tube is obtained by means of a differentiating circuit.

Suppose the glow connects to cathode *13*. A positive-going input pulse makes triode *35* conduct and guide *22* voltage is suppressed to cause the glow to shift to the right to guide *22*. Capacitor *56* and resistor *54* differentiate the amplified and inverted pulse such that triode *39* is triggered to conduction when the input pulse terminates. This shifts the glow to guide *23*. The change on capacitor *56* then runs down, triode *39* cuts off and the glow registers on cathode *13*.



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G-E Shift Registers can be designed within these parameters:

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GENERAL ELECTRIC

DEFENSE ELECTRONICS DIVISION
HEAVY MILITARY ELECTRONICS DEPARTMENT, SYRACUSE, N. Y.

CIRCLE 53 ON READER-SERVICE CARD

New UNION readout instruments withstand shock, vibration and extreme temperature changes

Union Switch & Signal's new READALL* readout instrument replaces complicated systems of lights and relays for reading, storing or transferring all types of information for industrial and military applications. It is not to be confused with conventional indicating devices.

Designed to meet requirements of MIL-E-5422D. The new READALL readout instrument is precision-built and provides instantaneous and continuous operation under conditions of shock, vibration and extreme ranges in temperature. The digital display includes characters in numerical sequence from 0 to 9 plus two blank spaces. 7/32-inch characters can be illuminated red or white as desired; when not illuminated, they appear white against a black background.

Reliability. Performance through one million random operations is an inherent feature of the new READALL instrument. Each module is gasket-sealed in its case to exclude moisture and seal out foreign particles. An especially thin enclosed DC motor, containing ball bearings, permits more efficient operation.

Modular Construction. A unique feature of the readout instrument is its modular construction. It can be used individually or in groups to display multiple characters in a single case.

Direct Code Translation. The operation of the READALL readout instrument is based on a positioning system using a four-bit code. The visual display is the result of a direct electro-mechanical conversion of a binary signal to a decimal read-out. There is no need for additional conversion equipment. Separate code and motor circuits permit the use of the readout instrument in low-level circuitry.

Electrical and Visual Data Storage. Once positioned, the information is displayed until a new code is transmitted to the instrument. No power is consumed while the information is retained. This data may be stored or read-out electrically for further transmission or recording.

Operate Time. The operate time varies from 0.1 second to 1.0 second depending on character position.

Weight and Size. Maximum weight including case is seven ounces; without case, four and one-half ounces. Size encased is 5 13/64 inches long, 1 47/64 inches high and 31/64 inch wide. The new READALL instrument is designed for operation over a temperature range of −54°C to +71°C in humidities up to 100% and altitudes up to 70,000 feet. For more information, write for Bulletin 1019. *Trademark

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PITTSBURGH 18, PENNSYLVANIA

CIRCLE 54 ON READER-SERVICE CARD

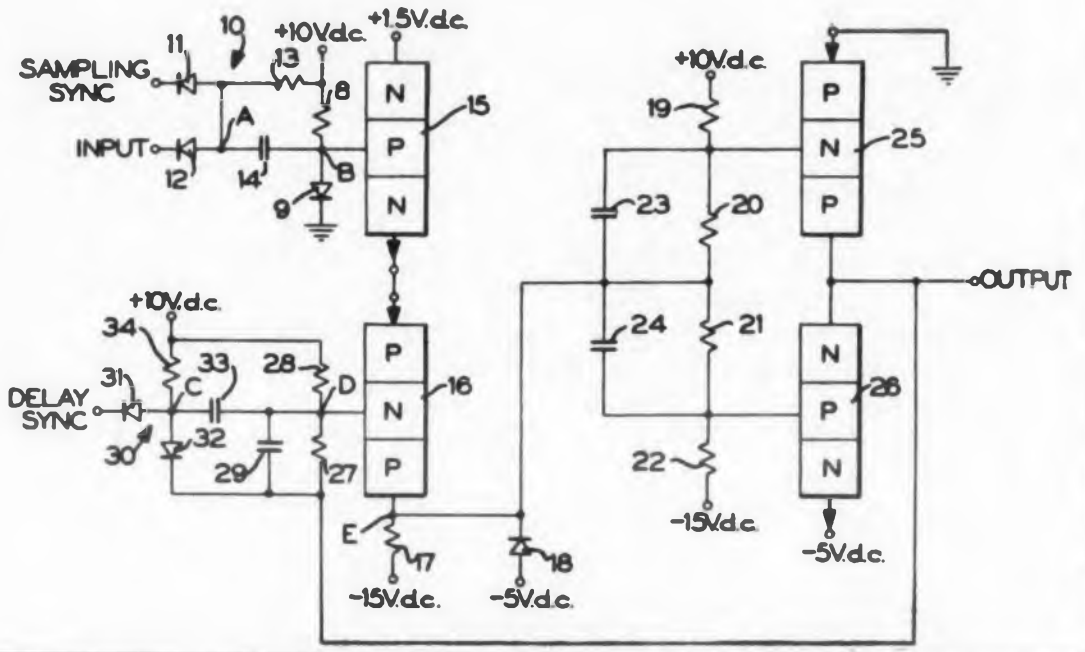
PATENTS

Transistor Delay Circuit

Patent No. 2,885,573. Genung L. Clapper (Assigned to International Business Machines Corp.)

The circuit delays the output one-bit time from the input signal.

A pulse from the sampling synch drives transistor *15* to cut off and transistor *16*, in series, is non-conducting. Complementary pair transistors *25* and *26* become biased negatively such that *25* conducts and the feedback clamps *16* to cut off. However, coincidence of input and delay synch pulses makes both *15* and *16* conducting and *26* produces an output delayed for the specified period.



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> A new "standard" Sola Constant Voltage Transformer provides famous Sola ±1% regulation, along with SINUSOIDAL OUTPUT AT NO PRICE PREMIUM OVER OTHER MAKES OF STATIC-MAGNETIC REGULATORS.
>
> Many "normal-harmonic" types of the Sola CV have been REDUCED IN PRICE, thus opening to you the benefits of supply voltage regulation in new fields where cost has heretofore been a deterrent.

The new Sola Standard Sinusoidal Constant Voltage Transformer affords all the proved benefits of a static-magnetic regulator. It provides output voltage regulation of ±1% for line voltage variation as great as ±15%. It provides completely automatic and continuous regulation, with output having less than 3% rms harmonic content.

In addition to the improved output wave form, the new design is substantially smaller and lighter than previous models. Because of design and production innovations, it is relatively compact compared to other equipment for comparable ac voltage regulation. It costs about the same as previous models which did not have sinusoidal output. This sine wave output feature at such a low cost permits use in many applications requiring harmonic-free input where previously the cost was prohibitive.

The sinusoidal output feature contributes to ease of selection and ordering. The buyer merely selects the stock unit whose output capacity equals or exceeds the desired equipment input. Formulae based on sinusoidal wave shape may be used in designing related load

... please turn page

... continued from preceding page

circuitry. The Sola Standard Sinusoidal CV Transformer is available in nine stock output ratings from 60va to 7500va.

The "Normal-Harmonic Type" -- the familiar "Sola CV" -- had become the "standard of the industry" for static-magnetic voltage regulation by virtue of its outstanding performance for over fifteen years. Now it, too, has been given a comprehensive re-design treatment which has yielded the same kind of weight and size reduction secured in the new sinusoidal type -- and without sacrificing the performance for which it was widely recognized.

Cost savings from this four-year program of refinement are NOW PASSED ON TO YOU in the form of appreciable price reductions on many of the most popular ratings. You can now consider the benefits of closely-regulated supply voltage for your equipment at less cost than ever.

With electrical control systems and components continuing to increase in number and complexity, and imposing more rigid reliability requirements, these new Sola Constant Voltage Transformers provide many advantages and virtually unlimited application. They are ideal where utmost reliability is required, with no transformer maintenance.

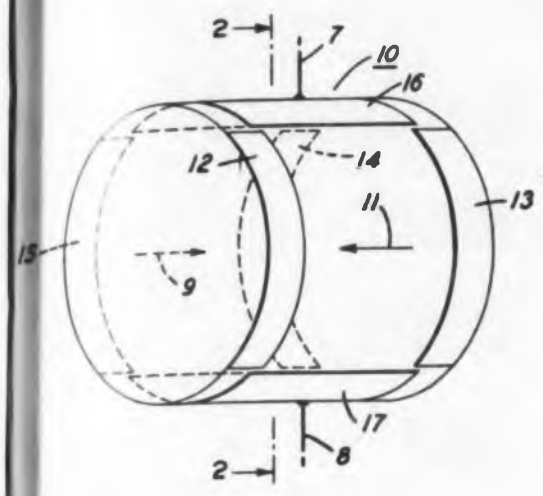
We would welcome the opportunity to provide you with more detailed information. Please write for Sola Product Bulletins for data on our stock models. Or write or call for full information on custom units for specific requirements, available in production quantities. Your request will be promptly handled.

Sincerely,

SOLA ELECTRIC CO.

Nelson P. Marshall

Nelson P. Marshall
General Sales Manager

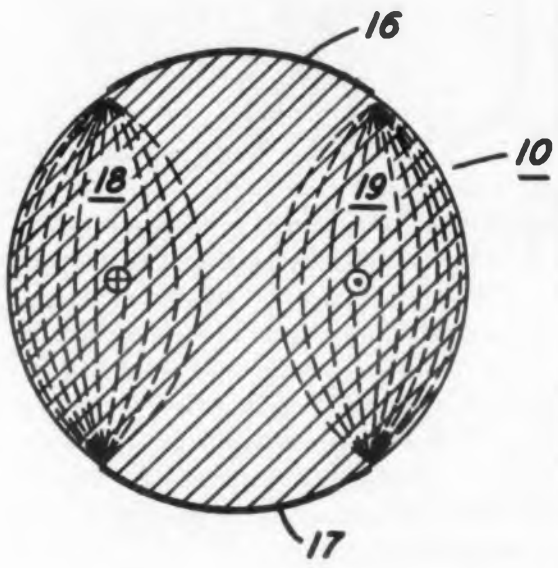


Ferroelectric Torsional Transducer

Patent No. 2,880,334. Warren P. Mason. (Assigned to Bell Telephone Laboratories, Inc.)

A solid or annular cylindrical transducer is more efficient and has a higher coefficient of electromechanical coupling when the element is initially bidirectionally polarized in the longitudinal direction over 220 degrees of arc.

Appropriate voltages are connected to electrode pairs *12* and *13* and *14* and *15* to polarize element *10* in directions *18* and *19* as shown. These electrodes are removed and electrodes *16* and *17*, each covering 70 degrees of arc and substantially three quarters of the length of the element, are centrally located between the ends of the cylinder. A signal voltage applied to electrodes *16* and *17* causes corresponding torsional vibration of the element.



Engineers Must Write, Too

William D. Bell
Mellonics
Tucson, Ariz.

TOO MANY engineers are wonders with transistors but failures with a pen. A dictating machine strikes them dumb. Yet engineers are called upon constantly to communicate with fellow engineers, with management, with sales personnel. In addition to writing technical reports, they are participating more and more in the preparation of sales proposals and correspondence.

Writing clear, concise English need not be difficult. Attention to a few simple guides will help.

Know Your Audience

Before writing a word, know your audience. To whom are you writing? Obviously the same approach would not be suitable for summarizing a research project, outlining a program to management or replying to technical queries from clients. "Writing down" is always a poor way to win the reader's confidence. Writing "over the reader's head" might antagonize him less quickly, but it will certainly not help him to understand your message. Decide first, if you can, on the audience you will address.

Write To Inform

Because you understand your subject thoroughly, you may find it hard to place yourself in the position of the uninformed reader. Time-honored advice is offered in the story of the preacher who was celebrated for his sermons. Asked for the secret of his success, he quipped: "Well, first I tell them what I'm going to tell them; then I tell them; and, finally, I tell them what I've told them."

This is sound advice. A condensed, explicit outline, followed by a detailed explanation and a summary will ensure reader understanding. Remember that you are writing for a purpose: to inform, to explain or to convince. These aims can be achieved only if you make it easy for your reader to follow you. And your success is doubly insured if your material is interesting.

Organize Your Material

To guarantee that your reader understands, present your material in an organized way. Just as there is logical organization in the design of an electronic device, there must be an organized flow of information in formal writing. To clarify your thinking and the organization of your material, try making a rough outline of the subject by topics before you begin to write.

Once you have a topical outline, stick to it.

Maintain Continuity

The reader must be led from topic to topic. At all times he must follow the path of your message. The easiest way to lose him is to skip from subject to subject; he will become irritated and rapidly abandon interest in what you are trying to tell him. By using connectives properly and maintaining smooth continuity, the professional writer holds his reader.

Continuity must be maintained between sentences. Continuity is also necessary between paragraphs. The linkage may be the repetition of a word or a thought from the preceding paragraph.

Sometimes you may be forced to make an abrupt transition. To make certain your reader does not get lost, write a "bridge." This is simply a transition that helps ease him over the gap. Such a bridge construction might be:

"Transducers must be attached, so that their liquids can be amplified and digitized without distortion. There are several ways of doing this."

In the second sentence you tell the reader you are shifting the subject.

There are other ways of introducing bridges. A new subject heading is an effective device.

Be Concise

Good writing is simple writing. Be brief in sentences and paragraphs. At first thought, this may seem to be "writing down." In reality concise, explicit writing is harder to execute than a meandering exposition. You will find that one of your most valuable tools is a red pencil for editing rough drafts of your material. If you are an average writer, you will find that you use more words than necessary in the first draft. Verbiage makes writing lose impact and clarity.

Let's study a simple example:

"The system utilizes one-half-inch magnetic tape."

A simpler way to express this thought would be:

"The system uses half-inch magnetic tape."

In misguided efforts to write authoritatively, engineers often choose a three-syllable, seven-letter word like "utilize" instead of a one-syllable, three-letter word, "use"—half the size and twice as effective.

Here is an example of wordiness:

"We are in receipt of your letter of the 23rd, in which you refer to the above purchase order placed on Blank Company, and we now enclose for your perusal a copy of a letter that we have addressed today to this firm."

Actually, this is part of a letter in my files. Although it is not technical writing, it illustrates how not to write. Compare this example with the following edited version:

"We have received your letter of June 23, 1959, referring to the purchase order of Blank Company. Enclosed is a copy of our letter to the Blank Company."

Remember Sales Emphasis

When writing for sales purposes, the engineer must remember to emphasize the right points. He knows that in designing a complex piece of equipment or a system, engineers expended much time, effort and company money to produce a superior product. To sell this product, he must answer these questions:

Why is it superior? What design features justify the selection of this product over that of a competitor?

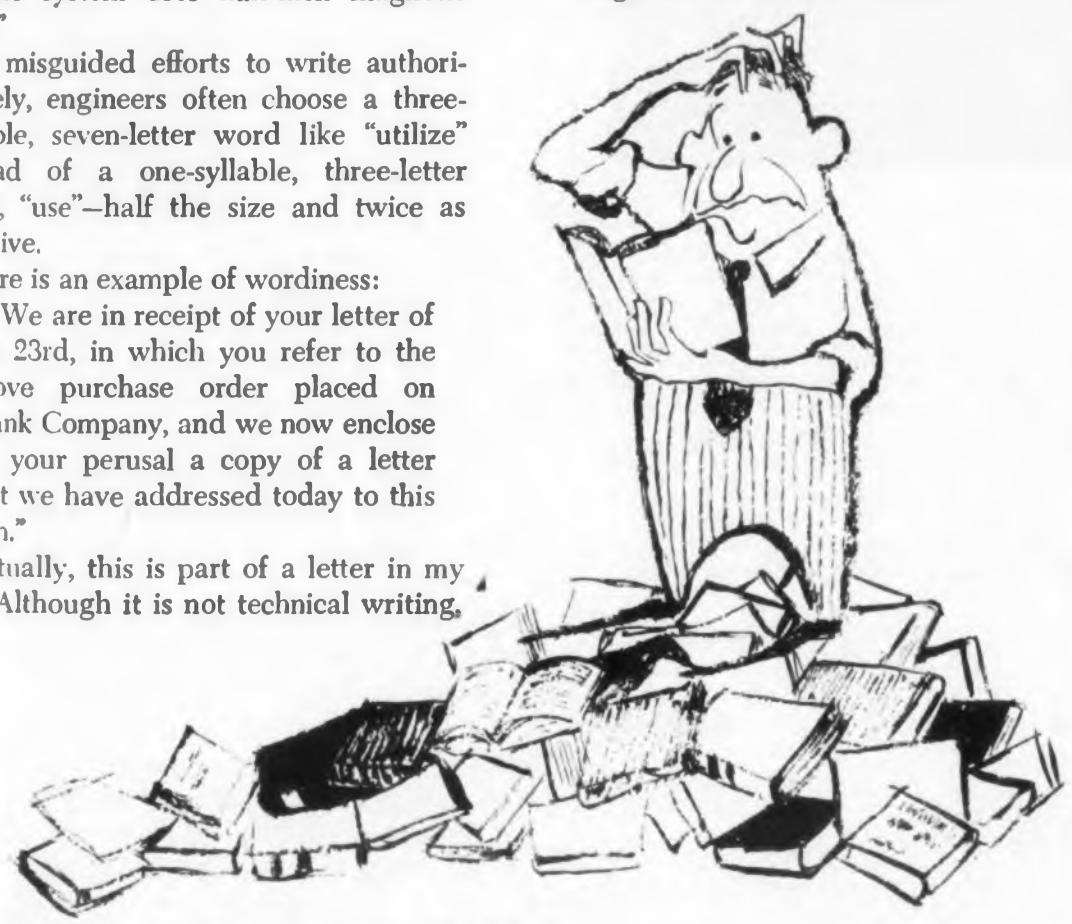
He may write:

"A special chopper is employed in the stabilizing circuit."

But he will be more effective in his sales approach by writing:

"A chopper with special shielding is being used. The result is a 6 db improvement in signal-to-noise ratio over conventional chopper circuits."

The engineer who would improve his writing must possess a genuine desire to do so. This incentive becomes automatic when he understands how important good writing can be to his career. ■ ■



CAREER OPPORTUNITIES BROCHURES

Advancement Your Goal? New Form Speeds Action

ELECTRONIC DESIGN's new Career Inquiry Service form is designed to help engineers advertise themselves. This new service will speed applicants to the jobs they seek. It is the first such service offered in the electronics field.

To present your qualifications immediately to the personnel managers of companies that interest you, simply fill in the attached standardized short resume.

Study the employment opportunity ads in this section, and circle the numbers at the bottom of the form that correspond to the numbers of the ads that interest you.

ELECTRONIC DESIGN's Reader Service Department will make photocopies of your standardized resume and send it to all companies you select . . . *the same day the resume is received.* (ELECTRONIC DESIGN will detach the circle number portion of the form, so that no company will know how many numbers you circled.)

The standardized resume will permit personnel managers to inspect your qualifications rapidly. If they are interested, they will get in touch with you directly. In the past much time has been lost through personnel-manager requests for resumes from applicants who proved ineligible.

Readers who desire only company brochures should use the regular Reader Service card.

Mail Career Inquiry Service form to Reader Service, ELECTRONIC DESIGN, 830 Third Ave., New York 22, N. Y.

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Educational History

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Recent Special Training _____

Employment History

Company	*City and State*	*Dates*	*Title*	*Engineering Specialt*

Outstanding Engineering and Administrative Experience _____

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Minimum Salary Requirements (Optional) _____

Use section below instead of Reader Service Card. Do not write personal data below this line. This section will be detached before processing.

Circle Career Inquiry numbers of companies that interest you

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CAREER OPPORTUNITIES

Radio Corporation of America

"A Guide to Engineering Opportunities at RCA" discusses the company as an electronics pioneer, shows company growth, and presents an organizational chart of products for industry, consumer, and government as well as number of employees. A partial listing of RCA products and services follows.

What RCA can offer the prospective employee covers salaries, professional development, facilities, benefits, individual recognition, and award systems.

Radio Corporation of America, Dept. ED, Camden, N.J.

CIRCLE 881 ON READER-SERVICE CARD

Westinghouse Electric Corporation

"New Dimensions", a generously illustrated brochure, includes a historical sketch of the company and describes its pioneering efforts in electronics. Separate projects underway in each of the four design and development divisions are heavily emphasized. Engineering positions available are discussed in terms of the four divisions: Advanced Development, Communications, Missile Ground Control, and Radar, the functions of which are treated in detail. Individual department functions and engineering services are considered.

Dr. J. A. Medwin, Employment Manager, Westinghouse Electric Corp., Dept. ED, Box 746, Dept. ND, Baltimore 3, Md.

CIRCLE 882 ON READER-SERVICE CARD

YOUR CAREER
NEWS, NOTES, NOTIONS

Engineers have long been maligned as half-educated "machine men" who lack an appreciation of the humanities. But what of liberal arts scholars and the masses? Are they not half-educated in their appreciation of engineering?

They are indeed, Paul E. Mohn, professor of mechanical engineering at the University of Buffalo, told a recent meeting of the American Society for Engineering Education. And in a modern world of technical progress, this ignorance of engineering handicaps the average person, Mr. Mohn asserted.

"Education for citizenship today," he said, "requires the individual to have an adequate background on which to assess the values of engineering works as a part of the development of our society.

"Citizens must vote and act on the building of roads, airports, sewage and water-supply systems, limitations of noise and atmospheric pollution, the size and power of their means of transportation, zoning regulations, as well as the vast array of devices inherent in their defense. These decisions on the part of a democratic society can no longer be completely delegated; neither can they be ignored or dismissed.

"The pattern of education in the days of the Greeks was based on the Muses. In our society one of the muses which commands the attention and interest of everyone is engineering."

Mr. Mohn suggests that it is time colleges recognize the impact of technology on living and add to their liberal-arts curriculums courses in "engineering appreciation." Recommendations on what such courses might contain, he indicated, could be made by the ASEE.

"The vast majority of our citizens," he said, "are educated on a liberal-arts-based concept. It is necessary to infuse into the liberal-arts curriculum courses in engineering—perhaps using the term 'an appreciation of engineering.' This requires a body of literature, recognizable, classified and available for their use. Such a body of literature, primarily for the use of the non-specialist, has not yet been identified.

"This group of specialists in ASEE, who have devoted themselves to the task of broadening the horizons of engineering students, need now turn their attention to broadening the horizons of the liberal-arts students and of the citizens generally."

It is hard to get humanists to agree to this viewpoint, though. As they see it, their domain is being swallowed up by a world of science and engineering.

"The voice of the humanist is hardly heard in the land, and the singing of the physicist has

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CIRCLE 906 ON CAREER INQUIRY FORM

come," Dr. Baird Whitlock of the Dept. of Humanities at Case Institute of Technology, told the same ASEE meeting. But he says humanists themselves are largely to blame.

The humanist, he lamented, "forgetting his role as guardian of the testament of the human spirit," has abandoned more and more of his "written and painted treasure" to the social and pure scientists.

"Indeed," he said, "we have almost lost even Leonardo from the realm of art to the realm of science and have forgotten that science until very recently was a part of philosophy—and only a part at that.

"Teachers of literature have built up in recent decades various critical schools which have all the appearance and trappings of scientific method without its necessary controls or applications."

Under the influence of this trend, Dr. Whitlock says, "there are many humanities teachers in engineering schools who feel exiled in a foreign land." What he favors essentially, of course, is what most humanists do: exposure of engineering and science students to a wide range of literature, music, art and philosophy.

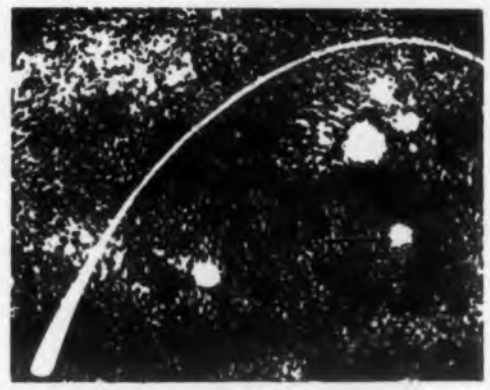
But getting the engineer to widen his interest beyond the purely mechanical appears fraught with frustration. He is apt to be more interested in "things" than in people. At cocktail parties he tends to talk shop rather than the plays of T. S. Eliot. Studies by the research department of Deutsch & Shea, Inc., technical manpower consultants, confirm this. The researchers found that the typical engineer had above-average mental ability but that it was usually restricted to a specialized field.

"He shows little interest in the social sciences, public affairs or even in those aspects of physical science that don't immediately relate to engineering," the studies concluded. "These tendencies apparently date back to the engineer's college days when he showed a marked distaste for English and cultural subjects."

The tendencies need not be irreversible, though, according to Erwin R. Steinberg, associate professor of English and head of the Dept. of General Studies at the Carnegie Institute of Technology. He indicated to the ASEE parley that engineering students did not differ from students of accounting, agriculture, home economics, psychology or secretarial studies in their ability to appreciate literature.

"All these students live in the same world," he said, "and as people have pretty much the same problems. Further, I do not believe that literature needs to be approached differently for any particular group of students, no matter what their major.

"I do believe, however, that the motivation we employ and the examples we supply are often more successful if we choose them with an eye to the students' interests than if we do not."



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CIRCLE 907 ON CAREER INQUIRY FORM

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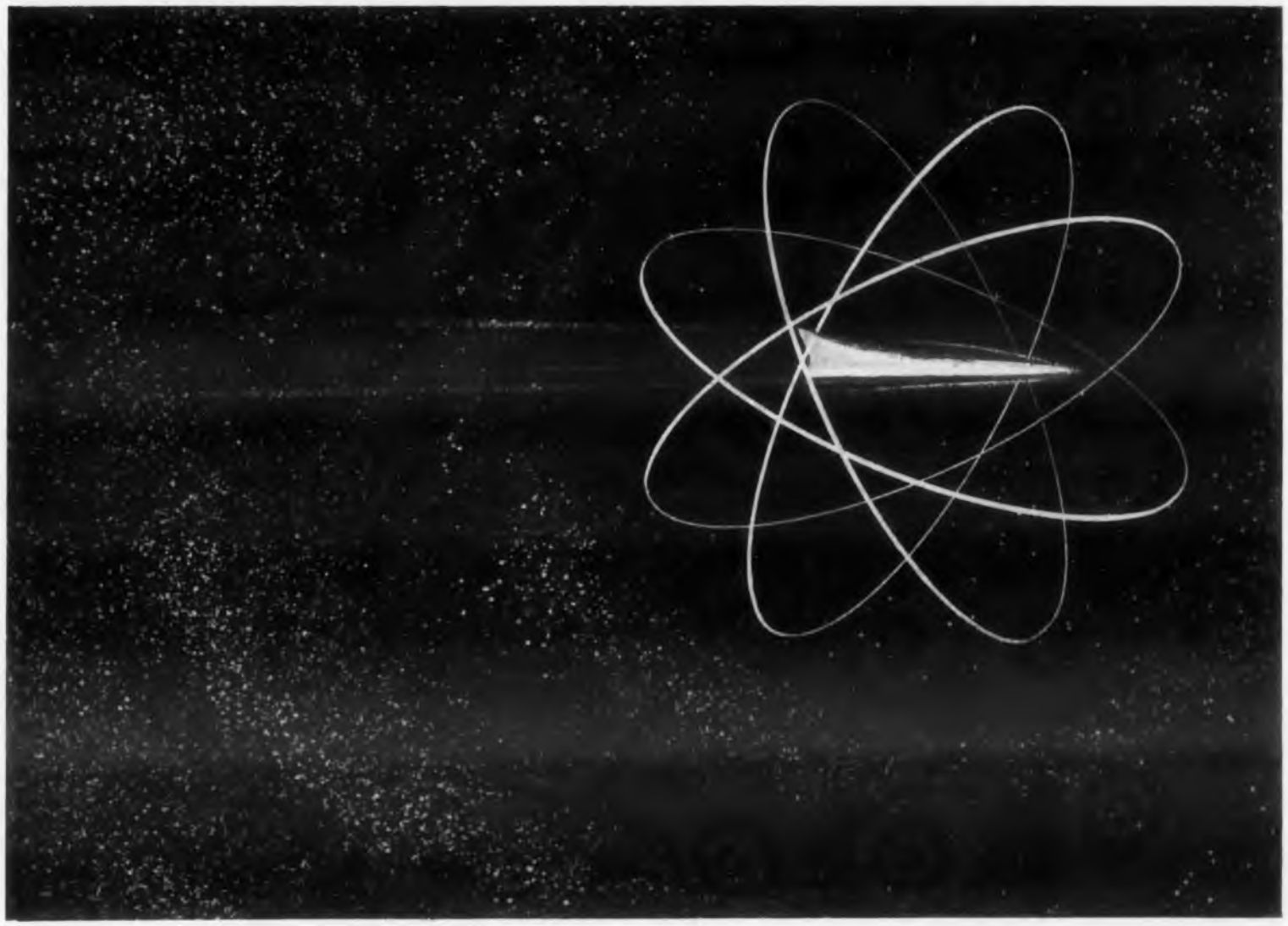
CIRCLE 913 ON CAREER INQUIRY FORM



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CIRCLE 917 ON CAREER INQUIRY FORM

Components Must Meet New Environmental Requirements

A NEW GUIDE listing environmental requirements that electronic component parts must meet when used in various types of military equipment was recently issued. Prepared by the Advisory Group on Electronic Parts, Office of the Assistant Secretary of Defense, the guide supersedes an earlier one dated October 1957 (*ED*, Jan. 22, 1958, p. 26).

The new guide has components listed in eight groups instead of ten, the previous number, and it has raised some of the requirements.

Called "Environmental Requirements Guide For Electronic Component Parts," ECP-2 and eleven pages long, it is available from the Office of Technical Services, Department of Commerce, Washington 25, D. C.

The guide contains the table shown below. It also explains the eight environmental groups and the test procedures, and lists applicable military specifications and standards. ■■

Environmental Characteristics	Group I	Group II	Group III	Group IV	Group V	Group VI	Group VII	Group VIII
Temperature:								
Operating	-55° +55°C.	-65° +85°C.	-65° +125°C.	-65° +125°C.	-65° +200°C.	-65° +200°C.	-65° +350°C.	-65° +500°C.
Storage	-65° +71°C.	-65° +85°C.	-65° +85°C.	-65° +85°C.	-65° +85°C	-65° +85°C.	-65° +85°C.	-65° +85°C.
Thermal Shock	NA*	-65° +85°C.	-65° +125°C.	-65° +125°C.	-65° +200°C.	-65° +200°C.	-65° +350°C.	-65° +500°C.
Pressure:								
Operating	20.58" Hg	1.32" Hg	20.58" Hg	0.326" Hg	0.326" Hg	0.043" Hg	0.043" Hg	0.043" Hg
Altitude (ft)	10,000	70,000	10,000	100,000	100,000	150,000	150,000	150,000
Nonoperating	3.4" Hg	NA	3.4" Hg	NA	NA	NA	NA	NA
Altitude (ft)	50,000		50,000					
Moisture	100-per cent relative humidity with condensation for all groups.							
Vibration:								
Cycles per second	10 - 55	10 - 2,000	10 - 55	10 - 2,000	10 - 2,000	10 - 2,000	10 - 2,000	10 - 3,000
Acceleration (g)	NA	10	NA	10	15	15	20	40
Shock:								
Acceleration (g)	50	50	50	50	50	50	50	50
Time in milliseconds	6	11 ±1	11 ±1	11 ±1	11 ±1	11 ±1	11 ±1	11 ±1
Air-induced vibration:								
Cycles per second	NA	NA	NA	150 - 9,600	150 - 9,600	150 - 9,600	150 - 9,600	150 - 9,600
Db above 2 x 10^{-4} dynes/sq cm	NA	NA	NA	165	165	165	165	165
Explosive atmosphere	The part is to be tested in accordance with Procedure I of MIL-E-5272 for all groups.							
Nuclear radiation (reactor):								
Neutron flux level (fast):								
Neutron cm^2-sec				NA	NA	10^{10}	NA	10^{10}
Time in hours				NA	NA	1,000	NA	1,000
Gamma photon flux level:								
Photon cm^2-sec				NA	NA	10^{11}	NA	10^{11}
Time in hours				NA	NA	1,000	NA	1,000
Thermal neutrons						**		**
Nuclear radiation (pulse):								
Neutron flux level (fast):								
Neutron/cm^2-sec				10^{17}	NA	10^{17}	NA	NA
Time in microseconds				80	NA	80	NA	NA
Gamma flux level:								
Roentgens/sec				10^8	NA	10^8	NA	NA
Time in microseconds				80	NA	80	NA	NA
Sand and dust	Applicable only to moving parts. See paragraph 5.2.11 for all groups.							
Salt atmosphere (hr)	96	96	96	96	96	96	96	96
Flammability	See paragraph 5.2.13 for all groups.							
Fungus resistance	Non-nutrient in all groups. See paragraph 5.2.14.							
Life (hr):								
Operating	30K	30K	30K	2K	20K	2K	2K	10K
Storage	5 years for all groups. See paragraph 5.2.15.							

NOTES: *Not applicable.
**Thermal neutrons are not listed as a requirement, but, since all neutron fluxes have some thermal component, this component should be measured and reported with all tests.

BOOKS

An Approach to Electrical Science

Henry G. Booker, McGraw-Hill Book Co., Inc., 330 W. 42 St., New York 36, N. Y., 826 pp, $9.50.

This integral approach to the fundamentals of electrical science provides a thorough and careful treatment of the topics usually covered in the elementary physics course in electricity and magnetism, plus those in the elementary electrical engineering courses in circuits and fields. It combines many of the strong points of the physics and engineering treatments, and it ensures a unity of perspective which is less likely to prevail in the split physics and engineering treatment.

The book presents the theoretical basis of electrical science, using for each topic what the author regards as the "best" approach, regardless of whether this is an engineering approach, a physics approach or a mathematics approach. In most cases the approach takes the form of a modification of one of the standard approaches in the light of the other two. In some cases, however, the author has been led to a presentation that would not be considered "standard" by either an electrical engineer, a physicist, or a mathematician.

Mathematics has been used throughout as a vehicle of thought in a scientific subject—not just as a "tool." This does not mean that difficult mathematics has been used. On the contrary, a conscious effort has been made to keep to simple mathematics, but to use it continuously as a vehicle of thought and hardly ever as a tool. A distinction between circuit theory and field theory has been avoided. The author seeks to fit both approaches into a

single integrated picture.

An unusual feature of the book is the introduction of the Poynting vector (although no vector calculus is used). The method adopted here is both novel and simple, and at the same time it avoids confusion concerning the interpretation of the Poynting vector in static electromagnetic fields.

The book contains 653 problems. Most are of an analytical nature, though in many cases numerical applications are appended. They involve a wide range of difficulty. Most of the simple problems (marked with an asterisk) have been used by the author in teaching sophomore electrical engineering students; there are also a number of more difficult examples, suitable for a more advanced field course. In addition, summarizing exercises at the end of each chapter, 267 in all, help the student to formulate summaries of the chapters in his own words.

The book is designed to provide in one year the basis necessary for either: (1) the study of electric networks involving any combination of inductors, capacitors, resistors and vacuum tubes; (2) the study of electromagnetic theory.

Electronic Avigation Engineering

Peter C. Sandretto, International Telephone and Telegraph Corp., 67 Broad St., New York 4, N.Y., 772 pp, $9.50.

This book covers radio and electronic aids to aviation. The various systems are grouped in four classes based on the operational problems of aircraft in (1) flight toward a destination airport, (2) flight near that airport, (3) approach and landing, and (4) movement on the airport surface. Emphasis is placed on the engineering principles of these systems and unusual features are detailed.

Descriptions are given of direction finders; four-course, TL, and omnidirectional ranges; consol, Post Office position indicator, navaglobe-navarho, decca, delrac, dectra, radux, loran, radar, radio high-altitude and landing altimeters, doppler drift, inertial systems, distance measurement, gee, tacan, surveillance radar, fixed-beam and radar low-approach systems; and to define the position of aircraft on the airport surface; traffic pads, ground magnetic loops, and surface radar. Material includes 527 figures, 667 equations and 380 references in selected bibliographies.

BOOKS

Basic Electronics

Bernard Grob, McGraw-Hill Book Company, Inc., 330 W. 42 St., New York 36, N.Y., 524 pp. $9.25.

All the essentials of electricity, electronics, and electronic components are included in this comprehensive reference and study book. For the reader with no background in electricity and little in mathematics, this book offers a guide to underlying principles and a thorough preparation for study of electronics, radio communication, fm, television, radar, and industrial electronic applications.

Problems are designed to test the reader's ability and comprehension, and use a minimum of mathematics. The reader is also oriented to the various applications and uses of electronics throughout industry—and the wide variety of opportunities in the field.

All components of dc and ac circuits are explained including tubes and transistors. Terminology is consistent; basic principles are explained by use of simple applications. Many illustrations accompany the text and in all cases photographs of the components are shown with their schematic symbols. Mathematics employed in the book is explained in the appendix, and a list of tools and soldering materials is also included.

Control Engineering

Gordon J. Murphy, D. Van Nostrand Company, Inc., 120 Alexander St., Princeton, N.J., 385 pp. $7.50.

Thorough coverage of modern automatic control theory at an intermediate level is presented here. Problems and illustrations are drawn from many fields, including process control, fire control, inertial guidance and nuclear reactor control.

Following an introductory chapter is a thorough discussion of time response, including development of Laplace transformations which are applied extensively throughout the book. The characteristics of a large number of control-system components are then presented, and design in the complex domain (the *s*-plane) is covered.

Use of frequency-response techniques, a complete treatment of ac carrier systems, and an analysis of systems with time lag are next presented. Sampled-

data systems and statistical analysis of linear control systems are dealt with at length. Final chapters are devoted to nonlinear control theory, including use of describing functions and the phase plane.

Experimental Music

Lejaren A. Hiller, Jr., Leonard M. Isaacson, McGraw-Hill Book Co., Inc., 330 W. 42 St., New York 36, N. Y., 197 pp, $6.00

Here is the first book presenting an application of scientific method to musical composition. It describes in detail the techniques used to produce music by means of electronic automatic high-speed digital computers. It does not merely present the bare outline of particular experiments, but also fills in enough details so that a reasonably complete picture of the potentialities of this research might be realized.

The book first introduces the reader to the aesthetic limits of the problem. It defines what can be accomplished musically with a computer at the present time, and what is—at the moment at least—outside the scope of available experimental tools. Included is a brief discussion of information theory, the theoretical basis of the method used throughout the text, which serves as a bridge to the material that follows.

The area of research musically is then defined, that is, to distinguish these experiments from and to correlate them with other types of musical experiments both of the past and now in progress. This is followed by a description of how modern computers operate, and a general discussion of the mathematical methods used to set up the problem of generating computer music.

The book next brings to the reader detailed descriptions of the experimental techniques and the experimental results, and reviews in considerable detail the programming techniques for the various musical problems studied. There follows description and an evaluation of the contents of the Illiac Suite, the musical composition produced as a consequence of those experiments. The concluding chapter of the book offers a suggestion of a number of possible extensions of this work in the fields of music analysis and music composition.

J. George Adashko

What the Russians Are Writing

Sampling Papers From Soviet Universities

We reported sometime ago in the columns of "What the Russians are Writing" that the Ministry of Higher Education of the U.S.S.R. has started (beginning with 1958) the publication of two series of journals, "Scientific Reports of the Higher Schools" and "News of the Higher Institutions of Learning". Each of these series is made up of a rather large number of periodicals, some quarterly, some bimonthly.

The "Scientific Reports" contains 16 journals devoted to biology, geology, mining, etc., the journals of interest to our readers being devoted to radio engineering and electronics, physics and mathematical sciences, and electromechanics and automation.

The "News of the Higher Institutions of Learning" is even more extensive since it includes 22 journals, of which the bimonthlies devoted to radio engineering, radio physics and physics are of greatest interest to us. Both journals contain high level scientific papers written by members of the various universities or the research institutes associated with the Ministry of Higher Education or with the Academy of Sciences of the U.S.S.R.

We are presenting here a selection from what is probably a typical issue of the "Scientific Reports of the Higher Schools—Radio Engineering and Electronics" (No. 2, April-June, 1958, latest received by Apr. 15, 1959). The issue contains 244 Russian pages and 32 articles, roughly an average of eight pages per article.

It is interesting to note that some articles are written by scientists who are not connected with any university. In spite of the considerable space devoted to semiconductors and transistor circuitry in the "professional" electronic literature, only one of the 32 articles was devoted to pn junctions.

In the next issue we will present selections from "News of the Higher Institutions of Learning".

Engineering Calculation of Broadband Matching Characteristics of Tuned Antennas, by D. M. Sazonov, Moscow Power Institute (pp 53-62, 9 figs.).

The equivalent circuit of the antenna and the matching network is shown in Fig. 1, the antenna being represented as a series-resonant circuit in accordance with the analysis first given by R. M. Fano (*Journal of the Franklin Institute*, Vol. 249, 1950). The broadband properties of the antenna, i.e., the maximum possible relative matching bandwidth, are estimated from the value of the minimum permissible standing wave ratio in the feeder and the known frequency characteristic of the input impedance of the antenna. The possible bandwidth of the circuit shown in Fig. 1 depends essentially on the Q of

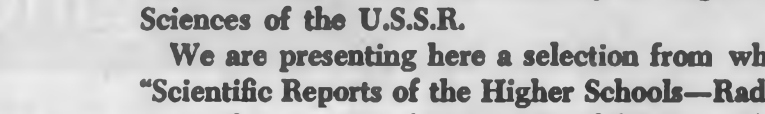

Fig. 1. Equivalent circuit showing broadband matching of an antenna, represented by a series resonant circuit.

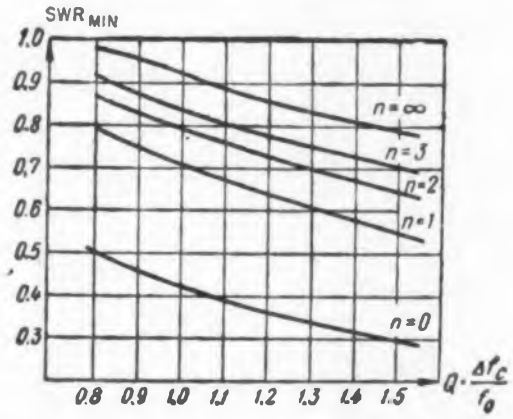

Fig. 2. Curves used to estimate the broadband properties of resonant antennas.

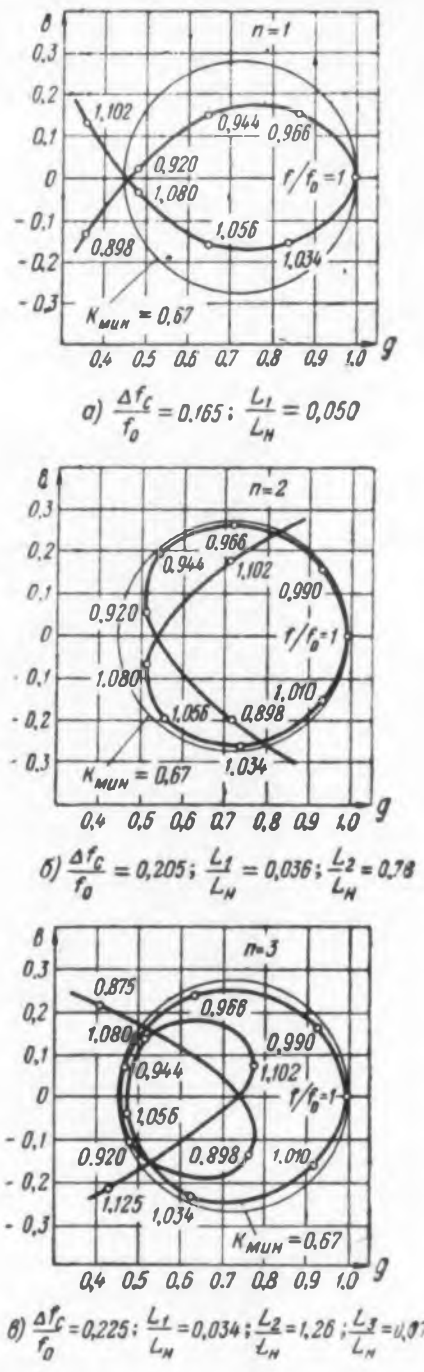

Fig. 3. Examples of broadband matching of a resonant antenna for various values of *n*.

the antenna equivalent circuit and on the number of elements n in the matching network.

The relationships between Q, the relative bandwidth, and the standing wave ratio are illustrated in Fig. 2, which can be used as the starting point for design. As an illustration, Fig. 3 shows plots of the normalized input admittances $(g+jb)$ of an optimum matching network for an antenna with $Q = 6.7$, for a minimum standing wave ratio of 0.67 and for 1, 2, and 3 elements in the matching network.

Of greatest value is broadband matching using only one compensating network element. It may be seen from Fig. 3a that to obtain optimum matching at $n = 1$, the input-admittance curve should form a loop on the diameter of a circle corresponding to a minimum standing wave ratio. This property can be used to determine graphically (Fig. 4) the parameters of the matching element.

Fig. 5 shows how a double parallel loop can be used to match a coaxial cable to a halfwave dipole.

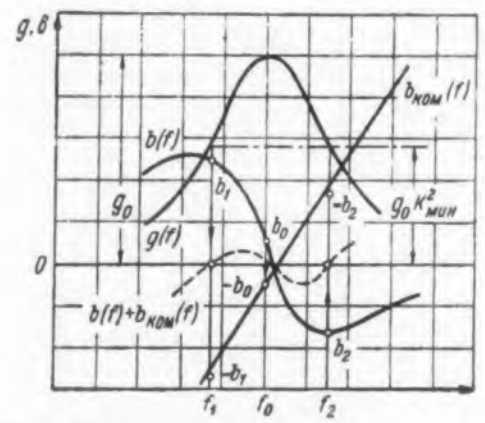

Fig. 4. Graphic calculation of the parameters of the matching network with $n = 1$.

Resonant Phenomena in an Oscillating System With Periodically Varying Regeneration, by Yu. N. Pashin, Moscow State University (pp 84-88, 4 figs.).

A simplified diagram of this system is shown in Fig. 6. The transconductance of the tube is periodically varied at twice the signal frequency.

It is assumed that the transconductance of the tube is linearly proportional to the voltage on the suppressor grid, and that the relationship between

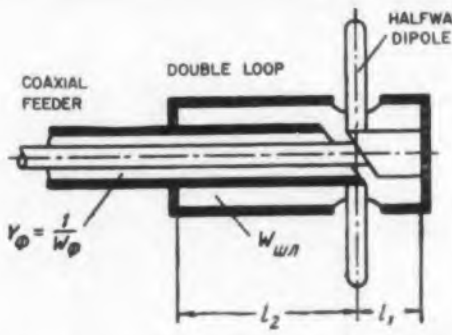

Fig. 5. Use of double parallel loop for matching.

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the plate current and the voltage of the control grid can be approximated by a quadratic polynomial.

A rather complicated relation exists between the circuit parameters and the amplitude of the induced oscillations, but it is shown that, depending on the phase of the applied signal, there are two types of resonances. A "strong one," when the amplitude of the induced oscillations is greater than when the suppressor-grid voltage is absent, and "weak" ($\sin 2\phi = -1$), when the amplitude of the induced oscillations is less than when the suppressor-grid voltage is absent. This implies the presence of phase selectivity. The region of "weak resonance" is smaller than the region of "strong resonance" and diminishes with increasing

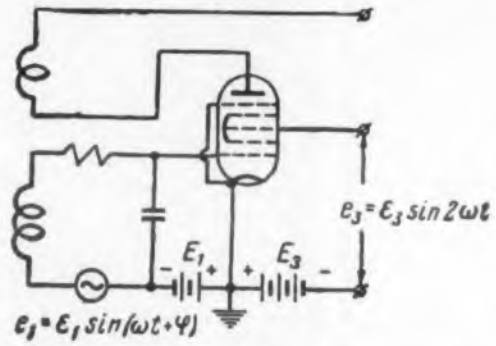

Fig. 6. Simplified diagram of oscillating system with periodically varying regeneration.

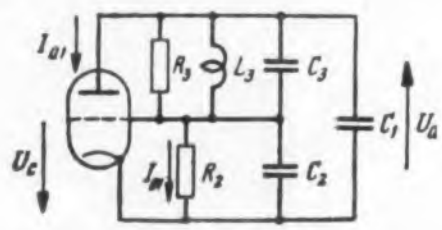

Fig. 7. Equivalent circuit of microwave oscillator at self-oscillation frequency.

depth of modulation. Finally, the parametric regeneration makes the gain in the region of "strong resonance" greater than the attenuation in the region of "weak resonance."

Choice of Opitmum Mode for Decimeter-Wave Generator, by Ye. P. Korchagina, Moscow Power Institute (pp 114-123, 7 figs.).

Detailed procedure is given for the design of the grounded-grid oscillator shown in Fig. 7. The calculations take into account the grid-circuit power and the fact that the feedback coefficient is complex. The dependence of the resultant efficiency on the oscillator parameters is shown explicitly for various types of tubes.

Transients in Self-Biased Self-Oscillators, by M. V. Blagoveshchenskiy, Moscow Power Institute (pp 124-133, 7 figs.).

Self-bias makes it possible to operate a self-oscillator with a steady-state cut-off angle of 60 to 70 deg. If the oscillator is used to generate

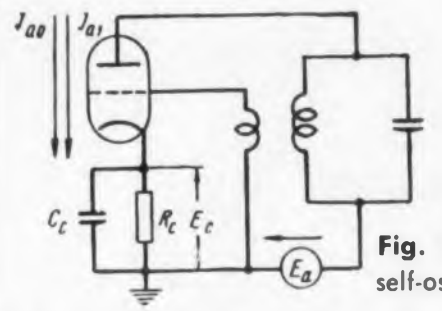

Fig. 8. Self-biased self-oscillator.

brief pulses, the transients in the self-bias circuit substantially influence the behavior of the plate circuit and consequently the waveform of the high frequency pulse. The author demonstrates the importance of a correct choice of the time constant of the bias circuit (Fig. 8) and solves for the transients in this oscillator in the time domain.

Push-Pull Voltage Dividers, by S. I. Yevtyanov, Moscow Power Institute (pp 134-137, 3 figs.).

Ordinary frequency dividers operate in the lock-in mode, in which the external frequency is approximately a multiple of the resonant frequency of the oscillator and the latter is locked-in over a certain frequency band, called the synchronism band. A shortcoming of such a scheme is that beats arise and the circuit becomes inoperative if the frequency deviation exceeds the synchronism band. There is also the danger that non-synchronous oscillations will be produced and taken for the synchronous ones.

Three types of "push-pull frequency dividers"

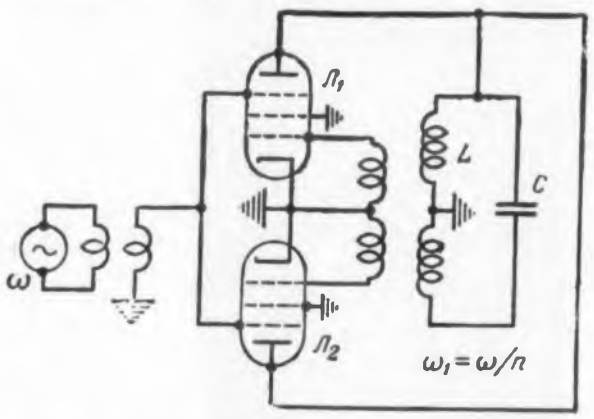

Fig. 9. Push-pull frequency divider with an odd frequency ratio ($n = 3, 5, \ldots$).

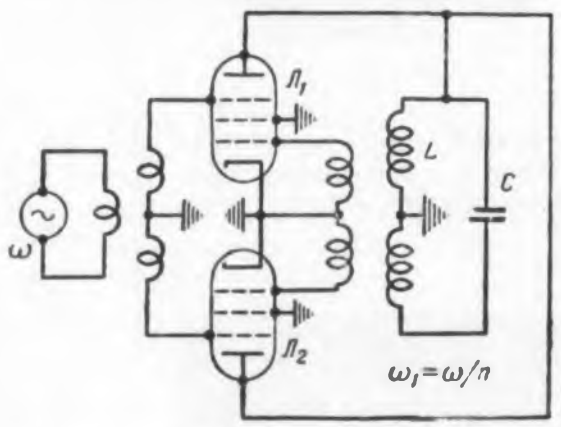

Fig. 10. Push-pull frequency divider with an even frequency ratio ($n = 2, 4, \ldots$).

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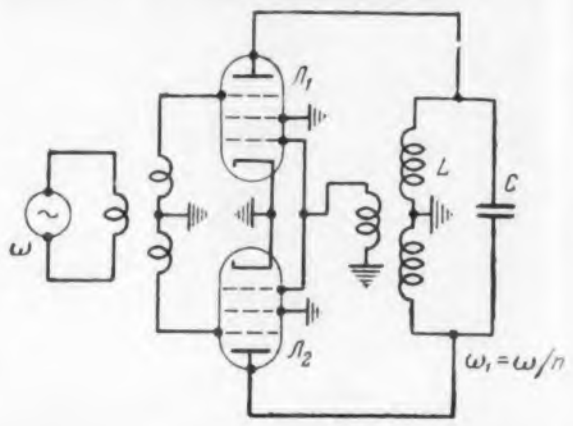

Fig. 11. Push-pull frequency divider with arbitrary frequency ratio.

which are free of this shortcoming are shown in Figs. 9 to 11. For example, in Fig. 9 the two tubes are parallel with the LC tank circuit. The feedback is applied to the control grids of the tubes in phase opposition, while the external voltage is applied in phase. It is easy to see that no free self-oscillations are possible. Since the signal is applied to both tubes in phase, plate-current harmonics with frequency are also in phase. Since the feedback is applied in phase opposition, harmonics of frequency $(n-1)$ will be in phase if $(n-1)$ is even, or n is odd. Thus the circuit can provide frequency division by an odd factor. Similarly, Fig. 10 shows frequency division by an even number, and Fig. 11 shows frequency division by any number.

A Transitron Generator Circuit, by P. A. Popov, Moscow Electrotechnical Comm. Institute (pp 171-174, 5 figs.).

The Transitron oscillator is frequently referred to in the literature in the form shown in Fig. 12, but the author points out that this circuit cannot

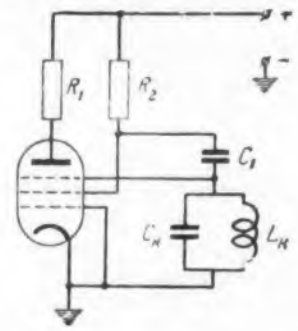

Fig. 12. Incorrect diagram of transitron oscillator (suppressor grid of the tube is at zero dc potential relative to the cathode).

oscillate and that for self-oscillation to take place the suppressor grid of the tube must be made negative relative to the cathode (Fig. 13).

Generators of Linearly-Varying Voltage With Zero Nonlinearity Coefficient, by V. N. Yakolev (pp 194-198, 3 figs.).

Fig. 14 shows a block diagram of a linear sweep generator. For the waveform to be truly

...near, the capacitor discharge current i_p must be constant or the potential of point a must be constant. It is easy to show that this takes place when $k_1 k_2 \beta = 1$, where $\beta = R_2/(R_1+R_2)$.

An examination of the figure shows that the sweep generator consists of two amplifiers, one inverting $(-k_1)$ and the other non-inverting.

(cont. on page 98)

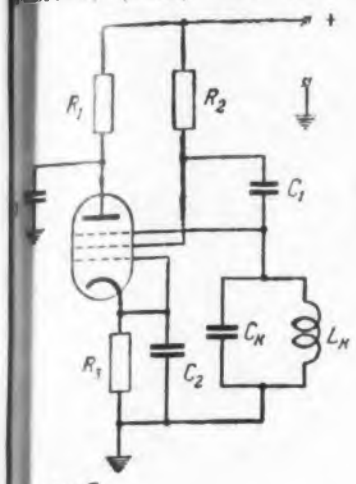

Fig. 13. Diagram of transitron oscillator.

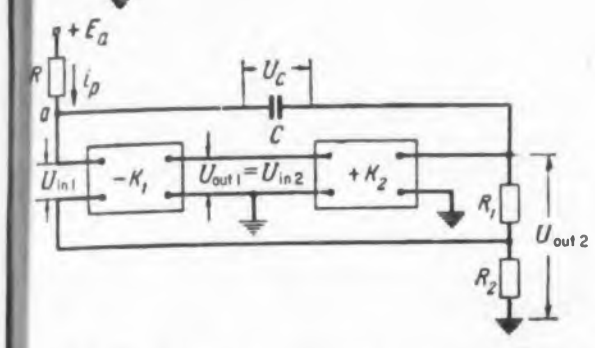

Fig. 14. Block diagram of linear sweep oscillator.

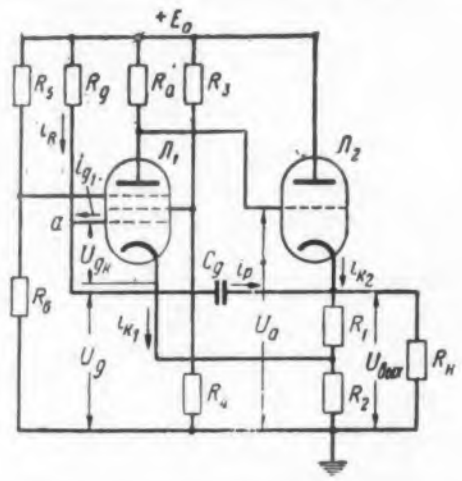

Fig. 15. Phantrastron type linear sweep oscillator.

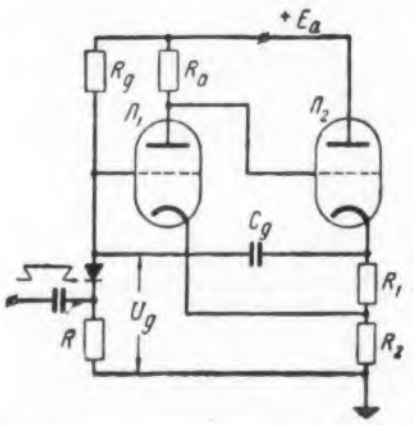

Fig. 16. Linear sweep oscillator employing triodes.

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Figs. 15 and 16 show two types of sweep generators that satisfy the above conditions. In Fig. 15 use is made of the transitron effect of the pentode and the sweep generator is therefore of the phantastron type. The author indicates in a straightforward manner how the condition for absolute linearity can be obtained in this circuit. In the circuit of Fig. 16 a pulse must be applied to the input to trigger the linear operation, but the linearity conditions remain the same. It is interesting to note that a Russian patent has been issued to the author for the principle illustrated in Fig. 14.

Selective Low-Frequency Amplifier, by S. V. Pantyushin, Central Scientific Research Institute (pp 199-202, 3 figs.).

This is a discussion of a theoretical and experimental investigation of a selective two tube amplifier using positive feedback (Fig. 17). The gain, the bandwidth, and the Q of the amplifier are calculated. It is indicated that the best RC network to use for the interstage coupling is a Wien bridge.

Analysis and Synthesis of Transients in Nonlinear Circuits With a Single Energy-Storage Element, by V. G. Karpov, Leningrad Air Force Engineering Academy (pp 203-214, 7 figs.).

Most treatments of nonlinear circuits cover only special cases and various linearizing or similar approximations are used. This applies particularly to transients in nonlinear circuits. This article is an excerpt of lecture notes delivered to the Leningrad Air Force Engineering Academy.

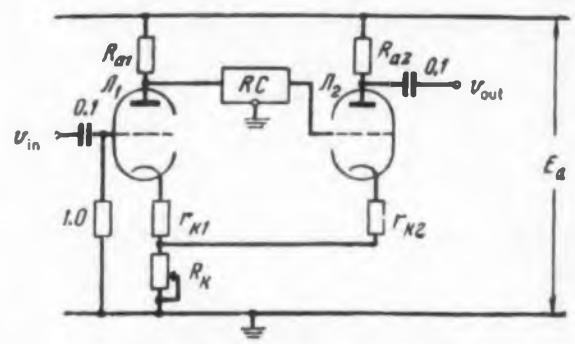


Fig. 17. Amplifier circuit.

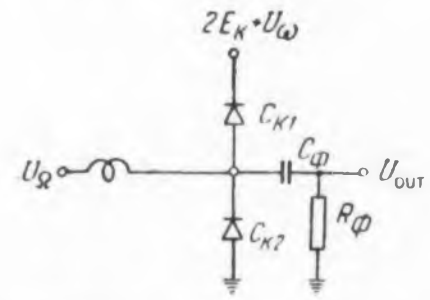


Fig. 18. Amplitude modulator of the capacitive-divider type.

It summarizes the various possible investigation procedures as applied to nonlinear RC and RL networks that can be described by differential first order equations.

The phase-trajectory method is used as the basic procedure, giving as it does an idea of the character of the process and leading at the same time to the necessary quantitative relationships. A connection is established between the phase portraits and the characteristics of the nonlinear

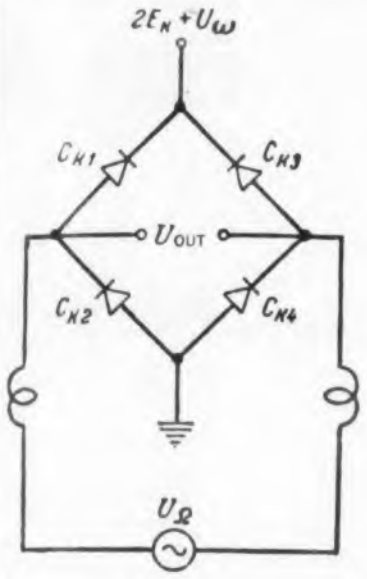


Fig. 19. Bridge-type amplitude modulator

elements both in the general case (when both circuit elements are nonlinear) and in various particular cases. Also considered is the problem of synthesis of a nonlinear network, i.e., the determination of characteristics of nonlinear elements that would lead to a transient of specified form.

Amplitude Modulation Employing the Capacities of an NP Junction, by V. I. Samoylenko, Moscow Aviation Institute (pp 226-232, 3 figs.).

Figs. 18, 19, and 20 show three types of amplitude modulators in which the modulation is effected by varying the capacitance of np junctions in semiconductor diodes or transistors. These circuits operate quite well at frequencies up to 500 mc. The temperature coefficient of the capacitance is commensurate with the temperature coefficients of ceramic or mica capacitors and little modulating power is required. The article is devoted to a calculation of the voltage gain, the modulation coefficient, the nonlinear distortion coefficient and several other characteristics.

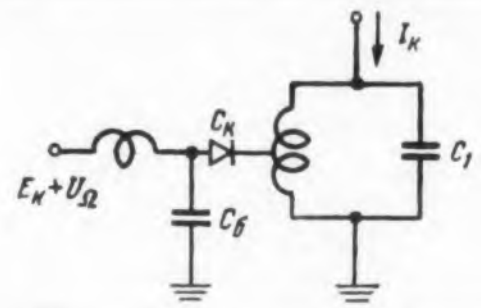


Fig. 20. Amplitude modulator using a parallel tank circuit.

GERMAN ABSTRACTS

Temperature
Ferrite

Achieved by

IN FERRITES which are biased by a constant magnetic field, the gyromagnetic resonant frequencies as well as the nonreciprocal characteristics depend on the magnetic saturation which in turn depends on temperature. It is possible to choose the dimensions of the ferrite object so that the resonant frequency, the nonreciprocal phase shift, or the Faraday rotation are virtually temperature independent. The conditions for achieving such temperature independence depends on choosing certain relationships between the resonant frequencies and the demagnetizing factors of the ferrite. The gyromagnetic radian resonant frequency ω_r is related to the saturation magnetization M and the external field H_{e^-} through the gyromagnetic ratio G and the demagnetizing factors N_x, N_y and N_z by

$$\omega_r^2 = G^2 \left[H_{e^-} + M\ (N_x - N_z)/\mu_o\right] \left[H_{e^-} + M\,(N_y - N_z)/\mu_o\right] \quad (1)$$

For a resonant directional line operating at a mean radian resonant frequency ω_m, with saturation magnetization M_o at the mean operating temperature, temperature independence requires fulfillment of the conditions

$$u_m^2 = (\omega_m\,\mu_o/GM_o)^2 = P^2QR/(Q - R)^2 \quad (2)$$

and

$$2RQ > N_z(Q - R) \quad (3)$$

where

$$P = N_x - N_y \quad (4a)$$
$$Q = N_y - N_z \quad (4b)$$
$$R = N_z - N_x \quad (4c)$$

For nonreciprocal phase shifters and Faraday

E. Brenner

Independent Strips

Selecting Particular Resonant Frequencies And Demagnetizing Factors of the Ferrite.

rotators, the conditions for temperature independence are

$$u_{ro}^2 = u_m^2 - 2RQ \pm [P^2 - 4QR)(u_m^2 - QR]\ 1/2 \quad (5)$$

and

$$u_{ro} - (u_m^2 - 2QR) > N_z (Q - R) \quad (6)$$

where

$$u_{ro} = \omega_{ro}\ \mu_o / GM_o$$

and the zero subscript refers to the mean temperature conditions.

With rotation of symmetrical bodies such as generally used in Faraday rotators, $N_x = N_y = N$ so that if u_{ro} is less than u_m (as is usual) it is necessary that N be less than N_z. This is only possible if the diameter of the rod is longer than its length.

A numerical example is included in which the dimensions of rectangular ferrite strips in rectangular wave guide are discussed.

Abstracted from an article by W. Haken and Ch. von Haza-Radlitz, Archiv der Elektrischen Uebertragung, *Vol. 13, No. 4, April 1959, pp 157-160. For the calculation of the demagnetizing factors in a ferrite in the presence of conducting walls reference is made to an article by W. Haken,* Archiv der Elektrischen Uebertragung, *Vol. 12, No. 12, pp 562-566.*

REPORT BRIEFS

Indicating-Instrument Rectifiers

Included in the investigations were 506 full-wave bridge rectifier assemblies (manufactured as such or as diodes connected to form full-wave bridge units), procured from nine manufacturers. The semiconducting elements represented were silicon, germanium, selenium, and copper oxide. Investigations were conducted to determine the effects of temperature, frequency, thermal cycling, moisture-resistance cycling, and shelf-life storage. *Component Evaluation and Specification Engineering. Task XX: Electrical Indicating-Instrument Rectifiers, L. H. Stember, Jr. and P. G. Perry, Battelle Memorial Institute, Columbus, Ohio, Sept. 1955, 71 pp, Microfilm $4.50, Photocopy $12.30. Order PB 136293 from Library of Congress, Washington 25, D.C.*

Drop-Outs From Magnetic Tape Systems

An investigation has been initiated, first, to determine the number and size of drop-outs obtained from magnetic tape recording systems and the extent that various factors affect the number and size of drop-outs and, second, to develop a reliable method of testing the drop-out characteristics of magnetic tape recording systems so that accurate evaluations of tape itself can be made and correlated to a specific end use. The instrumentation for classifying and counting drop-outs according to size is discussed in detail. Commercially available plug-in units are used throughout. A drop-out simulator used for calibration purposes is described along with the calibration technique used to evaluate the reliability of the overall system. Photographs of the signal amplitude envelopes of many types of drop-outs are included to show the various types of drop-outs that occur. Preliminary data on the number and size of drop-outs from present day tapes (and a standard machine) are given. There are curves showing the number of drop-outs per 1000 ft of tape for any amplitude reduction for one sample of tape from each manufacturer, and data on the lengths of drop-outs are plotted. One observation is that in general the drop-out distribution according to length is very similar for all standard instrumentation tapes. Another observation is that about 95 percent of all drop-outs greater than 3 db, on all tapes, except the new sandwich type, are shorter than 35 mils in length, regardless of the total number of drop-outs of all lengths. *The Classification and Counting of Drop-Outs From Magnetic Tape Recording Systems, Robert H. Carson, Naval Research Laboratory, Washington, D. C., Feb. 1959, 33 pp, $1.00. Order PB 151286 from OTS, Washington 25, D. C.*

Multiple-Channel Electronic Switch

A 36-position electronic switch with six analog channels and seven control channels in parallel, called the Fast Scan, was developed for the Naval Data Handling System (NDHS) at the U. S. Naval Research Laboratory's Chesapeake Bay Annex. The Fast Scan sequentially scans the NDHS stores at the radar pulse-repetition frequency and makes available target-position, velocity, height, and category data in parallel for each of 24 stores at the various PPI repeaters. The target plan-position and velocity-vector information is displayed during the radar recovery time and thus appears to be displayed simultaneously with the raw radar video. Each input position of each analog channel has an input impedance of one megohm when activated. The overall error from the activated input position to the output is less than ±50 mv over a range of ±30 v. The Fast Scan can be driven with pulse-repetition frequencies up to 4000 pps. The control channels provide the timing pulses so that the proper outputs of the Fast Scan are displayed at the various positions in the NDHS. The six analog channels require 12 vacuum-tube envelopes and 432 silicon-junction diodes. The seven control channels require ten vacuum-tube envelopes and 172 silicon diodes. The commutator which sequences the Fast Scan requires 4 magnetron beam switching tubes, 3 tube envelopes, and 37 diodes. *Fast Scan: A 36-Position Multiple-Channel Electronic Switch, Fred R. Fluhr, Naval Research Laboratory, Washington, D. C., Mar. 1959, 31 pp, Microfilm $3.00, Photocopy $6.30. Order PB 136512 from Library of Congress, Washington 25, D. C.*

Delay-Line Terminating Circuits

A single-tuned ultrasonic-delay-line terminating circuit is described which is unaffected by series lead inductance. This delay-line terminating circuit is convenient for multi-channel operation of a delay line. The series lead inductances are tuned and loaded to give the desired center frequencies and bandwidths. The terminating circuit is also effective for large-bandwidth single-channel operation. The circuit was adapted to the problem of measuring the intrinsic (acoustic) bandpass curve of a delay line. Nine delay lines from three different sources were measured. The bandpass curves were uniformly smooth. The center frequency was usually lower, and the 3-db bandwidth was always larger than that quoted by the manufacturer. *Ultrasonic Delay-Line Terminating Circuits and Passband Measurements, Martin Axalbank, Lincoln Laboratory, Massachusetts Institute of Technology, Lexington, July 1957, 8 pp, Microfilm $1.80, Photocopy $1.80. Order PB 139-238 from Library of Congress, Washington 25, D. C.*

REPORT BRIEFS

Stabilization For Instrument Servos

Three methods of phase compensation widely used to achieve stable operation in instrument servomechanisms are: lead networks, tachometer feedback, and viscous-coupled inertia dampers. This memorandum compares these types of compensation in such matters as servo bandwidth, velocity constant, torque constant, transient response, tolerance to gear train backlash, noise, and required amplifier gain. The purpose of this comparison is to provide a basis for selection of the most appropriate type of compensation for a particular problem. *Comparison Of Lead Network, Tachometer, And Damper Stabilization For Instrument Servos, George A. Biernson, Servomechanisms Laboratory, Mass. Inst. of Tech., Cambridge, Dec. 1956, 23 pp, Microfilm $2.70, Photocopy $4.80. Order PB 137294 from Library of Congress, Washington 25, D. C.*

Comparison of Two Cathode-Ray Tubes for Signal Detectability

This report discusses a study which was a comparison of a 12DP7 and a 12DP19 cathode-ray tube for signal detectability under various levels of grid bias voltage and random noise voltage. The curves relating signal detection to the above parameters were in general agreement with previous research. Under all viewing conditions of this experiment the 12DP19 was superior to the 12DP7, and when the minimum signal-to-noise ratios were compared, the 12DP19 showed a 22 per cent gain in range over the 12DP7. In addition, the report discusses the manner in which noise affects signal detectability. *A Comparison of Two Cathode-Ray Tubes for Signal Detectability as a Function of Random Noise Level, Robert L. Erdmann and John W. Gunvordahl, Rome Air Development Center, Griffiss AFB, N. Y., Sept. 1958, 19 pp, Microfilm $2.40, Photocopy $3.30. Order PB 136572 from Library of Congress, Washington 25, D. C.*

Human Factors in Maintenance—Part 2

This report explores the potential impact of recent developments in electronic subminiaturization techniques on the task of maintaining future electronic equipment. The results are summarized in the Brief of Study. *Human Factors in Maintenance, Part 2. Maintenance Problems Anticipated as a Result of Subminiaturization, Richard P. Runyon, Long Island University, Apr. 1958, 61 pp, Microfilm $3.90, Photocopy $10.80. Order PB 138563 from Library of Congress, Washington 25, D.C.*

Polynomial Expansions in The Analysis of Nonlinear Circuits

A brief review of the standard techniques of calculating the properties of nonlinear circuits, averaged signal, small signal, and Fourier series, is followed by a few notes on the use of the Vandermonde determinant with nonlinear circuits. The balance of the report is devoted to the use of orthogonal or Legendre polynomial techniques for the solution of simple nonlinear circuits and also circuits which have load contours representable by two branches. *The Application of Polynomial Expansions in The Analysis of Nonlinear Circuits, K. A. Pullen, Ballistic Research Laboratories, Aberdeen Proving Ground, Oct. 1958, 59 pp, Microfilm $3.60, Photocopy $9.30. Order PB 138129 from Library of Congress, Washington 25, D.C.*

Insulating Materials

The objectives of this investigation are to determine the effects of moisture and heat on the electrical and physical properties of representative plastics and ceramics of various types and to derive expressions of mathematical relations describing various effects on dielectric properties as functions of time, temperature and relative humidity. *Moisture Resistance and Dielectric Breakdown of Electrical Insulating Materials, John J. Chapman and Louis J. Frisco, Dielectrics Laboratory, Johns Hopkins University, Baltimore, Md., Jan., 1958, 35 pp, Microfilm $3.00, Photocopy $6.30, Washington 25, D. C.*

Pulse Duration Transistor Switches

Research report 1R12 covers basic design considerations of a dc-type amplifier. The circuit consists of a magnetic amplifier to transform a dc signal amplitude into a series of pulses of constant repetition rate and a pulse duration which is proportional to the dc signal. The magnetic amplifier output pulses are of sufficient height to operate a power transistor as a switch. The average value of the transistor load current is proportional to the magnetic amplifier control signal. Since the transistor is operated as a switch, its load power may be several times its rated power. Several curves are given to show the upper power levels expected at this stage of transistor development. *Pulse Duration Modulated Transistor Switches for DC Amplification, D. L. Anderson, Niels Jasper, and James C. Taylor, Army (Rocket and Guided) Missile Agency, Redstone, Ala., Mar. 1956, 21 pp, Microfilm $2.70, Photocopy $4.80, Order PB 137697 from Library of Congress, Washington 25, D. C.*

STANDARDS AND SPECS

Sherman H. Hubelbank

Connectors

MIL-C-3655, Twin Connectors for RF Cables, Amendment 2, 30 March 1959

Connectors are now to be marked in accordance with MIL-STD-130. Code-designating numbers shall be in accordance with Handbook H4-1. Qualification requirements have changed.

MIL-C-3643, HN Connectors for RF Cables, Amendment 3, 31 March 1959

Referenced specs and publications have been completely revised. Requirements for packing, and packaging and marking have been revised. Qualification requirements have changed.

MIL-C-3650, LC Connectors for RF Cables, Amendment 3, 31 March 1959

Individual spec sheets have been clarified. The list of applicable documents has been completely revised. Preparation for delivery requirements has been modified. The standard qualification clause has been added.

MIL-C-3607, Pulse Connectors for RF Cables, Amendment 2, 30 March 1959

References to other publications have been changed to include Handbooks H4-1 and H28. The requirements for marking and qualification have been changed.

MIL-C-3608, BNC Connectors for RF Cables, Amendment 2, 6 March 1959

Connectors are now to be marked in accordance with MIL-STD-130. Code-designating numbers shall be in accordance with Handbook H4-1. The requirements for qualification have changed.

Mounting Bases

MIL-C-172C Cases; Mounting Bases; and Vibration Mounts (for Use with Electronic Equipment in Aircraft), 8 December 1958

General requirements, dimensions, space limitations, performance requirements, and dimensional requirements are established by this spec. Long-stud vibration mounts (for flat mounting) are intended for use in instrument panels, center of gravity systems, etc. Vibration mounts covered by this spec are not intended for electronic equipment used in helicopters.

ASTM Selects Rad Standard Radiation Dose Unit

The rad has been recommended by ASTM as a national standard for reporting radiation dose. The rad which represents 100 ergs of energy absorbed per gram of material is independent of the kind of ionizing radiation (X-ray, gamma ray, beta ray, neutron, etc.), as well as the type of material being irradiated. In this respect the rad differs from most other units currently in use for measuring radiation intensity and radiation effects. For example, the well-known Roentgen applies only to X-ray and gamma radiation absorbed by air. In recommending the rad, the ASTM Committee on Plastics is recognizing what was expected in 1953 by the International Commission on Radiographic Units when it adopted the rad as a new unit of absorbed radiation dose.

Coils

MIL-C-15305A, Radio Frequency Coils and Intermediate and Radio Frequency Transformers, Supplement 1A, 25 March 1959

This supplement lists the military standards which form a part of this spec. Twenty miniature molded rf coils have been added. These coils have a maximum operating temperature of 85 C with a 13 C temperature rise at 72 C ambient temperature.

Phasing of Microphones

EIA RS-221, Polarization or Phasing of Broadcast Microphones, April 1959

Connections and methods of testing which will result in correct phasing of microphones for broadcast use are established in this standard. Correct phasing is important when two similar microphones are placed in symmetrical relation to a performer. In a lesser measure, correct phasing may be important for optimum operation of amplitude modulated transmitters because of the predominantly unsymmetrical aspect of speech sound. Copies of this standard are available from the Electronic Industries Association, 11 W. 42nd St., New York 36, N.Y., for 60 cents.

Standard Proceedings Available

Proceedings of the Standards Engineers Society, Seventh Annual Meeting

Twenty-three papers describe how to achieve the savings that standardization makes possible. Subjects include ways of utilizing manpower effectively, materials for the space age, advances in engineering practices, education in standardization, and standardization in Canada. Copies of this 89-page manual are available from the Standards Engineers Society, 1025 Connecticut Ave., N.W., Washington 25, D.C., for $5.00 for nonmembers.

NEW LITERATURE

Silicon Rectifiers 88

New specification and data sheets describe ITT line of "Gold Crown" high current power silicon rectifiers. The rectifiers cover the current range from 5 amps to over 70 amps, at a stud temperature of 150 deg C, and are available in peak inverse voltage ratings up to 800 v. Proposed JETEC packaging is used, up to 30 amps with a 1/4-28 stud size and up to 70 amps with a 3/8-24 stud size. ITT Components Div., International Telephone and Telegraph Corp., Clifton, N.J.

Pulse Transformers 89

More than 800 standard catalog numbers for pulse transformers are listed in these engineering data sheets (10005, 10010A 10020A, 10230A, 10330A, 10400A). The sheets describe subminiature and miniature metal-clad units, subminiature and bathtub-case designs, metal-encased and cast-housing plug-in styles, block-shaped units, and pancake-shaped designs, which cover the majority of applications for low-power pulse transformers for use in digital computers and other electronic devices. Sprague Electric Co., Special Products Div., North Adams, Mass.

Precision Potentiometer

Data Sheet 1543, covers the 1-7/16 in. single-turn Series 5400 precision potentiometer. The standard electrical and mechanical specifications in the data sheet are amplified by a table presenting the complete characteristics of standard linear coils ranging from 100 to 115,000 ohms. A power rating chart is included. *Write to: Beckman Instruments Inc., Helipot Div., Dept. ED, 25000 Fullerton Rd., Fullerton, Calif.*

Ceramic Capacitors 90

Catalog J-1 describes in four pages the firm's complete line of subminiature ceramic capacitors made in 12 types of ceramic material. An unlimited variety of micro-small shapes and lead arrangements are featured in these custom-made units. Mucon Corp., 9 St. Francis St., Newark 5, N.J.

Quartz And Glass 91

A general description of quartz and glass is provided in this four-page brochure. Typical applications for the materials are: electrical insulators; phase shifters; delay lines; and microwave test equipment. Dell Optics Co., Limited, 327-55th St., West New York, N.J.

Instrumentation

Thirty-two instruments and accessories are described including a new transistorized 50 kc frequency-period meter, a new digital voltmeter, and a fast versatile digital printer in this 12-page catalog. Other instruments included are universal countertimers, frequency-period meters, frequency meters, time interval meters, in-line in-plane read-outs, electronic go–no-go gages, preset counter controllers, and decade counting units. *Write to: Computer Measurements Co., Dept. ED, 5528 Vineland Ave., N. Hollywood, Calif.*

Instrument Catalog 92

Catalog 4220, 24 pages, covers instruments designed for general switchboard applications. Thirteen types are detailed, including: ac milliammeters; ac voltmeters; ac frequency meters; ac wattmeters; synchroscopes; power factor meters; dc ammeters; dc milliammeters; dc voltmeters; and dc millivoltmeters. Pictures are included, and technical data is provided in tabular form. Roller-Smith, Inc., 50 Avenue L, Newark 1, N.J.

Microwave Equipment 93

Both pictures and electrical specifications are contained in this condensed microwave equipment catalog. Included in the 12-page catalog are descriptions of field test equipment, antennas and components, ferromagnetic devices, laboratory instruments and standards, instrumentation for evaluation and monitoring of systems, and automatic military and commercial applications. Sperry Microwave Electronics Co., Div. of Sperry Rand Corp., Clearwater, Fla.

Thermosetting Laminates

NEMA Standards Publication LP 1-1959 describes colors, finishes, dimensions and tolerances, physical and electrical properties, and testing of the various grades of industrial thermosetting laminates in the form of sheets, tubes or rods. Included are paper-base, fabric-base, asbestos-base, and nylon-base grades, and copper-clad and GPO-1 polyester glass-mat sheet laminates. *Send $2.75 to National Electrical Mfrs. Assoc., 155 E. 44 St., New York 17, N.Y.*

Data Control 94

Products and facilities of the firm are covered in this two-color, 24-page brochure. Among the products described are: telemetry systems; test and analysis systems; data translators; instrumentation amplifiers, meters; multiplexers; and precision voltage reference sources. Epsco, Inc., 588 Commonwealth Ave., Boston 15, Mass.

NEW LITERATURE

Miniature Fasteners Catalog 106

Illustrated catalog 5711, 32 pages, presents designs and configurations in miniaturized self-locking fasteners for assembly or reduced dimension electronic equipment. Charts offer comparisons of size relationships between standard AN parts and the current NAS miniature nut standards. Included in this catalog are 18 pages of standard drawings of the various miniature hex, clinch, and floating anchor nuts. Elastic Stop Nut Corporation of America, 2330 Vauxhall Rd., Union, N.J.

Precision Potentiometers

Electrical and mechanical specifications for standard wirewound single and multiturn precision potentiometers are listed in this 100-page catalog 202. Included are descriptions of the firm's facilities for designing and producing special tolerance wirewound potentiometers, special nonlinear potentiometers, and precision mechanisms. *Write to: Spectrol Electronics Corp., Dept. ED, 1704 South Del Mar Ave., San Gabriel, Calif.*

Environmental Testing 07

This 31-page illustrated booklet describes the firm's environmental test facilities and services. The reproducible environments discussed include conditions of vibration with varying temperatures and altitudes, humidity, tension and compression, shock, acoustics, acceleration, and pressure. Also described are chambers that simulate natural conditions of rain, sunshine, sand, dust, salt spray, and fungus culture. General Electric Co., Missile and Space Vehicle Dept., 3198 Chestnut St., Philadelphia 4, Pa.

Laminated Plastics 108

Information on all standard and special laminated plastic grades made by the firm is contained in this 206-page Designer's Fact Book. A comparative chart and listing of materials by military specs are provided for the various plastic grades including paper-phenolic, fabric-melamine, wood-phenolic, glass-phenolic and glass-melamine. Formica Corp., 4614 Spring Grove Ave., Cincinnati 32, Ohio.

Silicon Power Rectifiers 111

Electrical and mechanical data and specifications for small silicon power rectifiers are given in this one-page, style 30 brochure. These rectifiers have peak inverse voltages ranging from 50 to 400 v, in 50 v steps. Syntron Co., 283 Lexington Ave., Homer City, Pa.

Copper Wire 112

Bulletin T-3 shows properties and applications of nickel-clad copper wire. Included in this folder are charts showing mechanical and electrical properties and photographs of typical applications. H. K. Porter Co., Inc., Riverside-Alloy Metal Div., Riverside, N.J.

Coil Forms

This 22 x 34 in. reference chart provides technical data on the firm's ceramic and phenolic coil forms. Scale drawings give dimensions, and all materials used are listed with military specs wherever they apply. *Write to: Cambridge Thermionic Corp., Dept. ED, 445 Concord Ave., Cambridge 38, Mass.*

Glass Fabrics 113

This four-page illustrated folder describes the properties, applications and available types of Fluorglas Teflon-coated fabrics and tapes. Strength, dielectric and moisture resistant characteristics of these fabrics are charted. Dodge Fibers Corp., Hoosick Falls, N.Y.

Rotary Selector Switch 114

Data sheet 162 describes a new series of rotary selector switch assemblies that feature a cock-and-fire actuating mechanism. The assemblies are for use on aircraft, electronic and computer panels and other areas where mounting surface is at a premium. Minneapolis-Honeywell Regulator Co., Micro Switch Div., Freeport, Ill.

Frequency Meters 115

Bulletin 200, six pages, provides illustrations and electrical specifications for precision direct reading, heterodyne, uhf, calibrated and frequency standard multiplier type frequency meters. Polytechnic Research and Development Co., Inc., 202 Tillary St., Brooklyn 1, N. Y.

NEW LITERATURE

Packaging Material 119

This brochure describes a film packaging material that prevents corrosion of certain metals. The material can be used to preserve electronic components. Physical properties, uses and other descriptive material are included. Daubert Chemical Co., 333 N. Michigan Ave., Chicago 1, Ill.

Power Supplies 120

Bulletin 765C, eight pages, describes a complete line of power supplies for laboratory and control use. Included are some application diagrams and descriptions for using programmable power supplies in automatic test equipment. Physical and electrical characteristics are listed for each model. Electronic Measurements Co., Inc., Eatontown, N.J.

Ground Support Equipment 121

This four-page bulletin, No. 3017, describes missile ground support equipment for countdown and pre-countdown checkout. Sections of the bulletin are devoted to a static checkout unit, a dynamic checkout unit and an ullage simulation assembly. Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif.

Components 122

This two-color, four-page brochure describes the MS-41 Magnetoresistor. It covers the magnetoresistive effect, and gives examples (with diagrams) of the applications of the component. Specifications and graphs showing the major characteristics are included. Ohio Semiconductors, Inc., 1035 W. Third Ave., Columbus 8, Ohio.

Rotary Components 123

This 12-page catalog describes and illustrates the firm's basic line of fhp electric motors, blowers and special products. Shaded pole, permanent split capacitor, and dc motors are illustrated. Dimension diagrams, standard ratings and other basic engineering information are included. Redmond Co., Inc., Owosso, Mich.

Terminals and Hardware 124

Catalog No. 31, 24 pages, contains detailed dimensions and drawings of nearly 400 terminals and electronic hardware items. Turret terminals, molded and Teflon-insulated terminals, terminal boards, handles and instrument control knobs are among the items covered. Lerco Electronics, Inc., 501 S. Varney St., Burbank, Calif.

Tube Data 125

The physical and electrical characteristics of over 60 single- and multi-gun cathode ray tubes for industrial and military applications are compiled on this chart. Listed are tubes that range in size from two to 12 in. Included are square and rectangular face types as well as many special purpose tubes. Electronic Tube Corp., 1200 E. Mermaid Lane, Philadelphia 18, Pa.

Recorders and Recording Controllers 126

Catalog GEA-6887, 12 pages, describes the firm's new line of continuous self-standardizing strip-chart recorders and recording controllers for measurement of electrical and process variables. Photographs, application data, typical control system schematics, specifications and dimensions are included. General Electric Co., Schenectady 5, N.Y.

Missiles 127

Called "Missiles—From Concept to Countdown," this 34-page booklet puts into perspective the relationship of the missile to the Nation's arsenal; the complexities of its manufacture; the reasons for its cost; and its potential use both in war and for peace. Aircraft Industries Association, 610 Shoreham Bldg., Washington 5, D.C.

Photographic Equipment 128

A photographic illumination device, called the Hinelight, that can be used in making shadow-free photos of electronic equipment is described in this six-page brochure. A description and pictorial material (including pictures of an electronic chassis, a photomultiplier tube and a radio receiver gear box) of the unit are included. Hinelight Corp., 2538 John St., Fort Wayne 5, Ind.

Fastening Devices 129

A door interlock switch for use on high-voltage cabinets, radio, radar, and other electronic cabinets is described in this two-page data sheet. The data sheet includes photographs, dimension drawings, characteristics, electrical ratings and price information. Micro Switch, Division of Minneapolis-Honeywell Regulator Co., Freeport, Ill.

Counting Instruments 130

In four pages this brochure describes: electric counters including dustproof and hermetically sealed models; switches for actuating electronic counters; stroke counters; revolution counters; dozens counters; coin counters; and other types of counters. General Controls Co., PIC Automation Controls Div., 8078D McCormick Blvd., Skokie, Ill.

NEW LITERATURE

Vibration Damper 133

A synthetic, non-woven fiber felt is described in this seven-page brochure called "TroyFelt." This felt can be used as a vibration damper for delicate electronic instruments. Troy Blanket Mills, 200 Madison Ave., New York 16, N.Y.

Eyelet Machine Catalog

This illustrated catalog, 48 pages, gives detailed information on the several classifications of eyelets and the firm's line of eyelet machines. Eyelets are used in rotary switches and printed circuits. *Write on company letterhead to United Shoe Machinery Corp., Eyelet Dept., Dept. ED, 140 Federal St., Boston 7, Mass.*

Tantalum Capacitors 134

"Techniques," vol. 59, No. 2, is a one-page bulletin describing the potentials of solid tantalum capacitors. Included in the bulletin are graphs on typical characteristics of these capacitors. Astron Corp., 255 Grant Ave., East Newark, N.J.

Subminiature Connectors 135

These catalog sheets contain specifications and dimensional drawings of the SMI-CSL series subminiature precision connectors. Among the connectors featured are hermetically sealed and screw-locking types. U.S. Components, Inc., 454 E. 148th St., New York 55, N.Y.

Delay Lines 136

Design of distributed-parameter delay elements through use of delay-line flats is described in bulletin No. 29. Electrical characteristics, delay-impedance chart and details of construction are included in this one-page bulletin. Columbia Technical Corp., 6102 31st Ave., Woodside 77, N.Y.

Pulse Generator 137

A precision pulse generator for calibration of single and multi-channel pulse height analyzers is described in one-page 3020-9 form. Performance and specification data are given. Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, Ohio.

Form Printer 139

Technical details of a form printer that prints electronically controlled data on pre-printed forms are presented in this 10-page brochure, No. S-112. Applications include recording automatic checkout data, logging instrumentation data and recording quality control reports. Electronics Div., Clary Corp., 408 Junipero St., San Gabriel, Calif.

Control Cable 140

Physical and electrical properties, application and construction of a thermoplastic control cable with polyethylene insulation and double Densheath jacket are given in DM 5844 bulletin. Anaconda Wire and Cable Co., Dept. EFL, 25 Broadway, New York 4, N.Y.

Capacitor Catalog 141

General and technical information on subminiature electrolytic capacitors is given in this six-page catalog, "Subminiature Electrolytic Capacitors." Illinois Condenser Co., 1616 North Throop St., Chicago 22, Ill.

Environmental Test Equipment 142

Environmental test equipment is described in catalog No. E9, 20 pages. Included in the illustrated brochure are engineering data, and material on the firm's trop-arctic test chambers, dimensional information, and a description of the components used. American-Marietta Co., Guardite Div., Wheeling, Ill.

Signal Generators 143

Signal generator type 225-A, frequency range 10 to 500 mc, signal generator type 202-G, frequency range 195 to 270 mc, and signal generator calibrator type 245-C, frequency range 500 kc to 1000 mc are described in this four-page brochure. Boonton Radio Corp., Boonton, N.J.

Plastics 144

Pocket-sized four-page booklet compares properties and industrial applications of 13 major plastic families. Included are acrylic, Teflon, polyethylene, butyrate, styrene and phenolic. Cadillac Plastic & Chemical Co., 1511 Second Ave., Detroit 3, Mich.

NEW LITERATURE

Wire Stitcher 148

Bulletin A-128, one page, describes retainer rings formed and assembled in one operation with wire stitcher. Retainer rings are used on potentiometer shafts, ceramic resistor terminals and motor brush leads. Ideal Stitcher Co., 2323 N. Knox Ave., Chicago 39, Ill.

Impedance Bridge 149

Four-page bulletin describes portable impedance bridge for measurement of resistance, inductance, and capacitance. Bridge has accuracy of 1% and can measure components with Q's as low as 0.02. General Radio Co., West Concord, Mass.

Industrial Hand Tools 150

Precision industrial hand tools are covered in this 12-page catalog. Among the items described are knives; the Lock-GriPlier, a device designed for use in fine soldering, crimping and positioning; and a variety of hand drill-pin vises and other tools. Handicraft Tools, Inc., 48-41 Van Dam St., Long Island City 1, N.Y.

Fiberglass Tubing

Four-page illustrated brochure describes the firm's polytube, a class B polyester varnished fiberglass tubing. Technical data is given on the heat stability, chemical resistance, flexibility, sizes and uses of this tubing. *Write on company letterhead to: L. Frank Markel & Sons, Dept. ED, Norristown, Pa.*

Diodes 151

One-sheet Short Form Catalog contains basic information on diodes and rectifiers, including high-voltage rectifiers, double anode diodes, and solid tantalum capacitors. U.S. Semiconductor Products, Inc., 3540 W. Osborn Rd., Phoenix, Ariz.

Devices Catalog 152

Miniature test equipment for electrical appliance and electronic servicing, as well as accessory components and equipment, are illustrated and described in catalog JBB. Industrial Devices, Inc., 982 River Rd., Edgewater, N.J.

Magnetic Tape Instrumentation 154

Catalog DC-3171, 24 pages, describes a multichannel magnetic tape system for laboratories, test cells and telemetering recording. Performance specifications are given for transports, fm pdm, direct and digital tracks. Minneapolis-Honeywell Regulator Co., 10721 Hanna St., Beltsville, Md.

Circuit Breaker Catalog 155

Mounting and performance data of circuit breakers made by this firm are given in this illustrated, 32-page catalog. Mechanical Products, Inc., 1824 River St., Jackson, Mich.

Transistors 156

Maximum power dissipation is discussed in this four-page bulletin. Methods of determining the maximum power which may be dissipated by a transistor and its effect on circuit considerations are illustrated. Included are power derating, collector characteristic, and transistor dissipation curves. Valor Instruments, Inc., 13214 Crenshaw Blvd., Gardena, Calif.

Heating Element Catalog 157

A film-type, sprayed-on heating element for hard-to-heat contour surfaces is described in 12-page catalog, No. HB-3-359. Included are physical, electrical and thermal characteristics, charts and graphs on protective coatings and insulation and temperature rise vs. time. Electrofilm, Inc., P.O. Box 106, North Hollywood, Calif.

Signaling Controller 158

Four-page catalog gives specifications and dimensions of the Thermo Electronic signaling controller. It may be used for automatic control of industrial processes. Thermo Electric Co., Inc., Saddle Brook, N.J.

Thermostats 159

Two-page bulletin 6100 describes hermetically sealed and semi-enclosed bimetal disc thermostats. Included are ratings, construction details, dimensions and terminal arrangements. Stevens Manufacturing Co., Inc., P.O. Box 1007, Mansfield, Ohio.

NEW LITERATURE

Thermistor Calculator

The "Thermistor Data and Curve Computer" simplifies design work with thermistors and reduces computations to a single sliderule setting. Users first select the thermistor shape desired and its resistance at 25 C. Then it is possible to read resistance directly opposite all temperature points on the curve of the appropriate thermistor. *Send $1.00 to Fenwal Electronics, Inc., Dept. ED, Mellen St., Framingham, Mass.*

Electric Wave Filters 163

Bulletin No. EWF/59-1, eight pages, shows schematics and typical transmission curves for basic LC and crystal filters. Bandpass, band-elimination, lowpass and highpass filters are described, and information needed for their design is given. Typical transmission response curves are included for filters of each type. Dynamics Corp. of America, Reeves-Hoffman Div., Carlisle, Pa.

Counters 164

Mechanical and magnetic counters are covered in this four-page condensed catalog. Pictures, physical dimensions, mechanical, and electrical characteristics are given. Veeder-Root Inc., Hartford 2, Conn.

Bimetal Thermostats 165

Four-page illustrated bulletin 8400 describes 19 major types of bimetal thermostats. It gives condensed technical data, operating ranges and ratings, and illustrations of the major types. Optional mountings, terminal arrangements and over-all dimensions are also given. Stevens Mfg. Co., P.O. Box 1007, Mansfield, Ohio.

Rhodium Electroplating 166

Illustrated, 20-page booklet "Rhodium Electroplating Processes" describes when, where and how to use rhodium electroplate to improve product performance and reliability in electrical and electronic applications. Included are charts and graphs of physical and electrical properties of this metal. Sel-Rex Corp., Nutley, N.J.

Indicator Lights 167

Eight-page illustrated brochure L-160A describes ultra-miniature indicator lights for use in data-processing equipment, computers, and automation applications. Electrical, physical and dimensional data are given for indicator lights with replaceable and unreplaceable lamps. Dialight Corp., 60 Stewart Ave., Brooklyn 37, N. Y.

Battery Chargers 170

Four-page brochure 5845 gives instructions on operation and maintenance of the firm's line of vertical motor-generator chargers for electric industrial truck batteries and other motive power applications. Wiring diagrams are included. Electric Storage Battery Co., Exide Industrial Div., Rising Sun and Adams Aves., Philadelphia 20, Pa.

Instruments Catalog 171

Bulletin 1310, 16 pages, describes the firm's line of dynamic-measuring and recording instruments including oscillographs, data amplifiers and bridge balances, vibration measuring equipment, and power supplies. A summary of specifications for galvanometers is also included. Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif.

Metal Film Resistors 172

Four-page brochure 155D gives physical, electrical and dimensional data on the company's line of series 77 metal film precision resistors. Included is information on the equivalent styles under military specs MIL-R-10509C and MIL-R-19074B. Ohmite Mfg. Co., 3629 Howard St., Skokie, Ill.

Transducers

This 32-page illustrated brochure 1000 SD 6 describes three basic force balance pressure transducers: static pressure, pressure ratio, and pressure difference. Detailed physical and mechanical information is given, including system schematics and graphs. Descriptions of some of the major transducer applications are also given. *Write on company stationery to M. Ten Bosch, Inc., Dept. ED, Pleasantville, N.Y.*

Chopper Catalog 173

Instrument chopper catalog, eight pages, gives a complete glossary of chopper terms, and component electrical and physical specifications. Also included are technical descriptions of chopper test and evaluation equipment. James Vibrapowr Co., 4050 N. Rockwell St., Chicago 18, Ill.

Components Catalog 174

Catalog 30, 32 pages, gives illustrations and electrical and physical data on a variety of electrical components. Included are rheostats, potentiometers, composition resistors, fixed resistors, general purpose relays, variable transformers, tap switches, chokes, and capacitors. Ohmite Mfg. Co., 3630 Howard St., Skokie, Ill.

NEW LITERATURE

Rotary Switches 179

Rotary selector switches with wafers that lift out instantly are described in these four two-page catalog sheets. Each sheet gives dimensional drawings, illustrates and describes a different size switch and provides details on construction. Chicago Dynamic Industries, Inc., Precision Products Div., 1725 Diversey Blvd., Chicago 14, Ill.

Transistor Chart 180

This two-page revised transistor chart lists typical operation, maximum ratings and primary applications of all production transistors. Included are specifications on high power, low power, and military type transistors. Bendix Aviation Corp., Semiconductor Products, Long Branch, N.J.

Cathode-Ray Tube Catalog 181

Six-page short form tube catalog gives physical characteristics, maximum electrical ratings, and typical operating conditions of the firm's standard cathode-ray tubes. Tubes are indexed for easy selection of correct sockets and connectors. Allen B. Du Mont Labs., Inc., Electronic Tube Div. Sales Dept., 750 Bloomfield Ave., Clifton, N.J.

Potentiometer 182

Two-page data sheet 22 covers electrical and mechanical specifications, design benefits, and general application information on the firm's series 4 ac potentiometer. Also included are basic differences between models of this series. Perkin-Elmer Corp., Norwalk, Conn.

Ultrasonic Switches

Ultrasonic Liquid Level Switches, 42 pages, provides information on the theory of operation of ultrasonic switches. Included are drawings and diagrams and a catalog section listing available probes and control units. Applications are described in detail, including those in the missile, aircraft, and nuclear fields. *Write on company letterhead to Acoustica Associates, Dept. ED, 100 Fairchild Court, Plainview, N.J.*

Picture Tube Guides 183

Wall-size television picture tube comparison chart and a pocket picture tube selector guide list the physical and electrical characteristics of over 350 types of picture tubes. Included are basic diagrams of all picture tubes listed. Sylvania Electric Products Inc., 1100 Main St., Buffalo, N.Y.

Miniature Screws

"Precision Miniature Screws," a four-page illustrated catalog, describes a large number of miniature machine screws in all head styles and a variety of metals. Sizes included are 0-80, 1-72, 1-64, 00-90 and 00-96. Lengths range from 1/16 to 1-1/2 in. Also included in a table of screw dimensions. *Write on company letterhead to Hardware Specialty Co., Inc., Dept. ED, 479 Washington St., New York 13, N.Y.*

Semiconductor Alloy Kit 186

One-page bulletin Z-100 describes a semiconductor alloy kit. The kit offers 24 different alloys with melting points in the range of 325 F to 1100 F for use in developing new devices or evaluating new processes. The alloys described are in the form of discs, washers, and spheres, and include indium, kovar, indium-germanium, and aluminum. Accurate Specialties Co., Inc., 37-11 57 St., Woodside 77, N.Y.

Time Recorders 187

This four-page illustrated brochure describes the Firm's line of modular time and event recorders for data printing. Included are a wide range of alpha-numeric printers and digital read-out systems. Also given are tables showing the large number of standard combinations possible using standard counters and time units. American Electronics, Inc., American Data Div., 75 Front St., Brooklyn 1, N.Y.

Timing Devices 188

Four-page brochure BX 265 gives a capsule review of mechanical timers, time switches and time-delayed relays, listing uses and typical assignments. Included are illustrations and cut-away photos. M. H. Rhodes, Inc., 30 Bartholomew Ave., Hartford 6, Conn.

Analyzers 189

One-page brochure "Let's Analyze the Situation" gives latest information on the firm's commercially available multi-channel analyzers. Included in this information sheet is data on the firm's 400 channel analyzer model 34-9. Radiation Instrument Development Lab., Inc., 5737 S. Halsted St., Chicago 21, Ill.

Electrolytic Capacitors 190

Two-page bulletin 152D describes series TF tantalum foil electrolytic capacitors. Included are electrical and dimensional specifications, and MIL-C-3965B performance test results. Ohmite Mfg. Co., 3634 Howard St., Skokie, Ill.

NEW PRODUCTS

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

Meter Relay Reads Past Set Point

The moving pointer on this CR meter relay shows the signal level even when the set point has been passed and control circuits energized. When the pointer reaches the set point, a set of contacts closes and pulls a surge of current through the meter. This adds enough torque to the pointer to cause it to snap a toggle switch which keeps the load energized. The pointer then moves freely; it reverses the toggle switch when it moves in the opposite direction.

Assembly Products Inc., Dept. ED, 75 Wilson Mills Rd., Chesterland, Ohio.
Booth 3101-3103

CIRCLE 192 ON READER-SERVICE CARD

Multimeter Has Low Power Drain

This volt and current meter, model 1477, drains essentially 0 w from the source being measured. It measures and amplifies dc currents and voltages ranging from 10 to 1000 μamp and from 1 to 1000 mv. The unit's power gain is sufficient to supply 1 ma output to drive its own indicating meter and any external load of 5 K or less. Long-time drift can be maintained to less than 2 μv after a few minutes warm-up time.

Daystrom, Inc., Weston Instruments Div., Dept. ED, 614 Frelinghuysen Ave., Newark 12, N. J.
Booth 3203-3205

CIRCLE 193 ON READER-SERVICE CARD

Wire Ignites at 650 C

When heated to about 650 C, this wire ignites explosively and reaches a temperature near 2000 C. Suited to many applications including fuze or detonator devices, the wire has a resistivity of 65 ohms per cmf at 25 C. The wire consists of two separate metals between which an exothermic alloying reaction takes place.

Sigmund Cohn Corp., Dept. ED, 121 S. Columbus Ave., Mount Vernon, N. Y.
Booth 3406

CIRCLE 194 ON READER-SERVICE CARD

Bridge Tests Tubes and Transistors

Having an amplification factor range of 0.001 to 10,000, the type 1661-A direct reading bridge measures both the low frequency dynamic coefficients of tubes and transistors. It is designed to operate in the 270 to 400 or 1000 cps range and makes use of ac null measurement techniques. Independent vacuum tube measurements can be made on forward and reverse voltage amplification factor, and resistance and transconductance. The bridge also determines the short circuit conductance parameters.

General Radio Co., 22 Baker Ave., Dept. ED, W. Concord, Mass.
Booth 2015-2016

CIRCLE 195 ON READER-SERVICE CARD

Trimmer Has Wide Range of Capacity Per Unit

These trimmer capacitors achieve a wide range of capacity per unit by laminating an electrode band of metallized silver onto a thin high-dielectric-constant precision-bore glass cylinder. This provides 300% more capacity per cm^2 of dielectric surface over conventional heavier wall cylinders. A typical Max-C capacitor 1 in. long by 3/8 in. in diam has a 60 μμf range. Models are available for mounting on panels and printed circuit boards.

JFD Electronics Corp., Dept. ED, 1462-62nd St., Brooklyn 4, N. Y.
Booth 202

CIRCLE 196 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Magnet Wire

Available in 51 AWG

Celenamel cellulose acetate film coated magnet wire is available in 51 AWG. Constructed of electrolytically pure copper wire, it solders at 650 to 700 F. Its diameter is 0.00088 in. before application of the insulation. This wire meets NEMA specs and has a nominal resistance of 13.39 ohms per ft at 20 C, with a resistance tolerance of ±8%.

Belden Manufacturing Co., Dept. ED, 415 S. Kilpatrick, Chicago 44, Ill.

Booth 615-617

CIRCLE 199 ON READER-SERVICE CARD

Rack and Panel Connectors

Available in 50 and 100 position units

These rack and panel connectors are available in 50 and 100 position units. The shells are polarized for positive correct mating under all conditions. Solderless contacts are protected against damage by extended alignment skirts on the shells and by bushings which line up the receptacle and plug.

AMP Inc., Capitron Div., Dept. ED, 155 Park St., Elizabethtown, Pa.

Booth 2502

CIRCLE 200 ON READER-SERVICE CARD

High Voltage Power Supply

Produces 16 kv dc at 200 μa

Model PS-28 high voltage power supply produces 16 kv dc at 200 μa from 26.5 v dc 650 ma nominal input. Conversion is through a mechanical vibrator, transformer and voltage doubler. It is housed in a die-cast aluminum case measuring 4-7/8 x 6-3/8 x 6-7/8 in. and weighs 8 lb. The unit meets military specs and operates at ambient temperatures from −65 to +125 F.

Southwestern Industrial Electronics Co., Dept. ED, 10201 Westheimer Rd., Houston, Tex.

Booth 420-422

CIRCLE 201 ON READER-SERVICE CARD

◀ CIRCLE 198 ON READER-SERVICE CAR

Rotary Switch

Handles up to 48 circuits

Type R-8 rotary switch allows up to 48 separate circuits to be switched. It uses a six section configuration. Contact rating at 28 v dc or 115 v ac is: continuous, 25 amp; resistive, 25 amp; inductive, 15 amp; overload, 50 amp. Maximum switching per section is: one pole, for eight positions, eight circuits; two poles, for four positions, eight circuits. Torque needed to operate the switch is 2 lb-in.

Standard Electrical Products Co., Dept. ED, Costa Mesa, Calif.
Booth 3321-3323

CIRCLE 202 ON READER-SERVICE CARD

Panel Switch

Is pushbutton type

This solenoid-held lighted pushbutton panel switch is used on control panels which require an electrical interlock system. It consists of four parts: a pushbutton which is made of colored plastic, an illumination source consisting of two 6 or 28 v lamps, a double-pole 5 amp switch, and a solenoid integral with the pushbutton mechanism. The unit requires one square inch of panel space.

Electrosnap Corp., Dept. ED, 4218 W. Lake St., Chicago 24, Ill.
Booth 121-123

CIRCLE 203 ON READER-SERVICE CARD

Transformer

"Do it yourself" type

The Flexiformer packaged transformer primary makes stocking of many fixed-ratio transformers unnecessary. It is a self-contained toroidal primary coil consisting of a strip-wound silicon steel core having a coil of 400 turns of No. 24 B&S gage copper wire. When used as a source of ac voltage, the proper number of secondary winding turns are threaded through the center opening to obtain the desired output voltage. Input rating is 120 v, 50/60 cps, and output is 150 va.

Superior Electric Co., Dept. ED, 83 Laurel St., Bristol, Conn.
Booth 603-605

CIRCLE 204 ON READER-SERVICE CARD

CIRCLE 205 ON READER-SERVICE CARD ➤

NEW PRODUCTS AT WESCON

Double Pulse Generator

Has output of 50 v max

Model 3352 pulse generator produces a pulse coincident with the prepulse and an identical additional pulse delayed by an accurately known time interval. Pulse repetition frequency ranges from 0.95 cps to 3 mc without duty cycle limitations. Minimum pulse width is 90 mμsec; rise time is 10 mμsec from 75 ohm source. Maximum output is 50 v from 1 K.

Marconi Instruments, Dept. ED, 111 Cedar Lane, Englewood, N.J. *Booth 314-316*

CIRCLE 206 ON READER-SERVICE CARD

Digital Read-Out

Projects any character or image

The Digilite in-line digital read-out can project any character or image that can be reproduced on film. Its case measures 1 x 1-1/2 x 5 in. Lamps may be replaced from the front of the unit.

Electrosnap Corp., Dept. ED, 4218 W. Lake St., Chicago 24, Ill. *Booth 121-123*

CIRCLE 207 ON READER-SERVICE CARD

Panel Meters

Ammeters, voltmeters

These panel meters have molded Bakelite bases, lance type pointers, 4-in. 100 deg arc scales, and a self-shielding mechanism which permits instrument mountings on magnetic panels without need of special adjustments. Model 1751 dc instruments (ammeters, milliammeters, microammeters and voltmeters) have an accuracy within ±2% of full scale. Model 1752 ac instruments (milliammeters, microammeters, and voltmeters) have an accuracy within ±3% of full scale. Dc ranges are 50 μa to 10 amp; ac ranges are 200 μa to 5 ma and up to 300 v. They measure 4-5/8 x 4-1/8 x 1-3/4 in.

Daystrom, Inc., Weston Instruments Div., Dept. ED, 614 Frelinghuysen Ave., Newark 12, N.J. *Booth 3203-3205*

CIRCLE 208 ON READER-SERVICE CARD

◀ CIRCLE 209 ON READER-SERVICE CARD

Calibrators

For ac or dc instruments

The model 60 series of ac and dc calibrators provide power source, circuitry, and control for design, development, and service calibration. Four consoles are available. Ranges from 0.75 to 1500 v can be calibrated by the model 63 ac voltmeter calibrator and from 1 to 50 amp by the model 62 ac ammeter calibrator. Ranges from 1.5 to 750 v, 1.5 to 30 ma and μa can be calibrated by the dc voltmeter calibrator model 64. Model 65 dc ammeter calibrator is used over ranges from 0.75 to 30 amp. All have an accuracy of 0.05% over the temperature range of 40 to 100 F, and measure 30-3/4 x 21-1/2 x 19-1/8 in.

Daystrom, Inc., Weston Instruments Div., Dept. ED, 614 Frelinghuysen Ave., Newark 12, N.J.
Booth 3203-3205

CIRCLE 210 ON READER-SERVICE CARD

Feed-Through Terminal

Has test-clip end

Model FT-2010 ML press-fit feedthrough terminal has beryllium-copper clip end. The Teflon insulator body provides a voltage breakdown rating of 11,000 v dc. This one-piece terminal presses into the given hole without need of screws, nuts, or washers.

Sealectro Corp., Dept. ED, 139 Hoyt St., Mamaroneck, N.Y.
Booth 1421

CIRCLE 211 ON READER-SERVICE CARD

Saucer Fan

With matched filter box

This saucer fan is 1-5/8 in. deep and delivers 260 cfm. It is available with a matched filter box with a media P96A high velocity viscous impingement type filter. The frame and filter form a one-piece assembly which may be removed for cleaning. The unit is mounted by using the through holes located 8-3/4 in. apart at the four corners.

Rotron Manufacturing Co., Dept. ED, Woodstock, N.Y.
Booth 2810-2812

CIRCLE 212 ON READER-SERVICE CARD

CIRCLE 213 ON READER-SERVICE CARD ➤

NEW PRODUCTS AT WESCON

Miniature Fan

Produces 45 cfm at 17,000 rpm

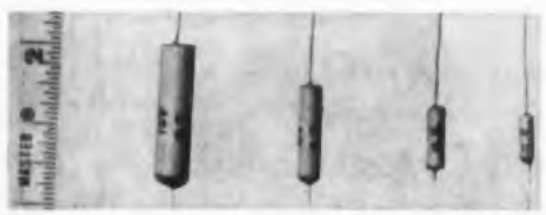
Model F2-17 miniaturized fan produces 45 cfm of air at 17,000 rpm. Powered by a 28 v dc motor, it is designed for electronic or avionic applications. It measures less than 2 in. in diam and 2 in. in length.

Western Gear Corp., Electro Products Div., Dept. ED, 12 W. Colorado Blvd., Pasadena, Calif.
Booth 2915-2917

CIRCLE 215 ON READER-SERVICE CARD

Tantalum Electrolytic Capacitors

Come in four case sizes



These wet slug tantalum electrolytic capacitors come in four case sizes ranging from 0.005 to 0.225 in. in diam and 0.312 to 0.875 in. long. Ratings are from 2 to 325 μf and 6 to 60 v dc. They meet the electrical and environmental characteristics of MIL-C-3965B. They are capable of at least 2000 hr of operation from −55 to +85 C and will sustain vibration up to 15 g at 2000 cps.

General Electric Co., Dept. ED, Schenectady 5, N. Y.
Booth 3118-3120

CIRCLE 216 ON READER-SERVICE CARD

Midget Toggle Switch

Has spst contacts

Having spst contacts, the type T4201 toggle switch may be capped with rubber boot for added protection against moisture. This unit is designated T4202. The switch is rated for 1 amp at 28 v dc resistive load at sea level. Its overall length is 57/64 in. and the case diameter is 21/64 in. The panel mounting hole is 1/4 in.

Hetherington Inc., Dept. ED, 1420 Delmar Dr., Folcroft, Penn.
Booth 304

CIRCLE 217 ON READER-SERVICE CARD

Toroidal Inductors

Weigh 0.06 oz

Model MT 34 toroidal inductors are available with inductances up to 500 mh for frequencies up to 30 kc. Model MT 35 inductors can be supplied with inductances up to 200 mh for frequencies up to 200 kc. MT 34 has a Q of more than 55 at 25 kc; MT 35 has a Q of more than 60 at 100 kc. The MT 34 is 0.281 in. long, with an OD of 0.437 in., and weighs 0.06 oz.

Burnell and Co., Dept. ED, 720 Mission St., S. Pasadena, Calif.
Booth 404

CIRCLE 218 ON READER-SERVICE CARD

Power Transistor

Meets military specs

Germanium pnp power transistor 2N297A meets military mechanical, environmental and electrical tests. V_{CB} is 60 v dc; V_{EB} is 40 v dc. The operating temperature range is —65 to +95 C. Collector power at 75 C is 10 w.

Motorola, Inc., Semiconductor Products Div., Dept. ED, 5005 E. McDowell Rd., Phoenix, Ariz.
Booth 3615-3617

CIRCLE 219 ON READER-SERVICE CARD

Gain Set

Measures gain, loss, or swr

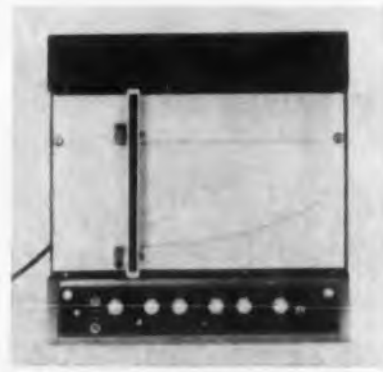
This gain set allows for precise measurement of gain, loss, swr or other properties of a microwave system from as low as 0.025 to 95 db. It consists of four components placed on separate rack panels. Preamplifier 621-A has an insertion gain adjustable between 45 and 50 db; input and output impedances are 70 ohms. Attenuator 622-A has attenuation steps of 1, 2, 3, 5, 10, and 20 db. Amplifier-detector 623-A has vswr of 1 db max. Power supply 624-A uses an input of 170 w, 117 v ac ±10%, 60 cps. The gain set has center frequencies of 30, 60, and 70 mc; bandwidth is 1.5 to 2.0 mc at 3 db down. Input impedance is 70 ohms; input vswr is 1 db.

Kay Electric Co., Dept. ED, Maple Ave., Pine Brook, N.J.
Booth 3114-3116

CIRCLE 220 ON READER-SERVICE CARD

CIRCLE 221 ON READER-SERVICE CARD ➤

NEW PRODUCTS AT WESCON



Recorder

Plots two functions

Model 4B Autograf, a two-pen two-axis graphic recorder, is designed for standard rack mounting. From dc signals, it plots two functions of "x" simultaneously. When the time base feature is used, it plots two functions of "t" simultaneously. The two pens mounted on the cross arm each travel full scale in the vertical axis, Y, while being driven simultaneously in the X direction. They are separated by about 0.1 in. in the X direction. A built-in sweep circuit provides the time base feature in the X axis. Paper size is 11 x 27 in. or 8.5 x 11 in.

F. L. Moseley Co., Dept. ED, 409 N. Fair Oaks Ave., Pasadena, Calif.

Booth 1414-1415

CIRCLE 223 ON READER-SERVICE CARD

Noise Source

Range is 0.5 to 1000 mc

This noise generator, called the Therma-Node, covers the frequency range of 0.5 to 1000 mc. The unit is accurate to ±0.1 db. Noise is generated by heating a resistive element to produce a constant controlled temperature. At this temperature, sufficient noise is generated to accommodate noise figure measurements up to 10 db. Noise temperature can be read to 2% accuracy. The fixed tuning range is from 0.5 to 500 mc and the variable tuning range is 0.5 to 1000 mc. The unit, which is portable, operates on either a 24 v battery or on 117 v ac.

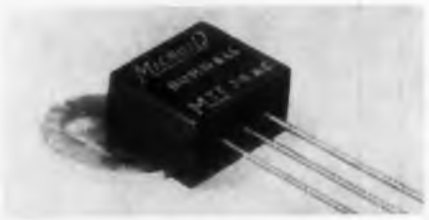
Kay Electric Co., Dept. ED, Maple Ave., Pine Brook, N. J.

Booth 3114-3116

CIRCLE 224 ON READER-SERVICE CARD

Microminiature Filters

Designed for transistor circuits



Engineered for transistor circuits, the type MTT Microid bandpass filter has a range of 7.35 to 100 kc. Its bandwidth is 15% at 3 db and 40 to 60% at 40 db. The unit measures 1/2 x 19/32 x 15/16 in. and weighs 0.3 oz. Fully encapsulated, the filter exceeds applicable Mil specs.

Burnell & Co., Dept. ED, 10 Pelham Pkwy., New York, N. Y.

Booth 404

CIRCLE 226 ON READER-SERVICE CARD

Wirewound Resistor

Has tolerance of 0.01%

Available in temperature coefficients of resistance as low as ±2 ppm per deg C and a tolerance of 0.01%, the R-10 miniature resistor exceeds MIL-R-93B and MIL-R-9444 performance specifications. It comes in a resistance range of 0.1 to 750 ohms, a power rating of 1/3 w and a maximum operating voltage of 500 v dc. This resistor has no bobbin; the resistive element floats in a special viscose fluid. It is ideal for computer and military applications.

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

Booth 3421-3423

CIRCLE 227 ON READER-SERVICE CARD

Voltage Regulator

Operates on 115 and 230 v

This automatic line-voltage regulator for military uses has a 6 kva power capacity. Two models, 115 and 230 v, are available for either ±10% or ±20% correction ranges. Output is held constant up to 1/4% accuracy without waveform distortion. The unit is unaffected by frequency deviations and delivers a fast 10 v per sec response.

Standard Electrical Products Co., Dept. ED, 2240 E. Third St., Dayton, Ohio.

Booth 3321-3323

CIRCLE 228 ON READER-SERVICE CARD

CIRCLE 230 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Tetrode Transistors

Have many uses

These two germanium tetrode transistors, 3N36 and 3N37, are designed for use as wideband rf amplifiers, radar if amplifiers and high frequency mixers and oscillators. The first has an operating range of 30 to 100 mc and the second operates in the range from 100 to 300 mc. Both transistors are capable of attaining maximum gain at power levels as low as 5 mw.

General Electric Co., Semiconductor Products Dept., Dept. ED, Liverpool, N. Y.
Booth 208-210

CIRCLE 231 ON READER-SERVICE CARD

Amplifier

Has all-transistor circuits

Having all-transistor circuit modules, the model CV-HZA high input impedance amplifier handles high voltage inputs and functions as a direct-coupled voltage follower. Its voltage gain is unity. Used as an insolation amplifier, the unit permits precise voltage measurements without disturbing the signal source.

Adage Inc., Dept. ED, 292 Main St., Cambridge 42, Mass.
Booth 418

CIRCLE 232 ON READER-SERVICE CARD

Carbon Deposited Resistors

Two precision types available

Designated CPC 1/8 RN60B, this ceramic encased 1/8 w Carbofilm precision resistor meets and exceeds the requirements of MIL-R-10509C. It is designed for severe environmental conditions. The type CP 1/4 unit, shown above, is designed for applications where size is an important consideration. It is 7/16 in. long and has a diameter of 0.093 in. It is coated for protection against handling and environmental conditions.

Aerovox Corp., Hi-Q Div., Dept. ED, Olean, N. Y.
Booth 306

CIRCLE 233 ON READER-SERVICE CARD

Telephone Type Relay

Designed for ac operation

Designated class 66A, this medium size telephone type relay was engineered for 60 cps operation. Shaded pole construction and a short operating arm to armature ratio is used for maximum contact pressures.

Magnecraft Electric Co., Dept. ED, 3350 W. Grand Ave., Chicago 51, Ill.
Booth 1422

CIRCLE 234 ON READER-SERVICE CARD

CIRCLE 235 ON READER-SERVICE CARD

Q Meter

Range is 1 kc to 300 mc

Model 1245 Q meter has a measurement range of from 1 kc to 300 mc. External oscillators are available to drive the meter at frequencies above 40 kc; below 40 kc almost any audio oscillator can be used as a driving source. The Q measurement range is from 4 to 1000 Q. Accuracy to 100 mc is ±5%.

Marconi Instruments, Dept. ED, 111 Cedar Lane, Englewood, N.J.
Booth 314-316

CIRCLE 236 ON READER-SERVICE CARD

Image Orthicon

For color and black-and-white TV

This image orthicon provides high-quality performance for color and black-and-white television cameras. Precision construction of this tube, RCA-7513, includes accurate alignment of each section of the tube with respect to the tube axis and maintenance of a high degree of uniformity for the location of all electrodes and interelectrode spacings. The three images produced within a color camera are practically identical as a result of this precise construction.

Radio Corporation of America, Electron Tube Div., Dept. ED, 415 Fifth St. S., Harrison, N.J.
Booth 507-509

CIRCLE 237 ON READER-SERVICE CARD

Parametric Amplifier Diode

Cut-off frequency is 70,000 mc

This parametric amplifier diode has a cut-off frequency of 70,000 mc and is available in two hermetically sealed versions. Model HPA-2800 is glass-enclosed with pigtail leads; model HPA-2810 is microwave packaged with styrene sleeves. This diode operates in the frequency range below 1000 mc and up to S-band frequencies.

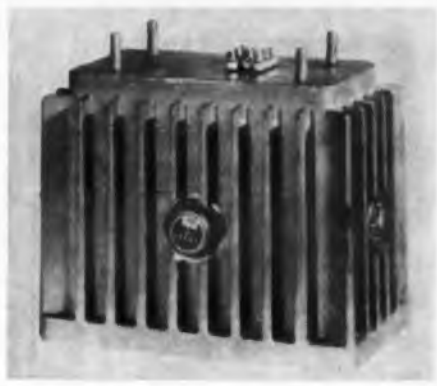
Hughes Aircraft Co., Hughes Products Div., Dept. ED, International Airport Sta., P.O. Box 90427, Los Angeles 45, Calif.
Booth 3016-3018

CIRCLE 238 ON READER-SERVICE CARD

NEW PRODUCTS

Power Supplies

Deliver 30 w



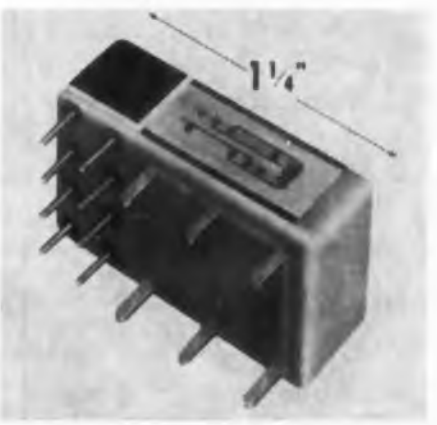
The SE series power supplies deliver 30 w with germanium transistors. Rated at 12 v from 0 to 3 amp continuous duty, the units have a voltage regulation of ±0.1% for both line and load. Ripple is 2 mv peak to peak and the units can be operated for moderate periods without cooling at ambients of 105 F. Immersion-proof, the units weigh about 6 lb and measure 4-1/4 x 7 x 6 in.

Mid-Eastern Electronics, Inc., Dept. ED, 32 Commerce St., Springfield, N. J.

CIRCLE 240 ON READER-SERVICE CARD

Miniature Relay

For printed circuits



Measuring 1.25 in. long and 0.5 in. high, this relay is epoxy potted and has side mounting for printed circuit applications. It operates in temperatures from −65 to +125 C and will stand shocks of 100 g, linear acceleration of 100 g, and vibration of 25 g over a 5 to 2000 cps frequency range. Standard units meet MIL-R-5757C and MIL-R-25018. Pull-in time is 7.5 msec max under nominal voltage and drop out time is 4 msec max. Contact rating is 2 amp resistive, non-inductive, at 26.5 v dc. Coil ratings are from 4.3 to 108 v dc.

Electronic Components, subsidiary of Telecomputing Corp., Dept. ED, 12838 Saticoy St., North Hollywood, Calif.

CIRCLE 241 ON READER-SERVICE CARD

CANNON PLUGS

Schweber

FOR IMMEDIATE LARGE QUANTITY DELIVERY AT FACTORY PRICES

2500

Yes! You can now order up to 2500 each of such popular Cannon Connector types as Miniature D, KO, DPD, DPA, DPX, etc. Immediate shipment at factory prices.

Schweber ELECTRONICS

60 HERRICKS ROAD, MINEOLA, L.I., N.Y.
PIONEER 6-6520 TWX G-CY-NY-580

CIRCLE 242 ON READER-SERVICE CARD

NEW

CANNON PLUGS

For greatest reliability in the hot spots

NEW HR SERIES

1000°F continuous duty type

The most advanced design to protect against extreme heat, nuclear radiation and moisture formation. Moistureproofing on these connectors is accomplished by means of ball cone seals on mating surfaces. Available in production quantities in wide range of MS-type shell styles and sizes. Two to 24 contacts per shell. Wide variety of insert patterns that mate with standard MS types. A modification of the HR series, rated at 650°F continuous duty, is also available.

Write today for Technical Bulletin T-111

NEW KE SERIES

Moisture-resistant firewall type

First plug to satisfy both high-temperature requirements for fireproof Class MS-K connector and vibration-proof, moisture-proof requirements of MS-E Class. Meets 2000° flame test specified in MIL-C-5015—stands up under 400°F continuous operation. Fluorinated silicone seals for moisture-proofing improve resistance to oil and skydrol hydraulic fluid. Two basic shell types for conduit and wire bundles. Wide variety of insert arrangements and shell sizes in long and short types.

Write today for Technical Bulletin T-98

27,000 KINDS TO CHOOSE FROM!

Call on Cannon for *all* your plug needs. If we don't have what you want, we'll make it for you—whether you need one or a million. We're ready to help you at any stage—from basic design to volume production—with the largest facilities in the world for plug research, development and manufacturing. Write us today about your problem. Please refer to Dept. 404.

CANNON PLUGS
CANNON ELECTRIC COMPANY
3208 Humboldt Street, Los Angeles 31, California

Where Reliability for YOUR Product is Our Constant Goal.

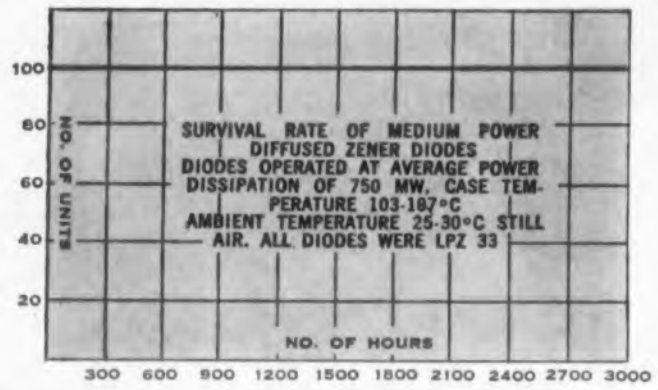
Factories in Los Angeles; Salem, Mass.; Toronto; London; Melbourne; Paris; Tokyo. Representatives and distributors in all principal cities. Please see your Telephone Yellow Book or write factory.

CIRCLE 243 ON READER-SERVICE CARD

U. S. SEMCOR PROVES HIGHER YIELD ASSURES LOW COST RELIABILITY

Due to the excellence of U. S. Semcor's quality control, the failure rate of diodes is negligible. This high yield makes possible superior reliability combined with lower prices.

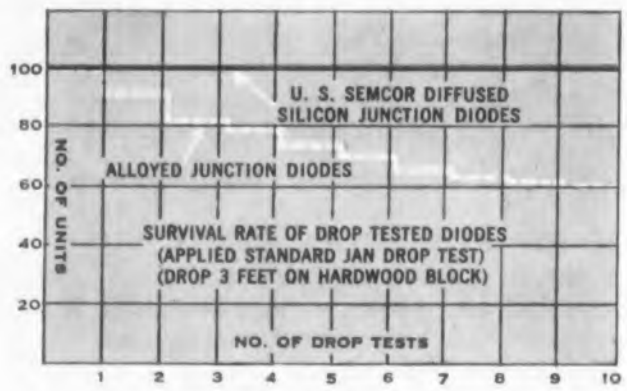
The savings to you are dramatically emphasized by test results. For example: 500 diodes accumulated approximately 2,000,000 hours in tests ranging up to 4,000 hours each of continuous operation . . . with *only 8 failures!* To be specific, observe the graph below, showing results for one group:



It should be noted that throughout the various life and stability tests of axial lead medium power zener diodes, the change in zener voltages was consistently negligible.

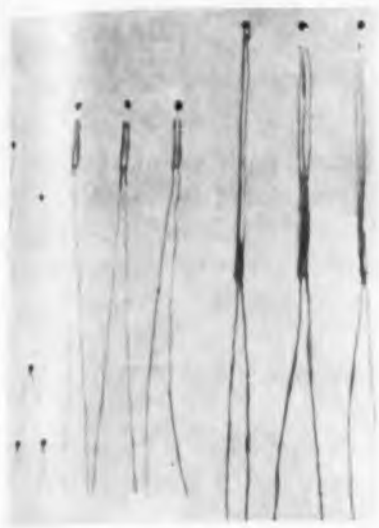
DIFFUSED JUNCTIONS INCREASE MECHANICAL STRENGTH

Much of the reliability long associated with the U. S. Semcor name can be attributed to advanced techniques used in creating diffused silicon junctions. The accompanying graph proves conclusively that diffused junctions—with coefficients of expansion matched to leads and stainless steel cases—are far stronger than other types. They resist vibration and extreme thermal shock.



No *other* zener diodes and rectifiers are as rugged mechanically as those manufactured by U. S. Semcor with diffused silicon junctions!

U. S. SEMICONDUCTOR PRODUCTS, A Division of TOPP Industries, Inc., 3540 W. OSBORN ROAD, PHOENIX, ARIZONA, Phone: BRowning 2-1341



Thermistors

For low temperature use

These lox bead and probe type thermistors are designed to measure and control low temperature liquids. Beads (05A1 and 05A2) are 0.43 in. in diam, and the probes (05A3 and 05A4) are 0.5 x 2 in. Resistance at −195.8 C is 300,000 ohms ±50% and the time constant in liquid nitrogen is less than 1 sec. Dissipation constant at 25 C is 1 mw per deg C in still air and 5 mw per deg C in still water. Temperature coefficient at −195.8 C is about −20% per C.

Victory Engineering Corp., Dept. ED, 519 Springfield Rd., Union, N. J.

CIRCLE 245 ON READER-SERVICE CARD

Reference Voltage Sources

Two models available

Models RVS-100 and RVS-100c reference voltage sources provide precision regulation that is continuously variable from 0 to 600 v in 0.0001 v steps. The units can be used with the firm's electrometer vtvm to null current. Fluctuations in line voltage do not affect the instruments more than 1 part in 10^5 and temperature fluctuations of 10 F have minimum effect on stability. Voltages are set by four output switches controlling 100, 10, 1 and 0.1 v. Model RVS-100c has a temperature regulating circuit to provide drift stability of ±3 parts in 10^5 per day under laboratory conditions.

Cyra Electronics Corp., Dept. ED, 518 N. Spring Ave., LaGrange Park, Ill.

CIRCLE 246 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Miniature Switches

Are pushbutton, snap-action type

Series B7001-B7002 miniature switches are pushbutton, snap-action type. Mounted by means of a 1/4-40 threaded bushing, they have a diameter of 11/32 in. and an overall length of 1-1/64 in. These units handle 2 amp at 28 v dc or 120 v ac with a minimum life of 25,000 operations.

Hetherington Inc., Dept. ED, 1420 Delmar Dr., Folcraft, Pa.
Booth 304

CIRCLE 249 ON READER-SERVICE CARD

Electronic Multiplier

Has accuracy of ±0.05%

Model MC-701 am/fm electronic multiplier has a dynamic accuracy of ±0.05% of full scale at 500 cps. It provides four quadrant multiplication of input variables at frequencies higher than are obtained by other methods. This permits its use in generating functions of two variables and in high speed repetitive operation. Phase shift is less than 1 deg at 500 cps; noise level is less than 30 mv, and drift is less than 50 mv per 8 hr. Its input impedance is more than 1 meg; output impedance is 0.05 ohm.

Computer Systems, Inc., Dept. ED, 611 Broadway, New York 12, N.Y.

CIRCLE 250 ON READER-SERVICE CARD

Cleaning Unit

For electronic components

Small glass cases, such as those used in making diodes, can be cleaned with the model 3077 cleaning machine. The unit has a cleaning capacity of several thousand parts per hour. Parts are placed in glass tanks which contain the cleaning liquid; rinsing and drying is done under partial vacuum. The 600-lb unit measures 5 x 3 x 4.5 ft.

Kahle Engineering Co., Dept. ED, Union City, N. J.

CIRCLE 251 ON READER-SERVICE CARD

◀ CIRCLE 248 ON READER-SERVICE CARD

Mercury Switch

Makes contact with tilted 10 deg

Type UZW mercury switch when tilted 10 deg in one direction, controls mercury flow in such a way that a momentary contact is produced. There is no contact upon return to original position. A number of circuit arrangments are offered, for example, two wipe contacts and two make-or-break contacts may be incorporated into a single switch. A standard switch is less than 2-3/4 in. long, less than 1/2 in. in diam. It is capable of carrying 5 amp at 115 v, and inrush overloads of up to 10 amp.

American Designed Components, Inc., Dept. ED, Jericho, N.Y.

CIRCLE 252 ON READER-SERVICE CARD

Lever Switch

Mounts on 3/4 in. centers

Series 4900 lever switch combines the advantages of single hole panel mounting with an independent detent mechanism, providing positive lever action. Its length is 3-9/16 in.; depth behind panel is 2-1/4 in. The switch has a capacity for up to 40 contact springs in any combination of 4 basic contact forms. It mounts on 3/4 in. centers, with a 3/8 in. threaded bushing.

Donald P. Mossman, Inc., Dept. ED, Brewster, N.Y.

CIRCLE 253 ON READER-SERVICE CARD

Resistance Welder Ignitron

Has copper cooling coil construction

Model NL-1009 resistance welder ignitron uses a copper cooling coil construction which permits a long averaging time. It can be used in either 600 or 1200 amp frame contactors. Its ratings are: anode voltage, 250 to 600 v; maximum demand, 1700 kva at maximum average anode current per tube of 120 amp; maximum average anode current per tube, 22 amp at corresponding maximum demand of 570 kva.

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

CIRCLE 254 ON READER-SERVICE CARD

CIRCLE 255 ON READER-SERVICE CARD ➤

NEW PRODUCTS AT WESCON

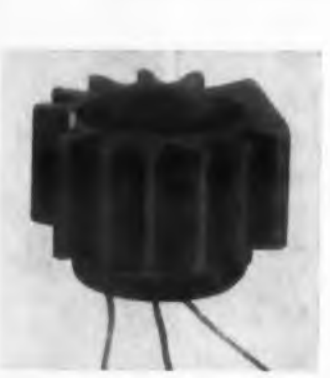
Solid State Switch

Weighs 9 oz

Weighing 9 oz, the Stat-Pack solid state control switch can regulate complex processes at a speed of 1000 a second. It measures 2 x 1.25 x 3 in. The unit also performs AND, OR, NOT and other logic functions. Application of 1 ma for a 5 v source permits switching of loads up to 20 w. The switch has both industrial and military uses.

Magnetic Amplifiers, Inc., Dept. ED, 632 Tinton Ave., New York 55, N. Y.
Booth 3828

CIRCLE 257 ON READER-SERVICE CARD



Transistor Radiators

Serve as retainer

This series of radiators, designed for cooling transistors, mount directly on a chassis or printed circuit board and serve as retainers. Designated as the 3A1-680 series, they are mounted by a tapped hole in the base of the radiator. Modifications are available to cover the full range of TO-6, TO-7 and TO-9 packages. Material is aluminum with anodized finish.

The Birtcher Corp., The Industrial Div., Dept. ED, 4371 Valley Blvd., Los Angeles 32, Calif.
Booth 2713

CIRCLE 258 ON READER-SERVICE CARD

Fhp Motors

Have 1.25 in. diam

This line of 1.25 in. diam permanent magnet dc motors comes in three frame lengths with

standard mounting holes. Designed to meet MIL-M-8609(ASG), they are designated type FYLM. Armatures are wound for voltages from 6 to 115 v dc. Ambient temperature range is from −65 to +200 F and custom designed units will withstand +400 F or −100 F. Their rated torque is 0.05 to 0.16 lb-in; weight is 0.26 to 0.43 lb. The motors are available with gearheads.

Barber-Colman Co., Electrical Components Div., Dept. ED, 1300 Rock St., Rockford, Ill.
Booth 3725-3727

CIRCLE 259 ON READER-SERVICE CARD

Shielded Coil Forms

Variable and fixed types

These shielded coil forms, called Top Hats, are each available in paper phenolic, Polypenco, or Kel-F with anodized aluminum housings. Coil form 2595 is a variable type, tuned by traversely moving powdered iron core in or out of the winding. Coil form 2695 is fixed. The first unit has a height of 3/4 in, the second a height of 11/32 in. Mounting flanges are 3/4 in. in diam with holes drilled for No. 2-56 screws.

Cambridge Thermionic Corp., Dept. ED, 445 Concord Ave., Cambridge 38, Mass.
Booth 1909

CIRCLE 260 ON READER-SERVICE CARD

Transistorized Amplifiers

Stand 15 g shock

Capable of withstanding shock as high as 15 g along any axis, this line of subminiature transistorized assemblies is suitable for a wide variety of missile system computer and control applications. They measure 2 in. in height and have an operating temperature range of −55 to +90 C. They can withstand up to 10 g of vibration to 2000 cps. Fifteen different amplifier types are available including units for summing, isolation, agc, relay, servo and pulse applications.

Reeves Instrument Corp., Components Div., Dept. ED, Roosevelt Field, Garden City, N. Y.
Booth 3303-3305

CIRCLE 261 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Silicon Diodes

Have low leakage

These silicon diodes have maximum leakage currents as low as 5 mμa and forward currents ranging up to 250 ma at 1 v. Maximum working voltage is 400 v and operating temperature is up to 200 C. They are hermetically sealed in a one-piece glass envelope 0.265 in. long and 0.108 in. in diam.

Rheem Semiconductor Corp., Dept. ED, P.O. Box 1327, Mountain View, Calif.

Booth 514

CIRCLE 264 ON READER-SERVICE CARD

Toggle Switch

Is dpst type

Toggle Switch model T4301 is a subminiature dpst type. Housed in a cadmium plated brass case, it is 29/32 in. long and 11/32 in. square, and weighs 0.006 lb. Four 10 in. leads are connected to the terminals. A silicon rubber boot is available to cap the toggle.

Hetherington Inc., Dept. ED, 1420 Delmar Dr., Folcraft, Pa.

Booth 304

CIRCLE 265 ON READER-SERVICE CARD

Servomotor-Rate Generator

Weighs 7.5 oz

Model 11 MG 630/600 size 11 servomotor-rate generator weighs 7.5 oz and will operate continuously at stall at a unit temperature of 200 C. Driven by a 6.3 v filament supply, it takes a power input of 3/8 w with a pf of 0.99. Excitation input up to 26 v is available. This unit has a no-load speed of 3200 rpm, a torque at stall of 0.65 oz-in., an acceleration at stall of 35,400 rad/sec^2, and torque/inertia of 23,000 oz-in.-sec^2.

Beckman Instruments, Inc., Helipot Div., Dept. ED, 2500 Fullerton Rd., Fullerton, Calif.

Booth 2007-2008

CIRCLE 266 ON READER-SERVICE CARD

◀ CIRCLE 263 ON READER-SERVICE CARD

Trimmer Potentiometers

Available in two types

These trimmer potentiometers meet all humidity requirements of MIL-STD-202A. Model 750 is rated at 2 w and has a resistance range of 10 ohms to 30 K. It weighs 2 g and measures 0.18 x 0.30 x 1.00 in. Model 1000 is rated at 2.5 w and has a resistance range of 10 ohms to 50 K. It weighs 2.5 g and measures 0.18 x 0.30 x 1.25 in. Both models have a standard tolerance of ±5%.

Dale Products, Inc., Dept. ED, P.O. Box 136, Columbus, Nebr.

Booth 2714-2716

CIRCLE 267 ON READER-SERVICE CARD

DC Motors

Available in three frame lengths

These 1-1/4 in. diam permanent magnet dc motors are available in three frame lengths. The armatures are wound for voltages from 6 to 115 v dc. They meet MIL-M-8609 (ASG) specs and have a normal ambient operating temperature range of −65 to +200 F. Rated output is 10 mph continuous to 35 mph intermittent. Rated torque is 0.05 to 0.16 lb-in. Weight is 0.26 to 0.43 lb.

Barber-Colman Co., Electrical Components Div., Dept. ED, Rockford, Ill.

Booth 3725

CIRCLE 268 ON READER-SERVICE CARD

High-Voltage Power Supplies

Maximum ripple is 4 or 5 mv

These continuously variable high-voltage regulated power supplies have a voltage regulation of better than 0.1% with a 10% variation of primary power. Model Z850A has a voltage range of 0 to 12 kv, 150 ma, with a 4 mv max ripple. Model Z851A has a voltage range of 0 to 10 kv, 250 ma, with a 5 mv ripple. Model Z852A has a voltage range of 0 to 18 kv, 1 amp, with a 5 mv ripple.

FXR, Inc., Dept. ED, 26-12 Borough Place, Woodside 77, N.Y.

Booth 1814-1816

CIRCLE 269 ON READER-SERVICE CARD

CIRCLE 270 ON READER-SERVICE CARD ➤

NEW PRODUCTS AT WESCON

Miniature Transformers

For transistor applications

These nine miniature transformers, designated DO-T28 through DO-T36, are designed for transistor applications. They are hermetically sealed to meet MIL-T-27A and have anchored leads that withstand a 10 lb pull test. All units are rated at 500 mw, and the primary resistance varies for the series from 10 to 950 ohms. Application for most units is for either single or push-pull outputs.

United Transformer Corp., Dept. ED, 150 Varick St., New York 13, N. Y.
Booth 1618

CIRCLE 272 ON READER-SERVICE CARD

Frequency Meter

Has ±0.25 accuracy

Having an accuracy of ±0.25%, this self-contained panel-mounting meter reads only in the range of 57 to 63 cps. It is direct reading and has a linear scale. Standard 400 cps models are also available and specification versions can be furnished for any center scale frequency between 60 and 1000 cps.

Beckman Instruments, Helipot Div., Dept. ED, 2500 Fullerton Rd., Fullerton, Calif.
Booth 2007-2008

CIRCLE 273 ON READER-SERVICE CARD

Recorders

Range is −40 to +550 F

Operating in an ambient temperature of from −40 to +160 F, these recorders have an indicating range of −40 to +550 F. They accommodate all standard charts and can function as a portable, wall or panel unit. The units, which include models 2200-A, -AF, -B, and -C, work with conventional stylus actuating mechanisms. A permanent, inkless record is made on Teledeltos paper.

The Electric Auto-Lite Co., General Products Group, Dept. ED, Champlain St., Toledo 1, Ohio.
Booth 1002

CIRCLE 274 ON READER-SERVICE CARD

Silicon Controlled Rectifiers

For average currents to 10 amp

Series X10RC2 through X10RC20 silicon controlled rectifiers are rated for average currents up to 10 amp and are available with piv's of 20, 30, 50, 70, 100, 150, and 200 v. Forward and reverse leakage currents are 12 ma and forward voltage drop in the conducting state is about 1.5 v at 25 C. All units have a microsecond switching time and operate to 100 C. They are hermetically sealed and 1.625 in. high.

International Rectifier Corp., Dept. ED, 1521 E. Grand Ave., El Segundo, Calif.

Booth 2011-2012

CIRCLE 290 ON READER-SERVICE CARD

Crystal Controlled Generator

Provides 0.1 to 100,000 μv metered output

Microvolt and crystal controlled generator model 295X affords continuous frequency coverage from 125 kc to 175 mc in eight calibrated bands, both modulated and unmodulated. It provides a metered output from 0.1 to 100,000 μv and does not require an external attenuation pad. The direct reading unit has vernier tuning and an oscillator that provides, through proper selection of crystals, frequencies up to 250 mc on harmonics. It can be used to: align and adjust rf, high if, low if, and audio stages of communication receivers; measure receiver sensitivity; tune and align discriminators; adjust agc and afc circuits; measure receiver and squelch circuit threshold sensitivity and noise quieting performance.

Hickok Electrical Instrument Co., Dept. ED, 10525 Dupont Ave., Cleveland, Ohio.

Booth 2618-2620

CIRCLE 291 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Solid State Power Supplies

Short circuit proof

From a 100 to 130 v ac, 60 cps input, Magitran power supply models 202M and 203M provide adjustable outputs of 10 to 150 and 10 to 300 v dc, respectively, at 0 to 200 ma. The solid state units combine magnetic and transistor regulator characteristics and offer full automatic protection against all types of short circuits or transients, either on an intermittent or continuous basis. They have less than 0.005% ripple and 0.05% line and load regulation. Intended for bench or subrelay mounting, they have 3-1/2 x 9-1/2 in. panel dimensions.

Electronic Research Associates, Inc., Dept. ED, 67 Factory Place, Cedar Grove, N.J.
Booth 3218-3220

CIRCLE 293 ON READER-SERVICE CARD

Klystron Power Supply

Has wide range

Designed to operate medium, low, and some high voltage klystrons, the model 438 power supply has a beam voltage range of 250 to 750 ±1 v for 105 to 125 v ac and 0 to 65 ma. Maximum ripple is 5 mv, and load regulation is ±3 v for 0 to 65 ma. At 0 to 150 v, sine wave modulation is 60 cps, square wave modulation is continuously variable from 300 to 300 cps, and sawtooth modulation is continuously variable from 30 to 180 cps.

Narda Microwave Corp., Dept. ED, 118-160 Herricks Rd., Mineola, N.Y.
Booth 307-309

CIRCLE 294 ON READER-SERVICE CARD

...silicones assure dependable components

Silastic Protects Against Corona, Humidity

This klystron tube for airborne radar utilizes Silastic®, the Dow Corning silicone rubber, to maintain frequency stability. Silastic moldings cover the tube's connections and lead wires, keeping out moisture and preventing corona. An excellent insulator, Silastic is unaffected by temperature extremes and ozone. Silastic retains its properties . . . can be relied upon to protect electronic gear in widely diverse and adverse environments.

In addition to its usefulness as a dielectric material, Silastic is often employed for purely physical reasons. Available in sponged or solid form, it protects delicate parts against shock and vibration. Silastic stays resilient from —90 to 260 C (—130 to 500 F), and resists the effects of extended storage, weathering, and corrosive atmospheres.

PHOTO COURTESY VARIAN ASSOCIATES

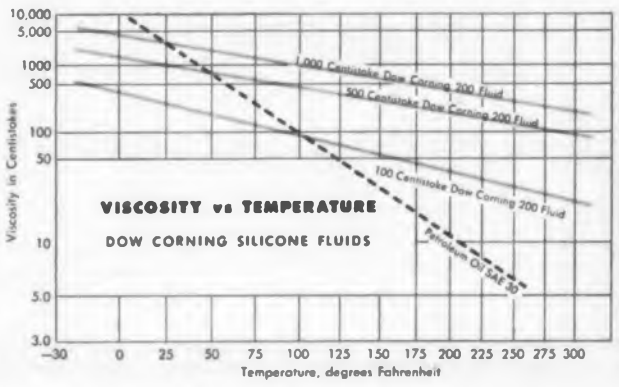
CIRCLE 601 ON READER-SERVICE CARD

Grease-Like Silicones Boost Transistor Dependability... Dow Corning silicone compound is ideal for potting transistors. It seals out moisture and conducts heat away rapidly. In addition, it reduces rejection rates by preventing metal splatter from reaching the transistor wafers when caps are welded in place. These silicone compounds don't melt, don't thicken, and retain their excellent dielectric properties from —40 to 210 C. Industro Transistor Corporation, manufacturer of the units illustrated, finds the grease-like silicone materials help build a new degree of reliability into their product.

Actually, transistor potting is but one of the many jobs performed by Dow Corning silicone compounds. They seal out moisture at joints, on terminals, and in many other applications . . . preventing arcs, shorts, flashovers, corrosion, and contamination . . . assuring the performance of electronic units.

CIRCLE 602 ON READER-SERVICE CARD

Cooling Fluid with Reliable Flow Rate



Because of their thermal stability and relatively flat viscosity-temperature curves, Dow Corning silicone fluids make excellent heat exchange media. Silicone fluids maintain consistency over a range of —65 to 250 C. They can be pumped at high speed without suffering breakdown due to shear, have good lubricity, and will not oxidize or act as corrosives, despite contact with metals at high temperatures. In sum, they allow heat exchange units to operate uniformly and almost indefinitely, as far as the coolant is concerned.

Recognizing these factors, the Hallicrafters Company utilizes Dow Corning silicone fluid as the cooling medium in their new heat exchangers for electronic equipment. Specifically designed to cool airborne, shipboard, and ground support electronic equipment, the Hallicrafters units have ratings up to 7,000 watts dissipation, meet MIL specs.

CIRCLE 603 ON READER-SERVICE CARD

Your nearest Dow Corning office is your number one source for latest information and technical service on silicones.

main office: MIDLAND, MICHIGAN / branches: ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D.C.

Silicon Power Rectifiers

25 to 35 amp, 50 to 500 piv

Rated 25 to 35 amp and 50 to 500 piv, these Quad-Sealed silicon power rectifiers have a four layer seal which makes them resistant to humidity, shock, vibration, temperature, and other environmental extremes. An oversized anode lug removes heat from the rectifier junction, allowing the unit to withstand high peak current surges. Full cycle average leakage current is 10 ma at 130 C base temperature. The anode lug has eyelets for easy wiring.

International Rectifier Corp., Dept. ED, 1521 E. Grand Ave., El Segundo, Calif.

Booth 2011-2012

CIRCLE 295 ON READER-SERVICE CARD

Crystal Case Relay

Weighs 1/2 oz

For control systems, computers, and missile electronic equipment, this miniature crystal case relay is designed to MIL-R-25018, MIL-R-5757C, and MS24250. It has a dpdt, bifurcated contact structure and is interchangeable with other standard subminiature relays. The unit is hermetically sealed, operates continuously from —65 to +125 C, and has a minimum life expectancy of 100,000 operations at rated loads. Slightly over 1 in. long, it weighs about 1/2 oz and is available in an oval or rectangular case with solder lugs, plug-in terminals, or 3 in. leads.

Union Switch & Signal, Div. of Westinghouse Air Brake Co., Dept. ED, Swissvale, Pa.

Booth 2613-2615

CIRCLE 296 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Wave and Noise Spectrum Analyzer

Covers 30 cps to 100 kc

Wave and noise spectrum analyzer model 303 has a frequency range of 30 cps to 100 kc, ±300 cy vernier and a voltage range of 100 μv to 300 v full scale in 3 to 1 steps, plus continuously variable gain control. A switch selects any of four constant bandwidths: −3 db at 10 and 30 cps round top, or 100 cps and 1 kc flat top. The meter is calibrated in rms millivolts and dbm with short and long time constants for noise measurements.

Quan-Tech Labs, Dept. ED, 236 Mt. Kemble Ave., Morristown, N.J.
Booth 3517

CIRCLE 297 ON READER-SERVICE CARD

Electronic Generators

Provide 160 and 250 va outputs

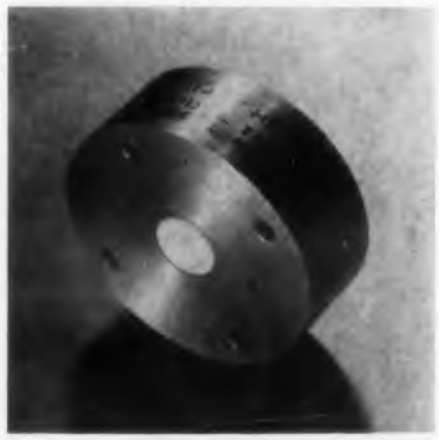
Model 150 and 250 Powertron electronic generators deliver output powers of 160 and 250 va, respectively. They have 400 cps ±0.25% fixed and 350 to 450 cps variable frequency outputs and are supplied with an input jack for output frequencies from 50 to 4000 cps. The units afford continuously variable output voltage from 0 to 120 v, less than 1% output distortion, and 1% regulation from no load to full load. They can be used with loads of any power factors and are available for two and three-phase operation. Dimensions are 19 x 8-3/4 x 13-1/2 in.

Industrial Test Equipment Co., Dept. ED, 55 E. 11th St., New York 3, N.Y.
Booth 3529

CIRCLE 298 ON READER-SERVICE CARD

Ferrite Isolator

Rated at 5 w average power



Designed to improve the performance of a klystron excited system, the model IKuL4 ferrite isolator provides a minimum of 25 db isolation from 16 to 17 kmc with a 0.45 db maximum insertion loss and a 1.12 maximum vswr. Rated at 5 w average power, the unit is 0.66 in. long and weighs 2.9 oz.

Raytheon Co., Special Microwave Devices Subdiv., Dept. ED, Waltham 54, Mass.
Booth 2131

CIRCLE 300 ON READER-SERVICE CARD

Airborne Tape Transport

Withstands 50 g impact forces

Model 733 airborne instrumentation tape transport is ruggedized and light weight. It is capable of withstanding 50 g impact forces and meets shock and vibration requirements in accordance with MIL-T-17113/MIL STD 167. Available with single or multiple tape speeds, it handles 1/4 or 1/2 in. tape, and 1 in. on special request. It has an 8 min playing time at 60 in. per sec with a 10-1/2 in. reel.

Midwestern Instruments, Dept. ED, P.O. Box 7186, Tulsa, Okla.
Booth 2115-2116

CIRCLE 301 ON READER-SERVICE CARD

Liquid Filled Potentiometers

Multiturn

The 10-turn, 1-1/16 in. model 4203, the 10-turn, 2 in. model 4613, and the 3-turn, 2 in. model 4713 are liquid filled potentiometers with a life span of 10 million shaft revolutions. The units can operate under water and provide high dielectric strength, good heat dissipation, and low noise.

Beckman Instruments, Inc., Helipot Div., Dept. ED, 2500 Fullerton Rd., Fullerton, Calif.
Booth 2007-2008

CIRCLE 302 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Tachometers

Have accuracies better than 1%

The series 7000 tachometer line has accuracies better than 1%. Types include multiple range, differential, expanded-range, control, and portable tachometers. Input signals may be supplied by electro-magnetic, photo-electric, and proximity pickups, tachometer generators, or turbine type flowmeters. Amplitude of the input signal may be as low as 0.005 v rms.

Airpax Electronics Inc., Seminole Div., Dept. ED, Fort Lauderdale, Fla.
Booth 521-523

CIRCLE 303 ON READER-SERVICE CARD

Plug and Jack

Have a locking device

It is possible to lock the connection when this Lock-Plug is inserted into its mating Lock-Extension-Jax. The Lock-Plug has a coupling ring that can be threaded to the thread projection of the mating jack. Proper contact may also be made without employing the locking device when a rapid disconnect is desired. Both plug and jack are available in two or three conductor types.

Switchcraft, Inc., Dept. ED, 5555 N. Elston Ave., Chicago 30, Ill.
Booth 1610

CIRCLE 304 ON READER-SERVICE CARD

Permanent Magnet Assembly

Energizes waveguide components

Designed to energize waveguide components in uhf electromagnetic applications, the Alnico V, Celastic coated model MA-8340 permanent magnet assembly is about 23 x 11 x 10 in. and weighs 432 lb. It consists of two magnets produced as single castings with an energy product value of 5.5 v 10^6 gauss-oersteds.

Crucible Steel Company of America, Dept. ED, P.O. Box 2518, Pittsburgh 30, Pa.
Booth 714-716

CIRCLE 305 ON READER-SERVICE CARD

Rack-and-Panel Connectors

Snap-in

Made with snap-in contacts and crimp type terminations, series DRS rectangular rack-and-panel connectors are available with 49 or 99 No. 20 contacts. They are spring mounted and self-aligning within 1/32 in. in either drawer or panel mounting, and require no guide or stop pins. The units are designed for operation at temperatures from −70 to +392 F and at altitudes up to 110,000 ft.

Deutsch Co., Electronic Components Div., Dept. ED, 7000 Avalon Blvd., Los Angeles 3, Calif.
Booth 611-613

CIRCLE 307 ON READER-SERVICE CARD

X-Band Ferrite Duplexer

Handles 1 kw average, 1 megawatt peak power

For use in radars operating in the 8500 to 9600 mc range, the model MA-124T ferrite duplexer handles 1 megawatt peak or 1 kw average power. Typical recovery time is about 1 μsec at 1 mw peak input to the circulator and 100 kw typical antenna line mismatch power to the crystal protector transmit-receive tube. Transmitter-receiver isolation is 25 db minimum under matched load conditions; antenna-transmitter isolation is 20 db minimum; insertion loss is 0.3 db maximum; and vswr is 1.15 maximum. Connections are RG-51/U.

Microwave Associates, Inc., Dept. ED, Burlington, Mass.
Booth 623

CIRCLE 308 ON READER-SERVICE CARD

Secondary-Emission Pulse Tube

Has 3 mμsec rise time

For use in trigger or free-running pulse generators, this secondary-emission pulse tube has a 3 mμsec rise time with a 1 amp pulse. The miniature pentode combines high transconductance with low capacitance, providing a gain bandwidth of 350. Also suited for wideband distributed amplifier use, it has a life expectancy of 5000 hr.

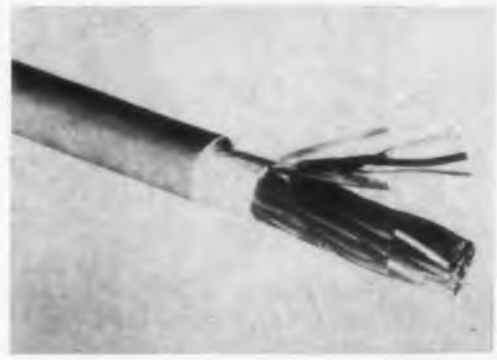
CBS Electronics, Dept. ED, Danvers, Mass.
Booth 2806-2808

CIRCLE 309 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Wire Shielding

Saves space and weight



Combining the conductivity of aluminum foil with the dielectric properties of Mylar, Beldfoil provides a completely isolated wire shield with a minimum diameter addition. It eliminates cross talk and external communications and permits the use of completely isolated, individually shielded and jacketed pairs in a small, light cable.

Belden Mfg. Co., Dept. ED, 415 S. Kilpatrick, Chicago 44, Ill.

Booth 615-517

CIRCLE 311 ON READER-SERVICE CARD

Seals

Two kinds available

These hermetic ceramic-to-metal seals include high voltage terminal bushings, feed-throughs and cable-end seals. They are vacuum-tight, have high dielectric strength and corrosion resistance. The ceramic-to-sapphire seals make use of the good transmission characteristics of sapphire as windows in infrared or microwave absorption cells or as entrance and exit windows for optical systems.

U. S. Stoneware Co., Alite Div., Dept. ED, Orrville, Ohio.

Booth 726

CIRCLE 312 ON READER-SERVICE CARD

Oscilloscope

Monitors low level signals

Model P1B1X12 transducer preamplifier and monitor Panelscope for low level signals is 5-3/16 x 5-1/4 in. and extends 10 in. behind the front panel. The preamplifier has a sensitivity of 3 mv rms and a 1 v rms output. Repetitive sweep frequencies of 0.5, 1, 2, and 4 cps, 1 and 5 kc are selected by a front panel control. The instrument contains its own high voltage supply; it requires 115 v ac, 10 ma of 325 v and 1.5 amp of 6.3 v ac.

Waterman Products Co., Inc., Dept. ED, 2445 Emerald St., Philadelphia 25, Pa.

Booth 401

CIRCLE 313 ON READER-SERVICE CARD

Thermocouples

Measure —350 to +2000 F

For missile and rocket engine application, these thermocouples are designed for immersion, heat transfer, and surface temperature measurements in the —350 to +2000 F range. They are made with various types of wire meeting NBS 14 RP 2415 curves and are calibrated at two points. In the heat transfer units (A), the thermocouple junction is controlled within ±0.001 in. of a fixed distance from the surface. The surface temperature units (B) come in plug, screw, and flat mounted types with junction at the surface. The immersion models (C) have a 250 msec average response time and are hydrostatically tested to 5000 psi. Both the heat transfer and surface temperature thermocouples are available with ceramic insulation.

Astra Technical Instrument Corp., Dept. ED, 1132 Mission St., South Pasadena, Calif.
Booth L-12

CIRCLE 316 ON READER-SERVICE CARD

Power Supply

Provides 170 to 1530 v dc

From a 117 v, 60 cps, single phase input, the model 409 nuclear power supply provides an output of 170 to 1530 v dc at 0 to 5 ma. It has a selective polarity, 0.02% stability, and less than 0.002% ripple. Regulation is within 0.01% for 10 v line changes, within 0.4% for 1 ma load changes. The unit is 19 x 3-1/2 x 12 in. and weighs 22 lb.

John Fluke Mfg. Co., Dept. ED, 1111 W. Nickerson St., Seattle 99, Wash.
Booth 2107-2108

CIRCLE 317 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Test Set

Provides swept and cw signals

To produce both swept and cw signals, the model 303 test set has three separate oscillators that operate in the 20 to 40 mc range and provide 1 v rms output into 50 ohms. Each output is separately metered and may be attenuated from 0 to 140 db in 1 db steps. The cw oscillator outputs may be used directly as test signals for measuring gain and similar circuit characteristics, or they may be used as variable markers for the swept signals produced by the third oscillator. Center frequency of the swept output can be tuned across the full range, and the width of the signal can be varied from 0.05 to 40% of the center frequency. Sweep rate is line frequency, 50 cps, or 60 cps. Overall accuracy of attenuation is 0.5 db.

Telonic Industries, Inc., Dept. ED, Beech Grove, Ind.
Booth 2526

CIRCLE 320 ON READER-SERVICE CARD

Pulsed Signal-Source Modulators

High power

For driving a wide range of magnetrons, klystrons, and traveling wave tubes, model 75M-1, 75M-2, and 75M-3 pulsed signal-source modulators offer peak pulse powers of 0.6, 1.2, and 2 megawatts, respectively. They include a high voltage dc power supply with less than 0.5% ripple and a filament supply with 40 kv low capacitance isolation. The units have standard pulse lengths of 0.5, 1, 2, 3, 4, and 5 μsec or any six special fixed lengths between 0.5 and 10 μsec. Rise time is adjustable from 100 to 175 kv per μsec. An internal trigger generator is continuously variable from 0 to 2000 cps.

Levinthal Electronic Products, Inc., Dept. ED, Stanford Industrial Park, Palo Alto, Calif.
Booth 305

CIRCLE 321 ON READER-SERVICE CARD

Oscilloscope

Monitors color TV sync pulses

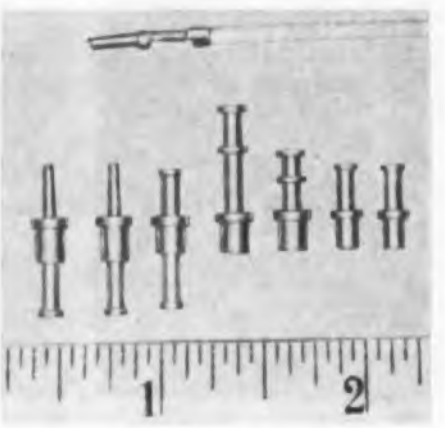
Designed to monitor color or black and white TV sync pulses, the model P1B7X2 Panelscope has a switch that selects one of three TV sync signals to be viewed at sweep rates of 1/2 the line or frame frequencies. Another selector position permits connection of an external calibrating signal to the vertical amplifier. The unit includes its own high voltage supply and provides two sweeps, 30 and 7875 cps, for both horizontal and vertical sync signals. The vertical channel has 1 v peak-to-peak sensitivity with a 6 mc bandwidth. Panel dimensions are 5-3/16 x 5-1/4 in.

Waterman Products Co., Inc., Dept. ED, 2445 Emerald St., Philadelphia 25, Pa.
Booth 401

CIRCLE 323 ON READER-SERVICE CARD

Taper Pin Terminal

Feedthrough type



Feedthrough terminal 1799 is designed for use with AMP series 53 taper pins and the company's x-2186, x-2113, x-2114, x-2115, and x-2132 taper pin receptacles. The unit has a 0.052 in. diam pin and a 0.64 in. diam receptacle, both with a 0.061 in. taper per in. It can be staked into 1/32, 1/16, 3/32, 1/8, 7/32, and 9/32 terminal boards.

Cambridge Thermionic Corp., Dept. ED, 445 Concord Ave., Cambridge 38, Mass.
Booth 1909

CIRCLE 324 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

12 Channel Recording System

Has interchangeable plug-in preamplifiers

With a choice of interchangeable plug-in preamplifiers, the model BSA-1200 recording system can provide simultaneous rectilinear ink tracings of up to 12 phenomena in the dc to 200 cps frequency range. All on one chart, the records are instantaneous and permanent and can be reproduced by conventional methods. The unit is of plug-in construction and each channel has its own power supply and driver amplifier. The system features 18 push-button chart speeds, an event marker and synchronous timer, optional plug-in remote controls, and micrometer adjustments for lateral and longitudinal pen alignment. It can be housed in a 19 x 31-5/8 x 17 in. space or in any 19 in. standard cabinet.

Cohu Electronics, Inc., Massa Div., Dept. ED, 5 Fottler Rd., Hingham, Mass.
Booth 2106

CIRCLE 325 ON READER-SERVICE CARD

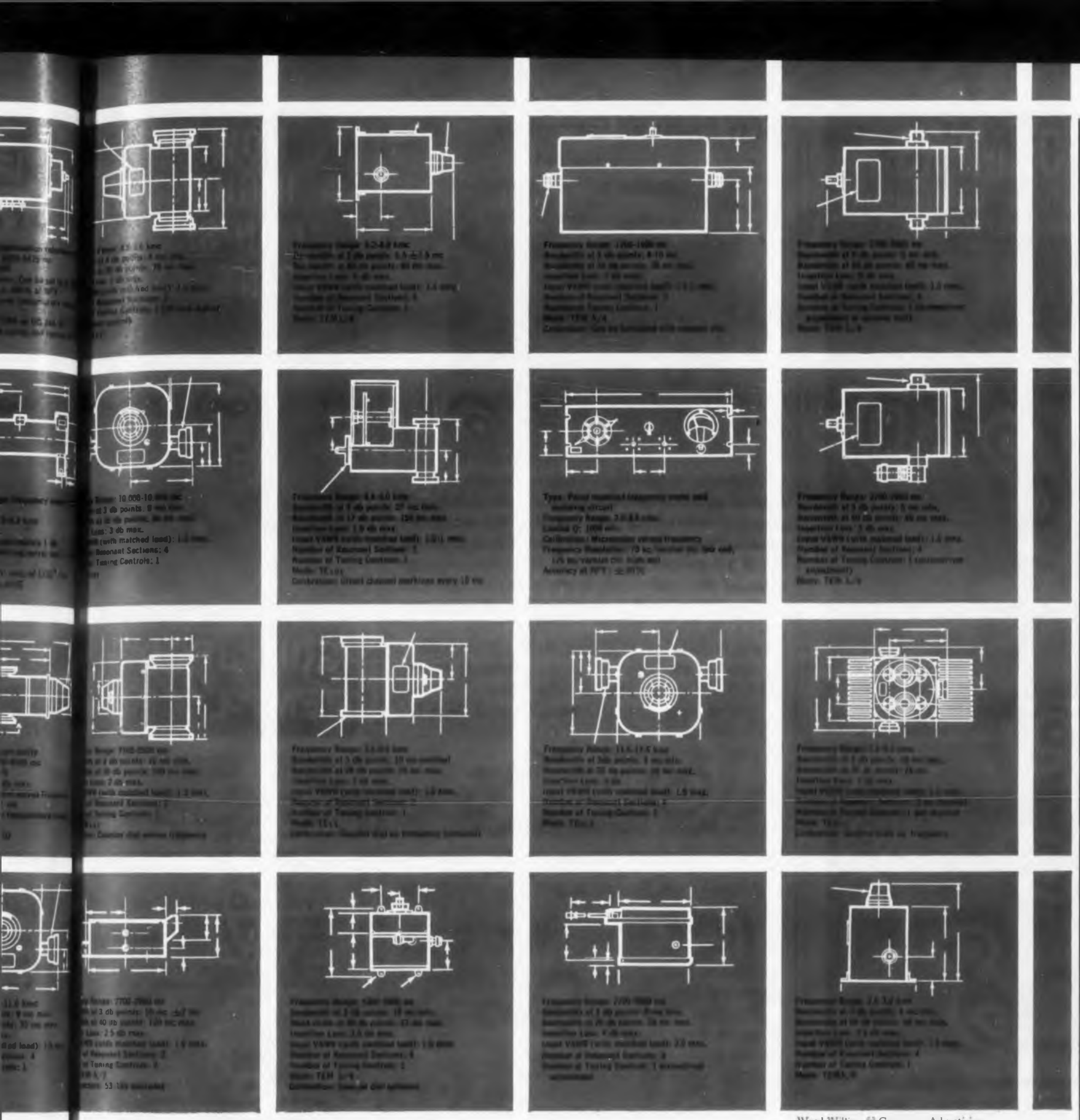
Air Dielectric Cable

Flexible

A flexible air dielectric copper cable, Heliax is available with 3/8, 5/8, 7/8, and 1-5/8 in. diam and a selection of end fittings.

Andrew Corp., Dept. ED, 363 E. 75th St., Chicago 19, Ill.
Booth 2001

CIRCLE 326 ON READER-SERVICE CARD



Ward William & Company, Advertising

ency meter or filter requirement

From over 400 microwave frequency meter and tunable band pass filter designs, your requirement can be filled easily and quickly. If the unit for your application is not already in stock, it can be produced readily by *modifying* one of the hundreds of Frequency Standard meters or filters now *available*. This means both minimum lead time and development costs.

Send your technical requirement for a prompt analysis or meet with our staff and discuss your specific problem.

Literature on Standard Products is Available on Request

Jersey

Silver-Zinc Battery

Provides 80 w-hr per lb

The model PM 200 Silvercel is a 4 lb, 5 oz, silver-zinc storage battery that provides outputs of 80 w-hr per lb. The unit can be recycled and also offers fast activation, up to three years activated shelf life, and a two month wet stand life. It operates from 0 to 165 F and can be used down to −65 F with heaters. At a fixed load, with temperature limits held to ±10 F, the plateau voltage can be regulated within ±2%. Charge retention after an activated stand of one month is up to 95%.

Yardney Electric Corp., Dept. ED, 40-50 Leonard St., New York 13, N.Y.

Booth 2901

CIRCLE 327 ON READER-SERVICE CARD

Servomotors

Inertia and velocity damped

In sizes 11, 15, and 18, these 115 v, 400 cps damped servomotors have stall torques ranging from 0.63 to 2.35 oz.-in. and operate at temperatures to 200 C. Inertia damped models 11IM460, 15IM461, and 18-IM460 have additional damping factors from 155 to 940 dyne cm sec/rad, while velocity damp 11VM460, 15VM460, and size 18 models have adjustable damping ranges between 10 and 330 dyne cm sec/rad.

Beckman Instruments, Inc., Helipot Div., Dept. ED, 2500 Fullerton Rd., Fullerton, Calif.

Booth 2007-2008

CIRCLE 328 ON READER-SERVICE CARD

◄ CIRCLE 329 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Portable AF Voltmeter

Has 0.5% absolute accuracy

Portable type M-121 voltmeter measures af and low rf signals to an absolute accuracy of 0.5% and has full scale ranges from 1 mv to 100 v rms. Relative levels can be measured from −70 to +22 db on a reference of 1 mw into 600 ohms, and an incremental decibel control permits readings with a discrimination of better than 0.03 db. The unit has a 20 cps to 400 kc frequency range and an input impedance of 10 meg on the 30 and 100 v ranges, 20 meg or more on the others. It is 17 x 11-1/2 x 10-1/4 in. and weighs 33 lb.

Wayne Kerr Corp., Dept. ED, 1633 Race St., Philadelphia 3, Pa.

Booth 3521

CIRCLE 331 ON READER-SERVICE CARD

Motor Starting Capacitor

Has low dissipation factor

Made to specification so that it mounts tightly around a motor, this hermetically sealed, plastic motor starting capacitor keeps installation cost and space at a minimum. It has high insulation resistance, high Q, low dissipation factor, and good stability.

Southern Electronics Corp., Dept. ED, 150 W. Cypress Ave., Burbank, Calif.

Booth 1423

CIRCLE 332 ON READER-SERVICE CARD

Linear Displacement Transducers

Have 0.5% linearity

Mainly for use with the company's carrier and demodulator amplifiers, model 580 and 581 linear displacement transducers have a ±0.05 in. maximum stroke, 0.5% linearity, and infinite resolution. Contact pressures are 10, 25, or 100 g.

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

Booth 1716-1718

CIRCLE 333 ON READER-SERVICE CARD

Miniature Relays

Four and six pole

Available in a variety of contact ratings for ac, dc, and dry circuit operation, these miniature four and six pole relays exceed the requirements of MIL-R-5757A, B, and C and MIL-R-25018. They incorporate balanced rotary motors for shock and vibration resistance, stepped headers for easy wiring and inspection, and Teflon spatter shields to prevent contact shorting. The units are hermetically sealed in a 1.176 in. diam, corrosion resistant can that stands 1.272 in. above the mounting plane.

North Electric Co., Dept. ED, Galion, Ohio.
Booth 2803-2805

CIRCLE 336 ON READER-SERVICE CARD

Oscilloscope

For tape recorder system

Designed for multi-channel tape recorders, model P1G9X1 transducer preamplifier and monitor is 5-3/16 x 5-1/4 in. and extends 10 in. behind the front panel. It contains a preamplifier-vertical deflection amplifier with a sensitivity of 1 my rms per in. and a referenced 1 v rms recorder output. It requires 26 ma of 325 v, 1.8 amp of 6.3 v ac, and 115 v ac. The power supply for the cathode ray tube is contained in the unit.

Waterman Products Co., Inc., Dept. ED, 2445 Emerald St., Philadelphia 25, Pa.
Booth 401

CIRCLE 337 ON READER-SERVICE CARD

Mesa Transistors

For high speed switching

Designed for high speed switching in electronic computers, mesa transistors 2N1300 and 2N1301 have typical gain-bandwidth products of 40 and 60 mc, respectively. Maximum power dissipation is 150 mw at 25 C; minimum collector-to-base breakdown voltage is −13 v.

Radio Corporation of America, Semiconductor and Materials Div., Dept. ED, Somerville, N.J.
Booth 410-412

CIRCLE 338 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Power Supply

Has 24 to 32 v, 50 amp output

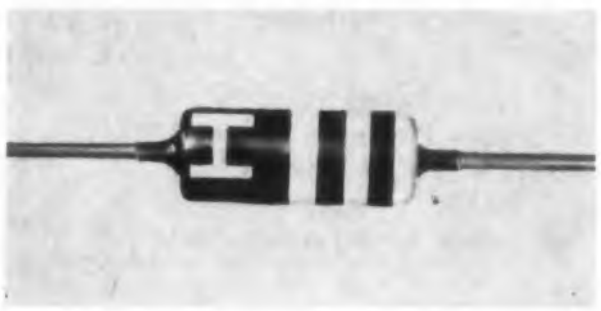
Transistorized model SR 28-50 regulated power supply has an output capacity of 24 to 32 v, 50 amp and 60% efficiency at maximum voltage. It contains no magnetic amplifiers and has no positive transient response characteristic. Line regulation is 0.1% for changes from 208 to 230 v at any output voltage from 0 to maximum; load regulation is 1% for changes from 0 to maximum and maximum to 0; and recovery time is 50 μsec with no positive transient. The unit will operate indefinitely into a dead short and has automatic current limiting, 1% ripple, 0.1% stability for 24 hr, and a 0.5% per deg C temperature coefficient. Panel height is 8-3/4 in.

Kepco, Inc., Dept. ED, 131-38 Sanford Ave., Flushing 55, N.Y.
Booth 515-517

CIRCLE 342 ON READER-SERVICE CARD

Silicon Switching Computer Diodes

Have 0.3 or 0.5 μsec recovery time



Designed for computer switching applications, these miniature silicon diodes have a maximum recovery time of 0.3 or 0.5 μsec, depending upon the model. Minimum forward currents at 1 v and 25 C are from 6 to 200 ma. Hermetically sealed in glass envelopes with a maximum length of 0.265 in. and a maximum diameter of 0.107 in., the units have a −65 to +150 C operating range and a −65 to +200 C storage range.

Hughes Products, Semiconductor Div., Dept. ED, P.O. Box 278, Newport Beach, Calif.
Booth 3012-3018

CIRCLE 343 ON READER-SERVICE CARD

CHOOSE FROM THESE MATERIALS...

Vulcanized Fibre: 10 standard grades; many special grades.

PHENOLITE Laminated Plastic: over 80 standard and modified grades; paper, cotton fabric, nylon, asbestos, glass fabric, cotton and glass mat bases; phenolic, melamine, polyester, epoxy teflon or silicone resins.

PEERLESS Electrical Insulation: coil, strip, corrugated.

Extruded Nylon: 2 grades; rod, strip, pressure tubing, special shapes.

Polyester Glass Mat: 4 standard sheet grades; custom molded shapes.

PHENOLITE Copper-Clad Laminates: 10 standard grades.

Combination Materials: Rubber-PHENOLITE; Rubber-Fibre; Wood-Fibre; Metal-Fibre; Asbestos-Fibre; PEERLESS-PHENOLITE.

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Field Application Assistance
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In Canada:
NATIONAL FIBRE COMPANY OF CANADA, LTD., Toronto 3, Ontario

CIRCLE 345 ON READER-SERVICE CARD

Panel Indicating Instrument

Measures 7/16 in. in diam

This sealed, 7/16 in. diam panel instrument includes an external pivot D'Arsonval movement and a high flux density Alnico magnet. The meter is available as a dc microammeter, milliammeter, ammeter, or voltmeter, and two units can be supplied as rectifier type ac instruments. Accuracy is ±5% of full scale. Watertight per MIL-M-6b, the unit is housed in steel and provided with a solder lug and a single wire lead terminal. There are two models: SC-031 with optional mounting, and the SC-030 with a faceplate and hex nut for front mounting.

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

Booth 402B

CIRCLE 346 ON READER-SERVICE CARD

Heat Pump Test Kit

Helps solve temperature control problems

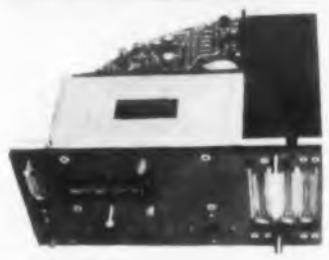
Test kit model E-8 is designed for instruction and experimentation in the thermoelectric heat pump field. It contains an assembled heat pump, four extra *p* and four extra *n* elements, and an instruction book. The kit can be used to determine the feasibility of heat pumps in various cooling, heat transfer, and temperature control applications.

Minnesota Mining and Mfg. Co., Dept. ED, 900 Bush Ave., St. Paul 6, Minn.

Booth 3301

CIRCLE 347 ON READER-SERVICE CARD

ADVANCED MULTICHANNEL PAM TELEMETRY



Complete plug-in missile commutation package

THE NATION'S MAJOR SUPPLIER OF COMMUTATION PRODUCTS. QUALIFIED MECHANICAL COMMUTATORS AND ALL ELECTRONIC SOLID STATE COMMUTATORS IN PRODUCTION FOR MAJOR PROGRAMS.

Complete missile package (shown above) includes 2 double pole electronic commutators and a low level electromechanical commutator and amplifier with power supplies.

Typical standard double pole solid state electronic commutators providing IRIG and special wave forms.

Typical of the many GDI mechanical commutator designs available for military, scientific and industrial application.
New minicom commutators providing low contact resistance, small size and long life.

We are always pleased to consult with you on your particular theoretical and/or practical problems. Please contact us at the address below.

GENERAL DEVICES, INC.
PRINCETON, NEW JERSEY
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OFFICES: LOS ANGELES, DALLAS, SEATTLE, ST. LOUIS, WASHINGTON, D.C., METROPOLITAN NEW YORK, FLORIDA, NEW YORK STATE AND NEW ENGLAND.
Top positions available in new expansion planning.

CIRCLE 348 ON READER-SERVICE CARD

ADVANCED MULTICHANNEL FM TELEMETRY

FO-4 SERIES SUBCARRIER OSCILLATORS
Smallest and lightest available.

SUBMINIATURE HIGH PERFORMANCE SOLID STATE FM SUBCARRIER COMPONENTS. COMPLETE SYSTEMS AND SUB SYSTEMS. CALIBRATORS AND SIGNAL CONDITIONING EQUIPMENT.

Series FO-4 subcarrier oscillators (shown above) are of the voltage sensing frequency modulating type and may be used for the measurement of positive and negative DC and/or AC voltages. These oscillators are available in various packaged forms in combination with silicon power supplier, signal calibration and conditioning equipment low level amplifiers, commutators and other telemetry apparatus.

Rugged SCO shelf available in various lengths for mounting up to 12 FO-4 series SCO's including the power supply and mixer.

We are always pleased to consult with you on your particular theoretical and/or practical problems. Please contact us at the address below.

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Top positions available in new expansion planning.

CIRCLE 349 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Impedance Bridge

Wide range

Impedance bridge model 502-A has rati ranges that extend to 120 billion to 1 for resis ance and 12 billion to 1 for capacitance and i ductance. It measures 6 x 7 x 9 in., weighs 10 l and has direct reading controls.

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

Booth 3419

CIRCLE 351 ON READER-SERVICE CARD

G-Accelerators

Two models available

Model A903 g-accelerator is available in fi infinitely variable standard ranges (1000 g max Maximum weight capacity is 2500 g-lb; wow 0.5% max; drift is 0.2% of operating rate-per-min ute max. It measures 32 x 32 x 38 in. Model B9 has a range of 1 to 100 g; maximum weight c pacity is 5000 g-lb max. Wow is 0.5% max; drift 0.2% of operating rate-per-minute max. It is 36 i high, and has a diameter of 60 in.

Genisco Inc., Dept. ED, 2233 Federal Ave., L Angeles 64, Calif.

Booth 3732-3734

CIRCLE 352 ON READER-SERVICE CARD

High-Voltage Power Supply

Produces 16 kv dc at 200 μa

High-voltage power supply PS-28 produces 1 kv dc at 200 μa from 26.5 v dc, 650 ma nomin input. Conversion is through a mechanical vibr tor, transformer and voltage doubler. It is hous in a 4-7/8 x 6-3/8 x 6-7/8 in. aluminum case, a weighs 8 lb.

Southwestern Industrial Electronics Co., Dep ED, 10201 Westheimer Rd., P.O. Box 130 Houston 19, Tex.

Booth 420-422

CIRCLE 353 ON READER-SERVICE CARD

differential DC amplifier

amplifies low-level telemetering signals with high efficiency

Smallest size available—only 2½" long x 1 3/16" square. Weighs only 8 ounces. ±10 millivolts "in"...±5 volts "out."

Excellent linearity. From null to 5 VDC output, the linearity is 0.5%. From null to 2.5 VDC, it's 0.25%.

High stability—1% of gain and null value in 5 minutes from a cold start. Unit is stable over the full environmental range, and over power input variations.

Sources floating—input, output and power sources are completely isolated from one another.

Meets MIL-E-5272A for humidity, vibration and shock. Designed with magnetic amplifier reliability.

Write for complete data.

NETWORKS ELECTRONIC CORPORATION

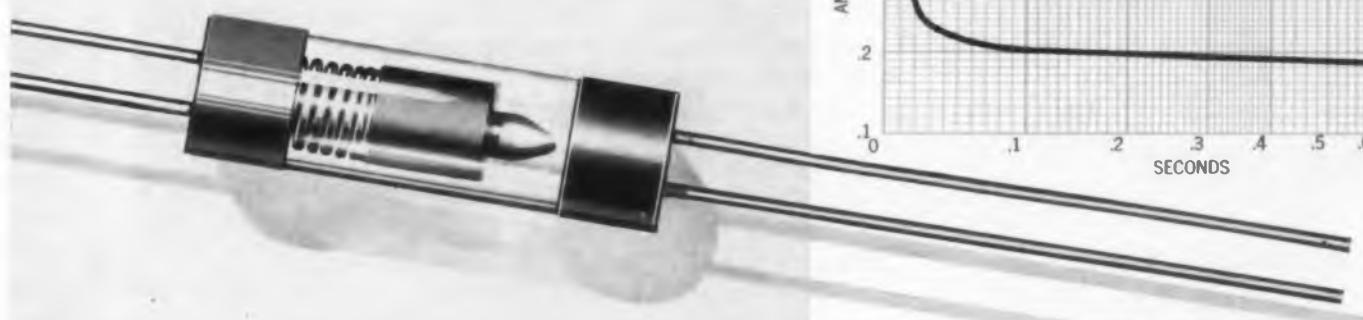
14806 Oxnard Street, Van Nuys, Calif.
Telephone: STate 2-3114

CIRCLE 358 ON READER-SERVICE CARD

NETWORKS ELECTRONIC

—originators of the glass-enclosed thermal relay —announce a **NEW**

LOW-CURRENT THERMAL RELAY



FOR SOLID STATE APPLICATIONS

—miniature size... hermetically sealed, and 99.99% proven reliability

Protect your costly transistors with this tiny new N.O. thermal relay, only .0125 cubic inch in volume. It fires positively at .180 amp. For higher firing currents see graph for time delays obtainable. The fuse supports .120 amp. max. continuous current without burning. Operation is based on the "fuse burnout" principle which gives wide latitude to systems designers. The N.C. type fires positively at .350 amp. and supports .230 amp. max. continuous current without burning.

Hermetically sealed in glass by NETWORKS' exclusive method of bonding metal headers to glass housings which are resistant to heat and shock. The glass provides interior visibility—a great advantage over metal or potted types.

Qualification tested in the completely equipped NETWORKS' environmental laboratories. Normally-open type is tested to withstand:

Temperature: —100°F to +400°F
Vibration: 20 to 2000 cps at 15 G's
Shock: 50 G's for 2 to 4 MS

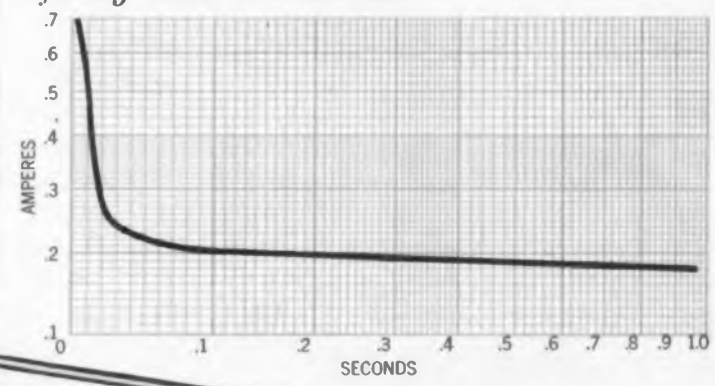
Higher ratings for Normally-closed type.

NETWORKS relays meet all pertinent Mil. Specs.

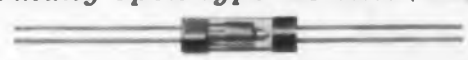
99.99% reliability. NETWORKS maintains continuous checks on daily production. If failure occurs in a lot, the entire lot is scrapped. There has been no failure in 1,000,000 delivered units.

Designed for use as a low-current sensing device, or for overload protection in guided-missile circuitry and complex electronic equipment. Used extensively to program parameters into pre-flight or flight computers.

firing time vs current

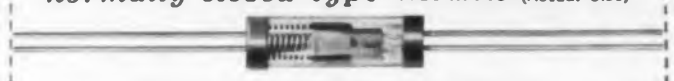


normally open type **NO. M555** (Actual Size)



Maximum Dimensions: .165" dia. x .550" long

normally closed type **NO. M449** (Actual Size)



Maximum Dimensions: .250" dia. x .860" long

Send for complete data.

NETWORKS ELECTRONIC CORPORATION

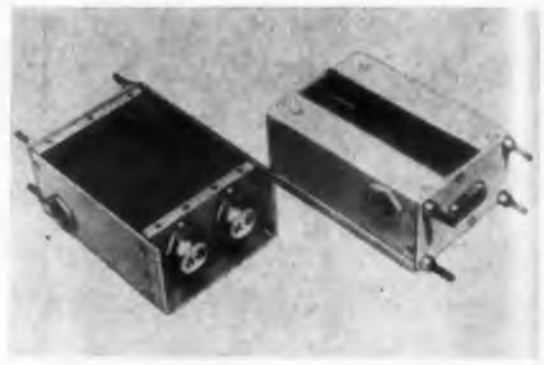
14806 OXNARD STREET • VAN NUYS, CALIFORNIA • STATE 2-3114
See Us At Booth #2421 at the WESCON SHOW

CIRCLE 359 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Transistorized Power Amplifier

Low level



For use as a high power preamplifier, a signal amplifier, or an intercommunication amplifier system, the 592478 transistorized power amplifier provides a 2 w balanced output into 8 ohms with an input of —30 dbm. It terminates and works from a 600 ohm balanced line and has a frequency response of ±2 db from 200 to 6000 cps at 100 mw output into 8 ohms. Noise is 70 db below full output. Designed to meet MIL-E-4158A, MIL-I-6181, and MIL-E-4970, the unit has a plug-in connector, measures 3-1/8 x 1-13/16 x 4-5/8 in., and mounts with four 6-32 x 1/2 in. studs on 1-1/2 x 2-5/8 in. centers.

North Electric Co., Dept. ED, Galion, Ohio.
Booth 2803-2805

CIRCLE 361 ON READER-SERVICE CARD

Miniature Transistorized Amplifier

For four-channel microphone mixers

The Mix-Amp transistorized amplifier overcomes loss in the Mini-Mix and four-channel microphone mixers; it provides a gain of 3 db. The size of a pack of cigarettes, model 501 has standard two-conductor phone jack input and phone plug output; model 502 is identical except that input and output have microphone connectors. It can be used with a microphone, having cable lengths up to 30 ft.

Switchcraft, Inc., Dept. ED, 5555 N. Elston Ave., Chicago 30, Ill.
Booth 1610

CIRCLE 362 ON READER-SERVICE CARD

Germanium Computer Transistors

Have 10 meg-hr life test

These eight, alloy germanium computer transistors have 10 meg-hr of recorded life test reliability data. They have emitter-to-base voltages of 25 v and collector-to-emitter voltages from 15 to 25 v. The collector-to-base voltage for the pnp

eries (2N1303, 2N1305, 2N1307, 2N1309) is 30 v and fo the npn types (2N1302, 2N1304, 2N1306, 2N130 25 v. Collector current is 300 ma; emitter cur nt is 300 ma; power dissipation is 150 mw.

Texas Instruments, Inc., Semiconductor Components Div., Dept. ED, P. O. Box 312, Dallas, Tex.

Booth 103-106

CIRCLE 363 ON READER-SERVICE CARD

Servo Breadboard Kits

In precision 1, 2, and 3 tolerances

These breadboard kits contain over 2000 different precision components adaptable to all mechanical and electronic applications. They include gears, speed reducers, differentials, limit stop assemblies, and other parts in 1/8, 3/16, and 1/4 in. shaft diameters and precision 1, 2, and 3 tolerances.

PIC Design Corp., Dept. ED, 477 Atlantic Ave., East Rockaway, N.Y.

Booth 120

CIRCLE 364 ON READER-SERVICE CARD

Locknuts

Are lighter than sheet metal

These cold-forged locknuts are lighter in some sizes, yet just as strong, as the sheet metal (NAS-679) and AN series nuts they replace. The FN-12 series permit close installation to a perpendicular bulkhead and have great fatigue and vibration strength. Available in diameter sizes No. 4 through 3/8 in., they meet MIL-N-25027 specs.

Standard Pressed Steel Co., Dept. ED, Jenkintown, Pa.

Booth 820-822

CIRCLE 365 ON READER-SERVICE CARD

Inclined Panel Consoles

Accept standard rack panels

Structural members of console models BI-1828, BI-2228, BI-2419, and BI-2421 are aluminum extrusions, and all joints are ball-cornered aluminum castings. The consoles have a 22.5 deg inclined panel and include a framework, top, bottom, two sides, and a reinforced door. The framework is drilled and tapped to accept standard rack panels, and casters may be attached to the bottom.

Bud Radio, Inc., Dept. ED, 2118 E. 55th St., Cleveland 3, Ohio.

Booth 1311-1312

CIRCLE 366 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Triode Cavities

Have 10% tuning range

Series 10 triode cavity components are engineered for restricted 10% tuning range. Small, and lightweight, they meet environmental requirements of MIL-E-5272 and construction requirements of MIL-E-5400. They are available in a frequency range from 255 mc up to high frequency limits of existing planar triodes.

J-V-M Microwave Co., ED, 9300 W. 47 St., Brookfield, Ill.

Booth 3714

CIRCLE 368 ON READER-SERVICE CARD

Silicon References

Temperature coefficients are 0.001% per C

Subminiature silicon voltage references, 1N821-1N827 series, provide an ideal thermal connection between a Zener diode and its compensating stabistor, assuring that the junctions operate at the same temperature. This eliminates warm-up transients. Also available as double anode types, they offer temperature coefficients as low as 0.001% per C.

Transitron Electronic Corp., Dept. ED, 168 Albion St., Wakefield, Mass.

Booth 3002-3004

CIRCLE 369 ON READER-SERVICE CARD

Double Shaft Gearmotor

Is driven by 200 v ac 400 cps 3-phase motor

Double shaft gearmotor, model 35YH29RP100, is driven by a 200 v ac 400 cps 3-phase motor. Typical speeds and torques which are produced by various different types of gear sets are 1700 rpm at 96 oz-in. of torque on one shaft, and 4700 rpm at 650 oz-in. torque on the opposite shaft.

Western Gear Corp., Electro Products Div., Dept. ED, 132 W. Colorado Blvd., Pasadena, Calif.

Booth 2915-2917

CIRCLE 370 ON READER-SERVICE CARD

Ferrite Duplexer

For 16 to 17 kmc frequency range

Light-weight ferrite duplexer MA-122TS is used in the 16 to 17 kmc frequency range Peak power is 150 kw; average power is 150 w. Receiver duplexer loss is 1.2 db max; transmit duplexer loss is 0.3 db max. Recovery time is 2 μsec, and it has 500 hr minimum life.

Microwave Associates, Inc., Dept. ED, Burlington, Mass.
Booth 623

CIRCLE 376 ON READER-SERVICE CARD

Parametric Diode

Has high cut-off frequency

These parametric diodes have cut-off frequencies ranging up to 150 kmc, and a zero-bias capacities as low as 0.4 μμf.

International Telephone and Telegraph Corp., Components Div., Dept. ED, Clifton, N.J.
Booth 2510-2512

CIRCLE 377 ON READER-SERVICE CARD

Data Storage Units

Have 200 kc operating rate

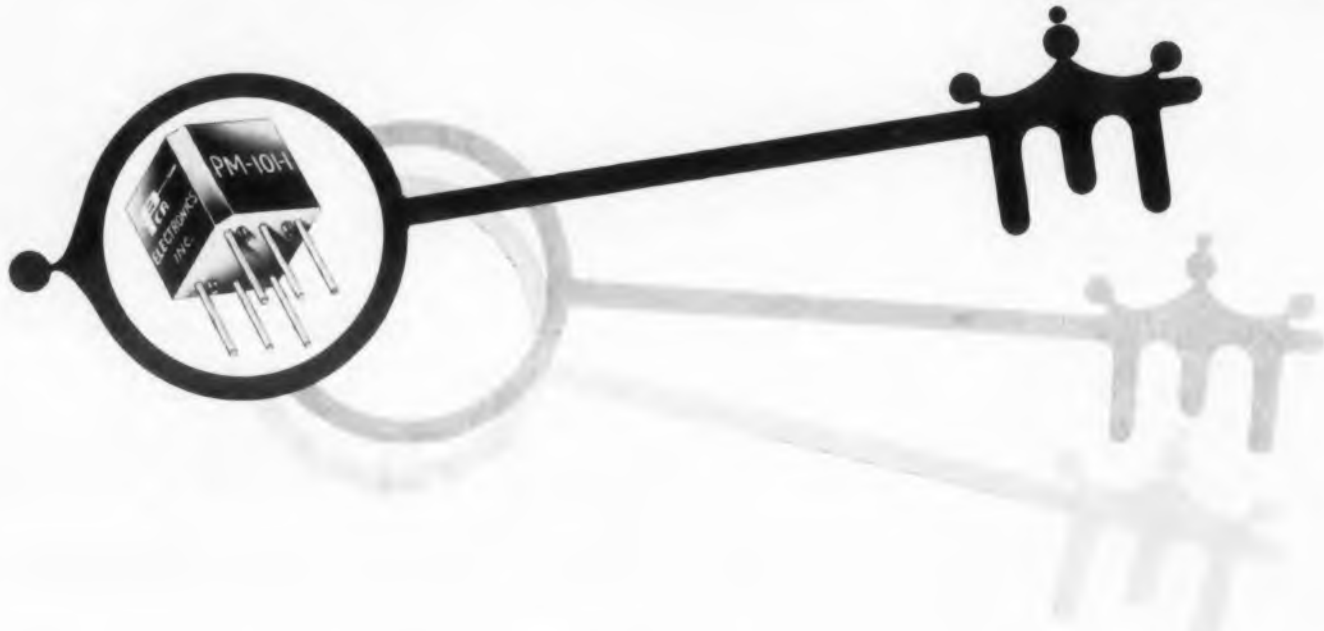
Series RB memory-buffer data storage units offer addressable random acces, sequential access, or a combination of both. They will accept pulses of either polarity and input may be changed during operation. Operating rate is 200 kc and capacities range from 128 to 1024 words of from 4 to 24 bits per word.

Telemeter Magnetics Inc., Dept. ED, 2245 Pontius Ave., Los Angeles 64, Calif.
Booth 2125-2126

CIRCLE 378 ON READER-SERVICE CARD

keyed for automation

PM
Style Pulse Transformers



Applicable specs: MIL-T-27... MIL-T-21038, Case H

PM STYLE PULSE TRANSFORMERS by PCA ELECTRONICS enable installation by automation! Precision molded, with a chamfered edge .062 inch in width, this highly miniaturized transformer features a core of grain oriented silicon steel. A vacuum impregnated internal assembly and case material in glass alkyd, combine to eliminate shock and vibration problems. Mounted by soldering on etched circuit boards, it has four bosses to prevent moisture condensation between unit and board.

PM Size	2 Wndg.	3 Wndg.	4 Wndg.
.400 x .400 x .400 ht.	PM-101—0.1 and under	PM-111—0.1 and under	Not available
.562 x .562 x .500 ht.	PM-101—0.2 to PM-101—5	PM-111—0.2 to PM-111—5	PM-1111—0 to PM-1111—4
.700 x .700 x .650 ht.	PM-101—6 to PM-101—25	PM-111—6 to PM-111—25	PM-1111—5 to PM-1111—25

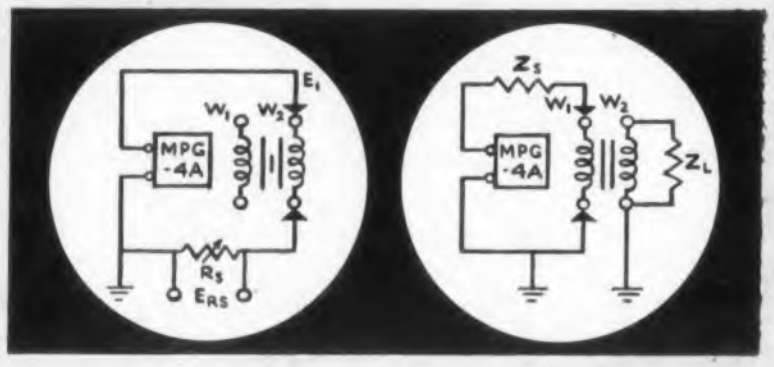
PM STYLE PULSE TRANSFORMERS by PCA ELECTRONICS are designed to serve a wide range of applications.

A few typical applications are usage in:

DC isolation circuits
Blocking oscillator circuits
Low voltage inter-stage coupling
As wide band input and output transformers
Impedance matching and phase inversion
Low-voltage and counting circuits
Triggering circuits
Pulse shaping circuits

DESIGN APPLICATIONS

The number following the dash (box left) represents an approximate pulse width obtained in a coupling circuit. If, for example, a 2 microsecond pulse is desired, a PCA transformer MPT-101-2 is suggested as an approximation. Should a third winding be required, an MPT-11X-2 may be used where X is the desired winding ratio.



Write Today For Complete Pulse Transformer Catalog

PCA ELECTRONICS, INC.

Leading Manufacturers of Pulse Transformers and Delay Lines

16799 SCHOENBORN STREET, SEPULVEDA, CALIFORNIA

CIRCLE 379 ON READER-SERVICE CARD

PCA ELECTRONICS, INC.

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P.O. Box 8215, Madeira Beach, Fla.
(Florida, Alabama, Georgia)

JAY STONE & ASSOCIATES
22250 Brookmill Rd., Los Altos, Calif.
(Northern California)

BOOTH WESCON 3404 SHOW

Rotary Stepping Switches

Supplied with plug-in connectors

All of the company's industrial rotary stepping switches can be supplied with plug-in connectors, prewired and ready for use. The type 45 switch is available in an AE-4500-B hermetically sealed enclosure with multiple-pin headers. Plugged into a matching socket mounting plate, this unit provides 462 connections in seconds. For cable connections, another quick-connect version of the AE-4500 enclosure can be furnished ready for direct insertion of previously wired matching cable plugs. The type 44 miniature switch is available in an AE-4400 unsealed enclosure.

Automatic Electric Co., Dept. ED, Northlake, Ill.

Booth 1406-1407

CIRCLE 380 ON READER-SERVICE CARD

Pulse Generator

Has less than 8 mμsec rise time

Pulse generator B-5-A has a less than 8 mμsec rise time. It has an electronic pulse delay that can be set to zero or is continuously variable from 0.030 to 500 μsec in five ranges. This generator has a fixed delay of 0.1 μsec between the synchronizing pulse out and the main pulse. The pulse width is continuously variable from 0.02 to 12.5 μsec in four ranges. It is also available in a double pulse version.

Rutherford Electronics Co., Dept. ED, 8944 Lindblade Ave., Culver City, Calif.

Booth 2002

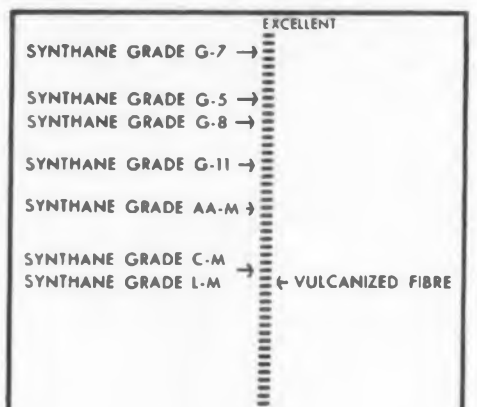
CIRCLE 382 ON READER-SERVICE CARD ➤

Arc Resistance with Synthane Laminated Plastics

Resistance to arcing is important in such applications as terminal boards, switch and fuse blocks, and circuit breakers. Usually, however, arc resistance alone is not sufficient to satisfy job requirements. Ceramics, for example, are excellent for arc resistance but they break easily and are difficult to machine. Mica has excellent arc resistance yet lacks strength.

Laminates have arc resistance plus

Laminated plastics have many desirable properties in combination. All grades of plastic laminates have good electrical properties. All have good dielectric strength, dissipation factor and insulation resistance. Some laminates also have excellent arc resistance and some—the phenolic laminates, for instance—are relatively poor in this respect.



Relative Arc Resistance of Several Plastic Laminates and Vulcanized Fibre.

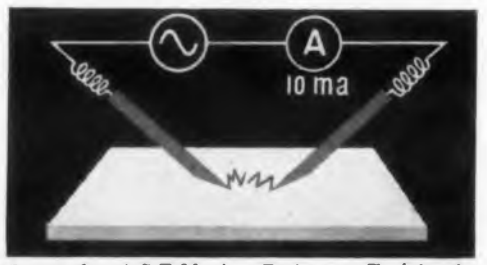
It is this failing of the phenolic grades which may have deterred you from thinking of laminates when arc resistance was required. But, outstanding progress has been made to supply laminates with excellent arc resistance. For example, Grades CM, LM, G-5 and G-7 have outstanding arc resistance properties.

There are several tests for arc resistance. One commonly used is ASTM Method D495-56T, which approximates service conditions in alternating current circuits operating at a high voltage, with currents limited to units and tens of milliamperes. Two pointed electrodes, 1/4" apart (see drawing), rest upon the material to be tested. The arc is applied intermittently, and at first mildly. Later the time between flashes is decreased and the amperage is increased until the arc finally burns a conducting path between the electrodes. The total time in seconds until failure occurs is the arc resistance of the material.

Arc resistance is related to time

Since the severity of the arc is progressively increased, the comparative arc resistance of two materials is not in direct proportion to the time. The accompanying chart gives you a fairly accurate relationship of the arc resistance of Synthane laminates—using the ASTM method. The first four are glass base grades. G-7, containing a silicone resin, tops the list in arc resistance as well as in dielectric strength, dissipation factor, insulation resistance and moisture resistance.

For specific information relating to Arc Resistance for your application or for the combined properties of Synthane laminates, write Synthane Corporation, 42 River Road, Oaks, Pa.



Set-up for A.S.T.M. Arc Resistance Test in the Synthane Laboratory.

SYNTHANE
CORPORATION **OAKS, PENNA.**
Laminated Plastics for Industry
Sheets, Rods, Tubes, Fabricated Parts
Molded-laminated, Molded-macerated

CIRCLE 383 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Temperature Test Chambers

Have ranges from −70 to +320 C

Bench type BC and rack type RC temperature test chambers are contained in metal cabinets 17-1/2 x 12 x 22 in. and weigh about 65 lb. Heating is accomplished by electric heaters and cooling is provided by solid or liquid CO_2. Models BC-2A and RC-2A have −55 to +175 C ranges with ±1 C control accuracy. Models BC-2B and RC-2B have the same control accuracy and a −70 to +175 C range. Models BC-4A and RC-4A Cover −55 to +320 C, while models BC-4B and RC-4B cover −70 to +320 C, all with ±2 C control accuracy. The units operate on 115 v, single phase, 50 to 60 cps power and contain 8 x 9-1/2 x 8 in. work chamber.

Statham Development Corp., Dept. ED, 1845 Pontius Ave., Los Angeles 25, Calif.
Booth 3701

CIRCLE 384 ON READER-SERVICE CARD

TWT Amplifier

Provides 0.1% regulation

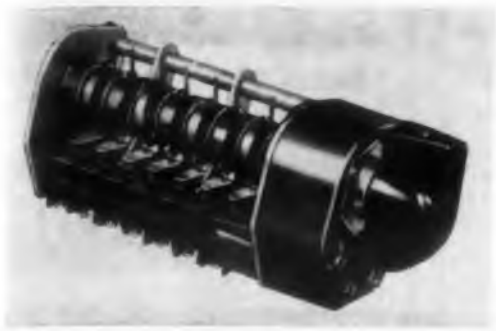
Permanent magnet focused twt amplifier model TA 36PM is a light compact unit for 0.5 to 1 kmc operation. It provides 0.1% regulation with a maximum ripple on the helix of less than 10 mv. Designed for relay rack or cabinet mounting, the unit has front panel metering for helix voltage, helix current, and beam current.

Menlo Park Engineering, Dept. ED, 711 Hamilton Ave., Menlo Park, Calif.
Booth 311

CIRCLE 385 ON READER-SERVICE CARD

Rotary Selector Switch Assemblies

For computer panels



For use on aircraft, electronic, and computer panels, series 28AS rotary selector switch assemblies can be provided with two to eight basic plastic enclosed spdt switches and two or three actuator positions. Detents are 90 deg. The actuating mechanism imparts a good feel of the detent action and provides immediate indication of each position in the operating cycle. Switching sequences can be adjusted to specifications and a stainless steel dust cover can be provided. Turret solder terminals are standard, but plastic covered leads embedded in epoxy are also available. The basic switches are UL listed for 5 amp, 125 or 250 v ac.

Micro Switch, Div. of Minneapolis-Honeywell Regulator Co., Dept. ED, Freeport, Ill.
Booth 2621-2623

CIRCLE 386 ON READER-SERVICE CARD

Amplifier

Operates as carrier or dc unit

The model 909 operational-carrier amplifier consists of two amplifiers. One is the carrier amplifier which includes the carrier oscillator, signal amplifier, demodulator, and balance circuits. The other is a chopper stabilized dc amplifier which provides the necessary current to drive the galvanometer. As a carrier amplifier, the unit has a range of 3 to 50 kc and a response that is flat ±1% dc to about 10% of carrier frequency. The dc amplifier response is dc to 5 kc ±0.1 db or dc to 10 kc ±1 db. Output capability is ±10 v at 200 ma.

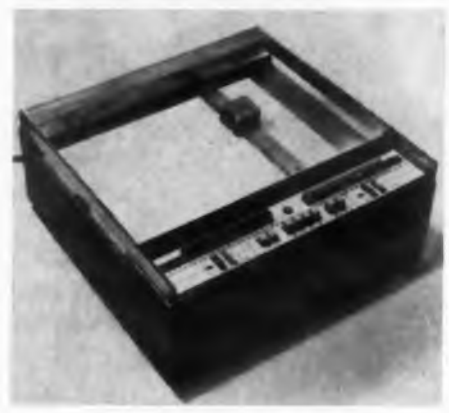
Midwestern Instruments, Inc., Dept. ED, 41st and Sheridan, Tulsa, Okla.
Booth 2115-2116

CIRCLE 387 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

X-Y Plotter

Has pushbutton controls



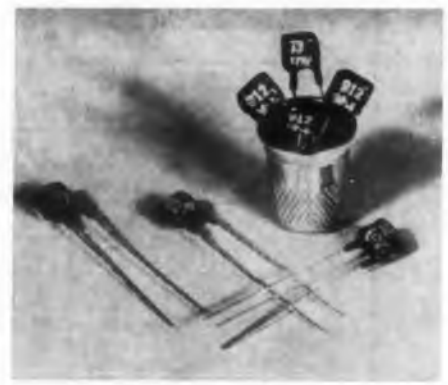
Featuring pushbutton controls and a full vernier control range, the model 210 X-Y plotter has a static accuracy of ±0.1% and a dynamic accuracy of ±0.2% at 10 ips tracing speed. Separate switching circuits for X and Y references permit translation of X and Y origins to any position in the plot area. Rated for 115 v, 60 cps operation, the unit consumes 225 w and has a response of 20 ips in either axis. It may be used in either a vertical or horizontal position. Both control panel and plotting table are available as standard table units or for 19 in. rack mounting.

Librascope, Inc., Dept. ED, Glendale, Calif.
Booth 3107-3109

CIRCLE 390 ON READER-SERVICE CARD

Solid Tantalum Capacitors

For printed circuits



Designed primarily for quick insertion in printed circuits, type TAM solid electrolyte tantalum capacitors are encapsulated in a flexible plastic coating which provides good dielectric insulation and moisture resistance. Their grid spaced leads meet EIA standards for printed circuitry. The units operate from −55 to +85 C, have capacitances from 6.8 to 56 μf, and are rated at 6 to 25 wvdc.

P. R. Mallory & Co., Inc., Capacitor Div., Dept. ED, Indianapolis 6, Ind.
Booth 601-602

CIRCLE 391 ON READER-SERVICE CARD

Using Thermistors

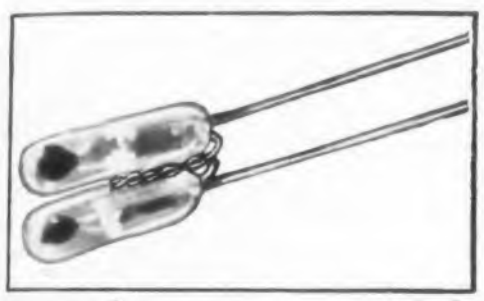
Edited by
FENWAL ELECTRONICS

—

NEW "IDENTICAL" THERMISTORS PERMIT COMPLETE INTERCHANGEABILITY

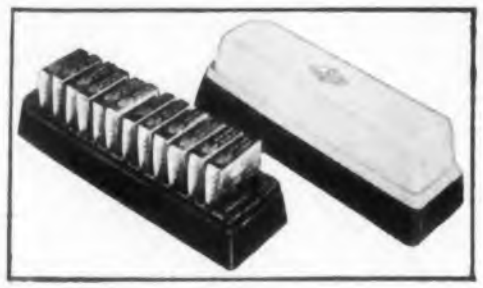
Now thermistor probes can be supplied with identical resistance temperature curves. These thermistors will meet a nominal curve tabulated in absolute resistance values at 1°F increments from 0°F to 350°F. All probes will be within ±2% of resistance at any temperature point on the curve.

This now offers the user complete interchangeability and the opportunity to provide multi-point indication or control without having to individually calibrate



Shown four times actual size. Patent Pending

each thermistor sensor. This, of course, is coupled with the advantage of tremendous sensitivity obtained from the inherent characteristic of a thermistor that gives, in this case, a resistance change of from 26,520 ohms at 0°F to 70.4 ohms at 350°F. This curve can be obtained from Fenwal Electronics. Other details on these and other closer tolerance thermistors, ideal for telemetry and instrumentation, can be obtained from Fenwal Electronics, Inc., 37 Mellen Street, Framingham, Mass.



EXPERIMENTERS' KIT

The G200 Experimental Kit shown here simplifies selection of the "right" thermistor. Contains 12 different thermistors, each with complete operating characteristics. Available from distributors or the Framingham plant, $19.95 net.

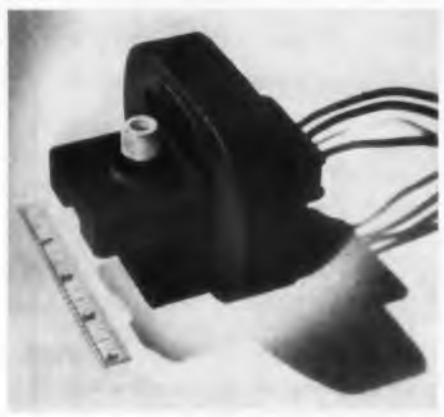
Fenwal Electronics

Making Precision Thermistors
to Make Your Design Ideas Come True

CIRCLE 393 ON READER-SERVICE CARD

Magnetron Package

Voltage tunable



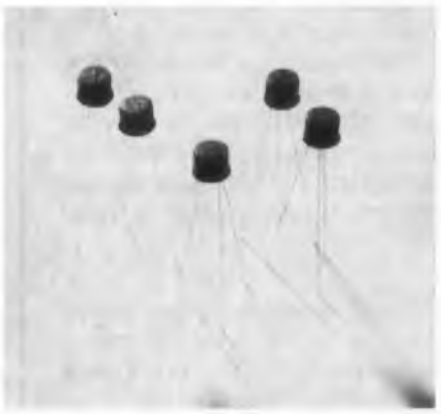
A complete radio frequency power source package, the model GL-7398 consists of a voltage tunable magnetron tube, a radio frequency circuit or cavity, and a magnet. It is voltage-tunable over part or all of a frequency spectrum from 2200 to 3850 mc with a minimum cw power output of 2 w across the full range. Power output response is flat over a 1.75 to 1 frequency range, and anode voltage is 1250 v at 3000 mc. The voltage tuning is essentially linear as a function of the anode voltage. The complete unit is 4 x 4 x 3-1/4 and weighs 3.1 lb. It can be used in a variety of airborne and spaceborne receiving and transmitting equipment.

General Electric Co., Power Tube Dept., Dept. ED, Schenectady 5, N. Y.
Booth 2113

CIRCLE 394 ON READER-SERVICE CARD

Fast Switching Transistors

For saturated logic circuits



Designed for saturated logic circuits operating at low current levels, the 2N706 silicon switching transistor provides a typical DCTL propagation delay of 5 μsec per inverter. The double diffused mesa unit can also be used in nonsaturating circuits or as a linear amplifier. Typical maximum frequency of oscillation is 400 mc.

Fairchild Semiconductor Corp., Dept. ED, 545 Whisman Rd., Mountain View, Calif.
Booth 616-618

CIRCLE 395 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Vibration Meter

Accepts six transducer outputs at once

Portable, battery powered model T-1A vibration meter provides direct readings of the velocity, displacement amplitude, and acceleration components of vibration. Frequency can be determined by a simple computation. The unit can accept up to six simultaneous transducer outputs, three for velocity type pickups and three for crystal accelerometers. It provides readings of up to 1000 g acceleration, 0.01 to 100 ips velocity, and 0.001 to 10 in. displacement. Overall accuracy is better than 5%.

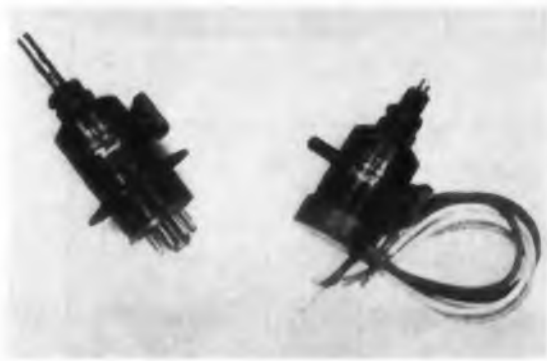
Southwestern Industrial Electronics Co., Dept. ED, 10201 Westheimer Rd., P.O. Box 13058, Houston 19, Tex.

Booth 420-422

CIRCLE 398 ON READER-SERVICE CARD

Klystron Tubes

Operate from 34 to 35.6 kmc



Tube types TE-53 and TE-78 are mechanically tuned reflex klystron oscillators that operate from 34 to 35.6 kmc. Ruggedly built, they have ceramic insulators, dielectric tuning, waveguide output, and an improved electron gun. The units provide stable operating frequency, low resonator voltage, and high power output in communication, countermeasure, and radar systems. They may serve as local oscillators, pump sources, or signal generators in these or other applications.

Bendix Aviation Corp., Red Bank Div., Dept. ED, Eatontown, N. J.

Booth 2007-2010

CIRCLE 399 ON READER-SERVICE CARD

Damping Motor Generator

Weighs 1.3 oz

This 1.3 oz, size 6 damping motor generator delivers a stall torque of 0.11 oz-in. min and requires an input of 1.25 w, 26 v at 400 cps. Acceleration from stall is 23,600 rad per sec^2; moment of inertia is 0.33 g-cm^2; maximum null is 12 mv; and minimum signal-to-noise ratio is not more than 8.

Daystrom Transicoil, Dept. ED, Worcester, Montgomery Co., Pa.

Booth 3209

CIRCLE 400 ON READER-SERVICE CARD

Rectangular Power Connector

Has 130 contacts

Suited for heavy duty aircraft applications, the 250130 rectangular, 130-contact plug and socket connector has a sea level rms voltage breakdown rating of 1800 v and a current rating of 10 amp, continuous and 13 amp, maximum. It incorporates polarizing screwlocks which are easily disconnected and yet provide a positive lock against vibration or accidental disconnection. The taper cup contacts accommodate AMP Series 53 taper pins for solderless wiring; the pin contacts are brass with gold over silver plate; and the socket contacts are phosphor bronze with gold over silver plate. Contact area of either plug or receptacle is slightly less than 5 sq in. The standard molding is glass filled diallyl phthalate.

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

Booth 402

CIRCLE 401 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Hydrogen Thyratron

Carries 2000 amp peak current

Designed for switching service in radar modulators, the GL7390 hydrogen thyratron is especially suitable for pulsing magnetrons and other high frequency oscillators with power inputs to 33 megawatts peak and 60 kw average. It carries maximum cathode currents of 2000 amp peak and 4 amp average and withstands maximum inverse and forward peak anode voltages of 33 kv. Anode dissipation factor is 30 x 10^9 and maximum anode current rise rate is 10,000 amp per μsec. The unit weighs 9 lb and operates from −55 to +75 C.

General Electric Co., Power Tube Dept., Dept. ED, Schenectady 5, N. Y.
Booth 2113

CIRCLE 404 ON READER-SERVICE CARD

Direct Reading Ohmmeter

Has 0.25% full scale accuracy

Instead of measuring current flowing through an unknown resistance from a fixed voltage source the model MV-279A direct reading ohmmeter measures the voltage drop produced across an unknown resistor by a constant current. This approach to resistance measurement affords 0.25% full scale of 1% absolute accuracy. The meter has a linear scale and 11 measuring ranges from 1 ohm to 1 meg full scale.

Millivac Instruments, Dept. ED, Box 997, Schenectady, N.Y.
Booth 2101

CIRCLE 405 ON READER-SERVICE CARD

in microwave design . . .

Put PERMANENT MAGNET SPECIALISTS

on your development team

Application of permanent magnets in microwave devices has resulted in vastly improved performance, lower costs and greater stability. Since the early days of microwave research, The Indiana Steel Products Company magnet design engineers have worked closely with leading manufacturers, providing expert help in developing special-purpose permanent magnet assemblies for such applications as radar magnetrons, backward wave oscillators, pm-focus traveling wave tubes and load isolators.

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World's largest manufacturer of permanent magnets

INDIANA PERMANENT MAGNETS

In CANADA: The Indiana Steel Products Company of Canada Limited, Kitchener, Ontario

CIRCLE 407 ON READER-SERVICE CARD

HV Power Supply

Has 0.01% per hr stability

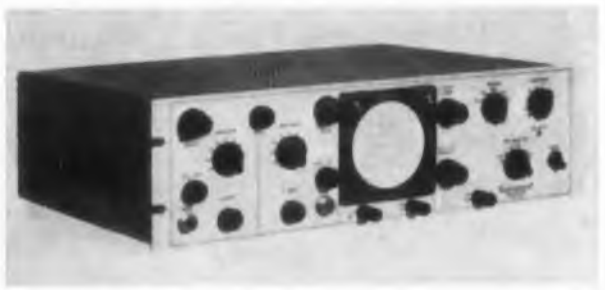
Power supply model 304 provides a continuously adjustable output of 500 to 2500 v at 25 ma. Load change is less than 0.002% for 0 to 25 ma output and regulation is 0.003% for line changes of 97 to 137. Ripple is less than 0.5 mv and stability is 0.01% per hr or 0.1% per day.

Interstate Electronics Corp., Dept. ED, 707 E. Vermont Ave., Anaheim, Calif.
Booth 2315-2316

CIRCLE 408 ON READER-SERVICE CARD

Double Beam Oscilloscope

For rack mounting



The model D31R double beam oscilloscope has a dual gun cathode ray tube, individual brightness controls, dc to 6 mc twin amplifiers, an automatic sync, trigger level control, and built-in time and voltage calibrators. Designed for rack mounting the low cost unit has a panel height of 7-3/4 in.

Scopes Co., Inc., Dept. ED, P.O. Box 56, Monsey, N.Y.
Booth 2033-2034

CIRCLE 409 ON READER-SERVICE CARD

Indicator Light Sockets

Mount in 15/32 in. clearance hole

Subminiature indicator light socket 162-8430-931 accommodates T-1-3/4 incandescent lamps; socket 137-8536-931 holds NE-2D or NE-2J neon lamps. Both sockets mount in 15/32 in. clearance hole from front of panel.

Dialight Corp., Dept. ED, 60 Stewart Ave., Brooklyn 37, N.Y.
Booth 1404-1405

CIRCLE 410 ON READER-SERVICE CARD

Design Economies with Vibrating Reeds

TIMING OR WARNING ALARMS

Vibration on case or housing creates buzz alarm for appliances, such as automatic washers, dryers, ranges, etc.

TOY SOUND EFFECTS

Remotely controlled train whistles and engine noises generated by repetitive electrical or mechanical pulses.

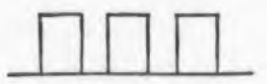
VIBRATION GENERATOR

Mechanical tapper tests for microphonics of tubes or other components.

LIGHT CHOPPER

Interrupts a beam of light at frequencies of 20 to 120 cps to provide a pulsating photoelectric output proportional to the light intensity.

PULSE POWER GENERATOR

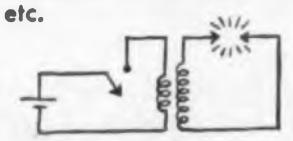


Typical application is for life testing devices such as relays which must be cycled rapidly. Cost is much lower than a geared motor with cam actuated switch performing a like function.

FREQUENCY SENSITIVE RELAY

Used with frequency generators as low cost remote controls for garage doors, television, etc.

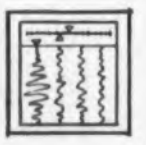
IGNITION DEVICES



Used as independent breaker points for car and aircraft heaters, jet engines, and other ignition jobs.

ECONOMICAL CHOPPERS

Available with power interrupting capability, low-noise and low-resistance variations.



Provides 100 cps from DC power sourc Driving circuit isolated from chopp contacts. Now being used in medic and aircraft equipment. Frequency do bler chopper operates at 120 cps wh driven by a 60 cps supply. Low cc 60 cps chopper for commercial us Polarized, will follow a 60 cps source

FREQUENCY GENERATOR

Typical uses include: 20 cps bell ringe 60 cps timing motors for jobs such as o erating taxi meters (eliminates tickin 60 cps *constant frequency* unit (±½ c over a voltage range of 4 to 1) for pr cision timers, clocks, tape recorde meters, etc. The latter is an exclusiv Oak patented design.

TEST EQUIPMENT

Used in instruments to check for "ho days" in insulation on pipe lines, mec ure insulation resistance, and test ig tion systems and timing of cars.

HIGH POWER CONVERTER

In addition to units for all standard po er ranges, Oak supplies a special hi power vibrator (patented) which allo any number of vibrators to be operat simultaneously at the same frequenc Using this system, four vibrators ha handled as much as 500 watts on an i termittent duty cycle.

There are many ingenious ways to use vibr ing reeds, which can lower costs throu simplified design.

If you've got an idea you'd like to c velop, Oak's engineering specialists will glad to help you work it out. Contact th today.

Oak also supplies a complete line conventional vibrators, custom-built for a application.

OAK MFG. CO.

1260 Clybourn Ave., Dept.
Chicago 10, Illinois
Phone: MOhawk 4-2222

Specialized Applications with Vibrating Reeds

NEW PRODUCTS AT WESCON

Toroidal Winding Machine

Handles No. 7 to 20 wire

Toroidal winding machine model U-14 covers a No. 7 to 20 wire range and handles cores with a maximum finished OD of 14 in. and a maximum finished height of 6 in.

Universal Mfg. Co., Inc., Dept. ED, 1168 Grove St., Irvington, N. J.
Booth 1121

CIRCLE 413 ON READER-SERVICE CARD

Power Supplies

Deliver 0.5 to 32 v dc

For laboratory use, these dc power supply models 62-141 and 62-142 provide 0.5 to 32 v dc at 0 to 5 and 0 to 10 amp, respectively. Line and load regulation are less than 18 mv, ripple is less than 1 mv, and load transients are less than 200 mv.

Dressen-Barnes Corp., Dept. ED, 250 N. Vinedo Ave., Pasadena, Calif.
Booth 2221

CIRCLE 414 ON READER-SERVICE CARD

Cabinet

For portable instruments

The Portacab is a lightweight contoured cabinet built to house various types of instruments requiring stylized appearance. Available in five sizes, it has a flexible carrying handle and is well louvered for ventilation.

Bud Radio, Inc., Dept. ED, 2118 E. 55 St., Cleveland 3, Ohio.
Booth 1311-1312

CIRCLE 415 ON READER-SERVICE CARD

Capacitance Bridge

Measures 0.0002 to 1000 μμf

Designed to operate at 1 mc, the model 75-A capacitance bridge has a self-contained oscillator and detector and measures capacitances from 0.0002 to 1000 μμf. It can be used in temperature coefficient work, affording differential measurements with ±1 ppm readability on nominal values above 200 μμf. The unit measures either direct or grounded capacitance and has a separate conductance balance with a 0.01 to 1000 μmho range. Provision is made for connecting an external oscillator and detector for measurements below 100 kc.

Boonton Electronics Corp., Dept. ED, 738 Speedwell Ave., Morris Plains, N. J.
Booth 317

CIRCLE 418 ON READER-SERVICE CARD

Recording Oscillographs

Offer wide choice of speeds

For direct presentation of test data and continuous monitoring of stress, pressure, vibration, and other phenomena, series 621 oscillographs record directly on readout paper 6 in. wide. Standard units have speeds from 0.2 to 40 ips in 18 steps selected by manual gear changes. Other available ranges are 0.02 to 40 ips, 0.3 to 60 ips, and 5 to 1000 mm per sec. Model 621S is a spit-out version with no take-up spool, while models 621-HT and 621-VT have take-up and storage spools and horizontal and vertical record tables, respectively.

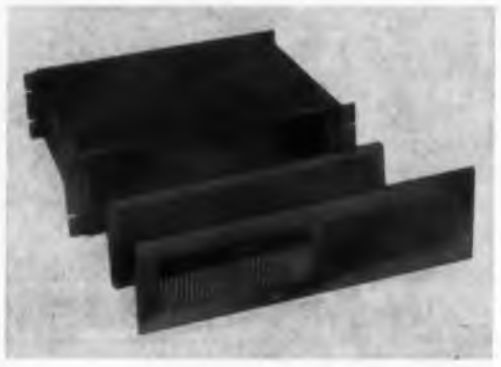
Midwestern Instruments, Dept. ED, 41st and Sheridan, Tulsa, Okla.
Booth 2115-2116

CIRCLE 419 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Blower

Fits standard racks and cabinets



Depending upon its mounting position, the model B-25 Trans-aire can be used as an exhaust or intake blower. It has a two-speed 1/10 hp motor and operates on 110 v, 60 cps current, delivering either 550 or 250 cfm at 0 deg static pressure. The unit, which is 5-1/4 in. high, 14-1/2 in. deep, and 17 in. wide, may be mounted to the rails of standard racks and cabinets. It operates in any position and is supplied with a model BF-26 oil impregnated, fiber glass replacement filter.

Bud Radio, Inc., Dept. ED, 2118 E. 55th St., Cleveland 3, Ohio.

Booth 1311-1132

CIRCLE 422 ON READER-SERVICE CARD

Photoconductive Cell

Covers 3300 to 7400 angstroms

A head-on type of cadmium-sulfide photoconductive cell, the model 7412 is designed for a variety of light-operated relay applications. It is hermetically sealed in a glass envelope for protection against humidity and has a photosensitive area of 0.2 x 0.02 in., a maximum diam of 0.3 in., and a maximum length of 1.35 in. without the flexible leads. Its spectral response range is 3300 to 7400 angstroms, with maximum response occurring at 5800 angstroms.

Radio Corporation of America, Electron Tube Div., Dept. ED, Harrison, N.J.

Booth 507-509

CIRCLE 423 ON READER-SERVICE CARD

Airborne Amplifier

Handles strain gage and accelerometer signals

Airborne amplifier model AC-1 is a rugged, 4-oz. unit for in-flight strain gage and accelerometer signal amplification. Mainly for use with piezoelectric accelerometers, it has a 500 meg grounded input and a 20 K grounded output. Gain is continuously variable from 10 to 100 at up to 60 mv rms input. Bandwidth is 5 cps to 10 kc; gain stability is 5%; and linearity is 1%. The unit operates at temperatures from −20 to +100 C, at altitudes to 100,000 ft, and under vibration to 10 g at 2 kc. The black anodized brass case is 3.4 cu in.

Southwestern Industrial Electronics Co., Dept. ED, 10201 Westheimer Rd., Houston 19, Tex.
Booth 420-422

CIRCLE 426 ON READER-SERVICE CARD

Toggle Switches

Have lever locking device

Series 13AT toggle switches have an integral locking device that holds the toggle lever in a set position and requires a pull of about 0.09 in. to be changed from one position to another. The units are available in many combinations from two to four pole, with or without gold contacts and turret terminals. The basic miniature switches are spdt, and UL listed at 5 amp, 250 v ac. The 30 v dc rating includes: inductive, 3 amp at sea level and 2.5 amp at 50,000 ft; resistive, 5 amp at sea level and 50,000 ft. Maximum inrush is 24 amp.

Micro Switch, Div. of Minneapolis-Honeywell Regulator Co., Dept. ED, Freeport, Ill.
Booth 2621-2623

CIRCLE 427 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Line Impedance Stabilization Networks

For conducted interference testing

When inserted in an ac-dc power line, the 50 amp model 91221-1 and 100 amp model 91222-1 impedance stabilization networks present a definite rf impedance to the interference producing equipment and to the power source. When the equipment is thus isolated, accurate and repeatable interference acceptance tests may be performed upon it in conjunction with radio interference measuring devices. Both networks meet MIL-I-6181B, MIL-I-1691OA, and commercial FCC regulations. The 50 amp model also meets MIL-I-26600.

Stoddart Aircraft Radio Co., Inc., Dept. ED, 6644 Santa Monica Blvd., Hollywood 38, Calif. *Booth 3704-3704A*

CIRCLE 430 ON READER-SERVICE CARD

Hand Size Ohmmeter

Reads down to 0.1 ohm

The hand size model 308 Lo-Ohmmeter has 0 to 50, 0 to 500, and 0 to 5000 ohm ranges with 1 ohm at center scale on the 0 to 50 range. The scale length to the 0.1 ohm position is 3/16 in. The unit has an elastic strap that anchors it to the palm and an adjustment knob that compensates for battery voltage variations. The self-shielded, 1 ma full scale meter is contained in an insulated 2-3/4 x 4-1/4 x 1-3/16 in. molded case.

The Triplett Electrical Instrument Co., Dept. ED, Bluffton, Ohio.
Booth 1503

CIRCLE 431 ON READER-SERVICE CARD

Indicator Tube

Has 2-in. characters

Nixie indicator tube B7031 provides a numerical display of the digits zero through nine in a common viewing area. The characters are 2 in. high and are visible at distances of over 150 ft. It has a life expectancy of 30,000 hr and a side viewing design which makes possible close stacking of tubes. Maximum ionization voltage is 300 v dc; minimum supply voltage is 300 v dc; average cathode current is 10 ma.

Burroughs Corp., Electronic Tube Div., Dept. ED, Plainfield, N.J.
Booth 2919-2921

CIRCLE 433 ON READER-SERVICE CARD

Linear Powder Core

Stabilizes filter networks

Used with a low cost polystyrene capacitor in filter networks, this linear molybdenum Permalloy powder core can produce 0.5% frequency stability for temperature swings between −55 and +85 C. Its inductance is within ±8% of nominal per 1000 turns.

Magnetics, Inc., Dept. ED, Butler, Pa.
Booth 403-405

CIRCLE 434 ON READER-SERVICE CARD

Printer

Features solid-state electronics

Solid-state printer model 400C-T is compatible with all makes of solid-state counting equipment having a four-line 1-2-2-4 binary coded decimal output. It uses transistorized plug-in drivers for each digit. These modules can be changed to match a variety of outputs. Other features include four lines per sec printout, parallel entry, and standard six digit printout. Code line input requires 6 v.

Computer-Measurements Co., Dept. ED, 5528 Vineland Ave., N. Hollywood, Calif.
Booth 2005-2006

CIRCLE 435 ON READER-SERVICE CARD

Electronic Products NEWS
by CARBORUNDUM
Registered Trade Mark

MEGAWATT transient handled by GLOBAR® 5 Watt SP Resistor to protect Miniaturized Pulse Generator

A tough problem was recently solved by Ramo-Woolridge, a division of Thompson Ramo Woolridge, Inc. It concerned protection against a transient discharge that caused breakdowns in a miniaturized pulse generator.

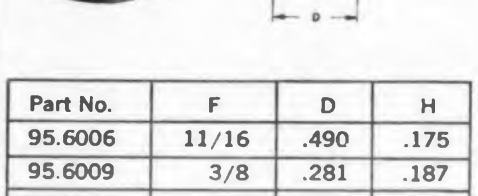
The circuitry, as shown above, involved a modulator for a 1-kw grid-controlled traveling wave tube. The grid would often arc to ground, shorting the energy stored in the condenser C2 through the modulator circuit and vaporizing the decoupling resistor R or the bias filter C3.

The answer was found in a GLOBAR Type SP 100Ω resistor, able to withstand the periodic 8000-v. discharge for several microseconds and to take a temperature of 1000 F. Since this resistor is non-inductive, it works well as decoupling element during normal operation, in addition to giving the protection needed when arcing occurs. 5 watt size 1¼" long, 5/16" diameter, obviates any space problem.

This example may suggest many similar applications. For more details on GLOBAR resistors, write Globar Plant, Refractories Division, Dept. EDR89, Carborundum Company, Niagara Falls, N. Y.

CIRCLE 712 ON READER-SERVICE CARD

Vacuum-tight, matched expansion GLASS-TO-METAL WINDOWS



Part No.	F	D	H
95.6006	11/16	.490	.175
95.6009	3/8	.281	.187
95.6010	7/8	.490	.078
95.6011	3/8	.250	1/8
95.6013	.220	.150	.150

Windows of the type shown above have a variety of applications where truly reliable vacuum-tightness or gas-tightness over a considerable temperature range is desired.

The advantage of these windows is that the frame and glass are united to form a chemically bonded, hermetically sealed unit. Use of KOVAR® alloy and borosilicate hard glass, which have practically identical expansion characteristics, eliminates stress and strain.

Large quantities of these windows are manufactured by Carborundum's Latrobe Plant. Bulletin 5133, giving complete information, is obtainable by writing to Latrobe Plant, Refractories Division, Dept. EDS89, Carborundum Company, Latrobe, Pa.

CIRCLE 713 ON READER-SERVICE CARD

CERAMIC DRUM AND END PLATES for radio tuner GROUND TO .001 ACCURACY

The drum coil and end plates shown in the photo are parts of a tuner for the Transport Radio Command and Ground Radio Command. The plate holes are ground to size with an accuracy of ±.001 and the hole spacing is held to a tolerance of ±.002. The drum with its stainless steel bearing sleeves is a direct ceramic-to-metal assembly. The bearings must withstand a vertical load of 60 lbs. Three of the end holes are tapped. The slot, the pitch and the depth of the spiral winding groove are ground to tolerances of ±.001.

This is an example of the accurate specifications that can be met with equipment at Carborundum's Latrobe Plant, which specializes in ceramic, ceramic-to-metal and glass-to-metal assemblies. Facilities are available for small or large production runs. For more information, write Latrobe Plant, Refractories Division, Dept. EDC89, Carborundum Company, Latrobe, Pa.

CIRCLE 714 ON READER-SERVICE CARD

NEW BOOKLET AVAILABLE ON GLOBAR® Type BRN VARISTORS

Non-linear, voltage sensitive resistors are finding many applications for stabilization or voltage control in electronic circuits. This booklet gives full information. For your copy, write Globar Plant, Refractories Division, Dept. EDV89, Carborundum Co., Niagara Falls, N. Y.

CIRCLE 715 ON READER-SERVICE CARD

CIRCLE 437 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Magnetic Tape Recorder

For frequencies up to 250 kc

Model FR-600 analog magnetic tape recorder has low flutter characteristics; it directly records frequencies as high as 250 kc. The fm response is from dc to 20 kc within 1/2 db. It uses air-lubricated tape guiding instead of fixed or rotating guides. Pulse-duration modulation, fm, direct, or digtal recording modes are available through plug-in modules; 1/2 and 1 in. tapes are interchangeable and both 10-1/2 and 14 in. reels can be used.

Ampex Corp.. Instrumentation Div., Dept. ED, 935 Charter St., Redwood City, Calif.
Booth 3531-3533.

CIRCLE 438 ON READER-SERVICE CARD

Plastic Tubular Capacitors

Have solid impregnant

In tubular plastic cases, Polycap solid impregnant capacitors are humidity resistant and need no outer wax coating. They have a long life, high insulation resistance, and low power factor.

Aerovox Corp., Dept. ED, New Bedford, Mass.
Booth 306-308

CIRCLE 439 ON READER-SERVICE CARD

Horizon Sensor

Provides stable vertical reference

Model 13-130 wide-angle horizon sensor is a passive infrared device which detects thermal discontinuity between the earth and space. Two of these sensors establish a stable vertical reference for control of the orientation or attitude of a missile or satellite. It operates with maximum reliability under severe environmental conditions. Completely self-contained, it weighs 2.5 lb and consumes 4 w.

Barnes Engineering Co., Dept. ED, 30 Commerce Rd., Stamford, Conn.
Booth 3717

CIRCLE 440 ON READER-SERVICE CARD

Core Storage Buffers

Operate at 100 kc

Core storage buffer models 144-BQ8A and 144-BA8A are designed for applications requiring an auxiliary memory to synchronize two data systems. They have a capacity of 144 8-bit characters and a 115 v 0.5 amp, 60 cps self-contained power supply that is unaffected by 100 to 130 v line variations. Loading and unloading occur at a rate of 100,000 characters per sec. Bits are loaded and unloaded in parallel, characters in sequence. The units operate best from 0 to 40 C and derate at 55 C.

Telemeter Magnetics, Inc., Dept. ED, 2245 Pontius Ave., Los Angeles 64, Calif.

Booth 2125-2126

CIRCLE 441 ON READER-SERVICE CARD

Programmable Power Supplies

Have 0.1% accuracy

For precision test use, programmable power supply models PS-32, PS-33, and PS-34 operate from a programmed source such as a magnetic tape reader or punched card, or by manual selection from panel buttons. They furnish a voltage that is accurate within 0.1% and regulated within 0.1% from no load to full load. Voltage ranges are 6 to 36 v dc in 0.1 v steps at 30 amp for the PS-32, 1 to 500 v dc in 1 v steps at 1 amp for the PS-33, and 0 to 99.9 v dc in 0.1 v steps at 1.5 amp for the PS-34.

Southwestern Industrial Electronics Co., Dept. ED, 10201 Westheimer Rd., P.O. Box 13058, Houston 19, Tex.

Booth 420-422

CIRCLE 442 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Resistance Meter

Measures 0 to 10 million meg

The series C-6B resistance meter embodies circuitry with three separate test voltages for measuring 0 to 10 million meg resistances. Overall accuracy is 3% to 10,000 meg and 5% from 10,000 to 10 million meg.

Southwestern Industrial Electronics Co., Dept. ED, 10201 Westheimer Rd., Houston 19, Tex.
Booth 420-422

CIRCLE 445 ON READER-SERVICE CARD

Plug-In Oscillator

Operates over a broad brand

Model LF-3 plug-in oscillator can be used with crystals which have a natural frequency as low as 5 kc and as high as 500 kc without any tuning adjustment or circuit change. It consists of two RC coupled amplifiers that produce a self-regulated, constant output voltage over a wide range of frequencies. Output stability is better that ±2%, with an output voltage of over 1.5 v rms into 50 K. Harmonic distortions are less than 5%.

Telonic Industries, Inc., Dept. ED, Beech Grove, Ind.
Booth 2526

CIRCLE 446 ON READER-SERVICE CARD

Shielded Cable

Has a foam polyethylene insulation

This 25 AWG shielded low-loss cable has a foam polyethylene insulation for lower capacitance and a spiral tinned copper shield to minimize interference. The conductor consists of four strands of tinned Copperweld and three strands of tinned copper.

Belden Mfg. Co., Dept. ED, 415 S. Kilpatrick, Chicago, Ill.
Booth 615-617

CIRCLE 447 ON READER-SERVICE CARD

Feedback Winding Resolvers

Have 0.1% functional error

Designed for use with transistorized amplifiers, these size 8 feedback winding resolvers permit the solution of spherical triangles in a cascaded resolver chain. They can be used to generate complex trigonometric and coordinate axis transformation functions with a functional error of 0.1% or less. Stator input is 15 v, 400 cps; rotor and compensator outputs are both 13.7 v; phase shift with the stator as the primary is 20.5 deg; and maximum null voltage is 1 mv per v.

Clifton Precision Products Co., Inc., Dept. ED, 9014 W. Chester Pike, Upper Darby, Pa.

CIRCLE 450 ON READER-SERVICE CARD

Voltmeters

Measure to 150 kv

Voltages to 150 kv peak in power supplies, vacuum tubes and similar devices can be measured directly with the series 8520 Hypot voltmeters. The meters measure dc, rms or true positive and negative peaks of any wave shape. Maximum drain from the measured circuit is 100 μamp. The meters come with single or multiple ranges and with built-in high voltage multiplier bushings to a full-scale range of 75 kv. For voltage ranges above this value, the high voltage multiplier gushing is separately mounted with low voltage leads extending to the metering assembly.

Associated Research, Inc., Dept. ED, 3777 W. Belmont Ave., Chicago 18, Ill.

CIRCLE 451 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Longitude Counter

Miniature

For airborne navigational computers, dead reckoning systems, and missile tracking devices, the miniature model 10468 longitude counter provides longitudinal indications adding from 0 to 180 deg in west indication and then transfers to east indication and subtracts to 0 deg. In the indications, 0 deg east represents 0 deg and 0 deg west represents 180 deg. The unit is corrosion resistant, meets MIL-E-5272A, and operates continuously at 500 rpm or intermittently at 1000 rpm. One revolution of the input shaft changes the reading by 10 min.

Bowmar Instrument Corp., Dept. ED, 8000 Bluffton Rd., Ft. Wayne, Ind.
Booth 2912

CIRCLE 456 ON READER-SERVICE CARD

Counter Module

Resolves pulses at 250 kc rates

Miniature decade counter module DC-110 combines solid state devices and a miniature shielded beam switching tube in a circuit which resolves pulses at 250 kc. Electrical outputs are provided to operate remote Nixie indicator tubes or printers. This plug-in module is cascadable and can be driven by a 12 v signal. Total power consumption is two watts.

Burroughs Corp., Electronic Tube Div., Dept. ED, Plainfield, N.J.
Booth 2919-2921

CIRCLE 457 ON READER-SERVICE CARD

Vibration Mountings and Bases

Meet MIL-C-172 revision

Designed to meet revised MIL-C-172 specifications, Temproof mountings and mounting bases provide vibration and shock protection for base-mounted avionic equipment at temperatures from −80 to +250 F. and frequencies from 5 to 500 cps. They incorporate amplitude sensitive damping which limits transmissibility at resonance to 3 without impairing isolation efficiency at higher frequencies.

Lord Manufacturing Co., Dept. ED, Erie, Pa.
Booth 105-107

CIRCLE 458 ON READER-SERVICE CARD

Fans and Blowers

Need no running capacitors

Designed to MIL-E-5400 and MIL-E-5272A, these axial fans and centrifugal blowers incorporate 320 to 1000 cps, 200 v, three-phase variable frequency motors that eliminate the need for running capacitors. The 4 in. axial fan, a typical unit, delivers 240 cfm at 0 in. static pressure, 400 cps. Ambient range is −55 to +125 C.

Air Marine Motors, Inc., Dept. ED, 369 Bayview Ave., Amityville, N. Y.
Booth 607-609

CIRCLE 462 ON READER-SERVICE CARD

Multiple Warning Signal

Uses human voice

The VIP uses the human voice to alert the pilot to flight hazards; it selects the highest priority warning. It provides for continuous monitoring of 12 potentially hazardous conditions. The prerecorded message is repeated until the hazard is corrected. Messages always start from the beginning. Supply voltage can vary between 14 and 31 v dc.

Nortronics, Dept. ED, 222 N. Prairie Ave., Hawthorne, Calif.
Booth 3408-3410

CIRCLE 463 ON READER-SERVICE CARD

Television Camera

Has 600 line resolution

This closed circuit television camera provides detail in excess of 600 line resolution. It has single operating control, a fully regulated power supply, keyed automatic black level control, and automatic light compensator. Minimum illumination for usable picture is 2 ft-c; bandwidth is 8 mc; video output is 1.4 v peak-to-peak composite signal with 30% sync.

Packard-Bell Electronics Corp., Dept. ED, 12333 W. Olympic Blvd., Los Angeles 64, Calif.
Booth 1304-1305

CIRCLE 464 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Miniature Relay

Has self-wiping contacts

The series 51C relay is a small, light, plate circuit unit with self-wiping contacts. For dc operation, it has a standard adjustment of 10 mw and adjustable 2 amp, spdt screw contacts. Available variations include 5 amp contacts, hermetic sealing, and coils to 20 K. The unit is mounted with two 6-32 tapped holes on 0.437 in. centers.

Kurman Electric Co., Dept. ED, 191 Newel St., Brooklyn 22, N. Y.

Booth 3516

CIRCLE 467 ON READER-SERVICE CARD

Microwave Absorbers

Have —40 db reflectivity

Light resistive foams made from polyurethane resins, Eccosorb CV-6 and CV-9 are flexible and fire retardant. Respectively, they are 6 and 9 in. thick with 5.5 to 50 and 2.5 to 50 kmc frequency ranges. Their reflectivity level is —40 db.

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

Booth 1105

CIRCLE 468 ON READER-SERVICE CARD

This product featured in May 27, 1959 issue, pg. 122.

CIRCLE 469 ON READER-SERVICE CARD

Vacuum Transfer Relay

Has 25 kv rating

Designed for antenna switching, pulse forming networks, and similar rf and dc circuits, the model RE6B vacuum transfer relay has a 60 cps or dc operating voltage rating of 25 kv and a peak test voltage of 35 kv. A simple leaf contact moving 0.03 in. provides fast spdt operation. The unit is 3-1/4 in. high and will carry continuous currents of 25 amp at 60 cps or 9 amp at 16 mc. It has a continuous dc interrupting rating of 20 kw and employs a 26.5 v dc actuating coil that operates up to 125 C.

Jennings Radio Mfg. Corp., Dept. ED, P. O. Box 1278, San Jose, Calif.
Booth 1602-1603

CIRCLE 470 ON READER-SERVICE CARD

Induction Unit

To silver-solder motor rotors

This induction unit is used to silver-solder motor rotors. The operation is semi-automatic and will turn out up to eight finished rotors per min, with one operator.

Silver or soft solder rings may be used. Equipment consists of a 7.5 kw output induction generator with heating coils for various diameter rotors. A sliding and indexing jig facilitates the heating of three or four rotors at one time, while three or four others are being loaded.

Reeve Electronics, Inc., Dept. ED, 609 W. Lake St., Chicago 6, Ill.
Booth 916

CIRCLE 471 ON READER-SERVICE CARD

tell us about it at WESCON

Several of *Electronic Design's* editors go west each year to cover WESCON. This is your chance to arrange a meeting, discuss plans for articles, ask questions, exchange ideas. Tom Mount, your regular contact on the West Coast (shown above during a WESCON interview) will be joined by Editor, Edward E. Grazda, Managing Ed., James A. Lippke, and Assoc. Ed., L.O. Shergalis. These men want to meet and talk to you in order to keep 30,000 of your fellow design engineer readers informed of the progress you are making and the problems you have solved. Stop in while you are visiting the show.

Contact Electronic Design Editorial Representatives in Hayden Booth 2311, WESCON.

Free—Information for Authors

"It's easy to Write for Electronic Design." *If you have not already received your copy of this guide for prospective authors, write to us now, or pick up a copy at the show.*

CIRCLE 153 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Pulse Generators

Three types available

Model 3450C fast-rise pulse generator operates up to 2 mc. It has 50 w peak power output, rise time variable to less than 20 mμsec, with pulse delay and duration variable to 10,000 μsec. The 5100B series coded-current pulse generators add multichannel 10 bit programmed triggering to the 3000 series, providing control of programming and output for the design and test of memory and switch cores, and magnetic logic. The 2130B series pulse code generators provide up to five outputs per cycle. Outputs are independently variable in pulse duration and nominal relative time position, with provision for position modulation by external signals. Model 3450C and series 2130B are modular plug-in types.

Electro-Pulse, Inc., Dept. ED, 11861 Teale St., Culver City, Calif.
Booth 1911-1913

CIRCLE 475 ON READER-SERVICE CARD

Fuse Holder

For location of blown fuses

This subminiature indicating fuse holder, for quick location of blown fuses, has a voltage rating of up to 125 v and a current rating of 5 amp. Lamp life is 500 hr.

Littelfuse, Inc., Dept. ED, Des Plaines, Ill.
Booth 2201

CIRCLE 476 ON READER-SERVICE CARD

Miniature Test Clips

Have adjustable spring tension

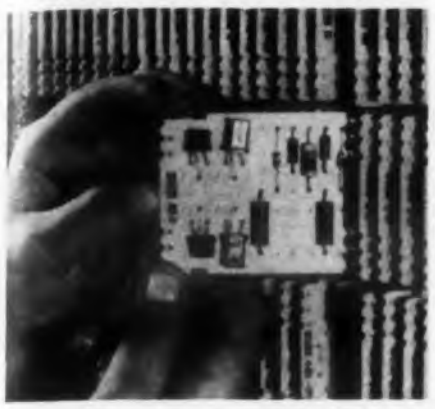
Miniature test clip 2-21 allows rapid connection without manually opening and closing jaws. Spring tension is adjustable by loosening or tightening hex nut. This banana-plug-type clip is made of nickel-plated brass and is 1.56 in. long.

Grayhill, Inc., Dept. ED, 577 W. Hillgrove Ave., La Grange, Ill.
Booth 2907

CIRCLE 477 ON READER-SERVICE CARD

Epoxy Paper Laminate

Will not support combustion



Designed for computer circuits where high reliability is required, Textolite Grade 11574 epoxy paper laminate is self-extinguishing and exceeds all NEMA XXXP standards. It is cyanide resistant and easily punched at room temperature. Insulation resistance is 1 million meg; flexural strength, 26,000 psi.

General Electric Co., Laminated Products Dept., Dept. ED, Coshocton, Ohio.

Booth 810

CIRCLE 500 ON READER-SERVICE CARD

Tantalum Foil Capacitors

Meet MIL-C-3965B requirements

Series TF tantalum foil electrolytic capacitors meet MIL-C-3965B requirements for sizes C1, C2, and C3. The units operate at extreme temperatures and provide high capacitance per unit volume, low leakage, and low power factor.

Ohmite Mfg. Co., Dept. ED, 3631 Howard St., Skokie, Ill.

Booth 1703-1705

CIRCLE 501 ON READER-SERVICE CARD

Circular Waveguide System

For X-band

A 3 in. circular waveguide with line accessories, the type 51300 provides a low loss, closed loop transmission line system for the 8.2 to 12.4 kmc band. It is suited for connection between an instrumentation blockhouse and a missile test stand.

Andrew Corp., Dept. ED, 363 E. 75th St., Chicago 19, Ill.

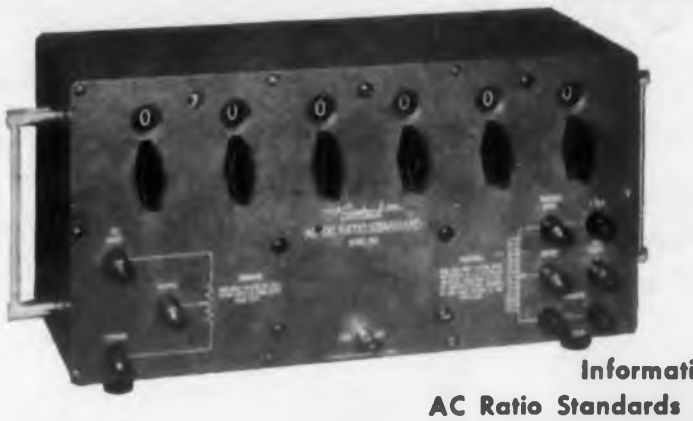
Booth 2001

CIRCLE 502 ON READER-SERVICE CARD

AC/DC RATIO STANDARD

For those who require an AC/DC RATIO STANDARD in a single package, Gertsch offers its Models 1001 and 1002. Like all GERTSCH RATIO STANDARDS (1000 Series), these units feature: heavy duty instrument switches, transient suppression, AC Ratios up to 1.11111, bold in-line readout and extra-heavy mechanical construction to insure TRUE STANDARDS PERFORMANCE.

	AC	DC
Linearity:	1 part per million (0.0001%)	10 parts per million (0.001%)
Resolution:	6 Place (0.0001%)	6 Place (0.0001%)



Information on AC Ratio Standards in the GERTSCH RATIO STANDARDS SERIES, Models 1000, 1003 and 1004, is also available.

GERTSCH PRODUCTS, Inc.
3211 South La Cienega Boulevard, Los Angeles 16, California
TExas 0-2761 - VErmont 9-2201

Gertsch

See Us At Booth #1502, 1504 at the WESCON SHOW

CIRCLE 503 ON READER-SERVICE CARD

5 x 10^{-10}/Day

With Laboratory Standard JKFS-1100T

FREQUENCY STANDARDS

Fully Transistorized, with Double Proportional Control Oven

Today's most advanced design, with each unit aged in and calibrated directly with WWV at Washington, D. C. **Input:** 24 to 32V DC. **Output:** 1V into 50 ohms at 1 MC and 100 KC. **Dimensions:** 6.0"H x 4 13/16"W x 12 1/2"D. **Power Supply Unit:** operates from 115V AC, with 12-20-hour self-contained stand-by batteries. Fully automatic switch-over. Dimensions: 6.0"H x 3 3/16"W x 12 1/2"D. Write for literature on JKFS **1100T**

Visit our WESCON BOOTH 1407

THE JAMES KNIGHTS COMPANY, Sandwich, Illinois

CIRCLE 504 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Transistor Tone Modulator

For grid dip meters

Containing a transistor oscillator with a mercury battery, the model 90751 transistor tone modulator plugs into the phone jack of a grid dip meter to modulate the signal at about 800 cps. The modulator is automatically turned on when it is plugged in.

James Millen Mfg. Co., Inc., Dept. ED, 150 Exchange St., Malden, Mass.

Booth 1505

CIRCLE 506 ON READER-SERVICE CARD

Miniature Chopper

Has less than 1 μv thermal drift

Miniature chopper model C1430 has a dry circuit to 100 v contact rating and less than 1 μv thermal drift. The unit is resistant to shock and vibration and is available in plug-in models or in two-hole, four-hole, side, or clamp mounting types. Temperatures from −65 to +125 C have negligible effect on phase angle.

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

Booth 3425

CIRCLE 507 ON READER-SERVICE CARD

Panel Oscilloscope

Has 100 mv rms sensitivity

The model P1B2X10 general purpose Panelscope occupies 5-3/16 x 5-1/4 in. of panel and extends 10 in. behind. It features 100 mv rms sensitivity, a dc to 1 mc bandwidth, and a repetitive sweep continuously variable from 10 cps to 20 kc. Compensated attenuator steps of 1, 10, 100, and 1000 together with a 10 to 1 nonfrequency discriminating vernier provide a 10,000 to 1 continuously variable attenuation range. The unit contains its own high voltage supply and requires 115 v ac, 38 ma of +325 v dc and 2.1 amp of 6.3 v ac for operation.

Waterman Products Co., Inc., Dept. ED, 2445 Emerald St., Philadelphia 25, Pa.

Booth 401

CIRCLE 509 ON READER-SERVICE CARD

Door Interlock Switch

For electronic cabinets

In high voltage and radio, radar, sonar, or other electronic cabinets, the miniature 17AC1-T door interlock switch automatically cuts the power off when the service door is opened. At 125 or 250 v ac, the 1.182 x 1.5 x 0.35 in. unit is rated at 5 amp. At 30 v dc, it is rated 3 amp inductive and amp resistive. The inductive rating decreases to 2.5 amp at 50,000 ft, while the resistive load remains the same. Maximum inrush is 24 amp.

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

Booth 2624-2626

CIRCLE 510 ON READER-SERVICE CARD

CIRCLE 511 ON READER-SERVICE CARD

CIRCLE 512 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Band Pass Filter

Can be motor tuned

A four-section resonator, this microwave filter has a manual tuning range of 1000 mc in the X band. A 26 v dc motor operated by push-buttons provides automatic setting of the filter to f_0, $f_0 + 3$ mc, and $f_0 - 3$ mc. The resonant cavity is cylindrical; maximum insertion loss is 2.5 db; and maximum vswr is 1.5.

Frequency Standards, Inc., Dept. ED, P.O. Box 504, Asbury Park, N.J.
Booth 2218-2219

CIRCLE 513 ON READER-SERVICE CARD

Power Pentodes

For use in audio output stages

Types 25EH5 and 50EH5 miniature power pentodes are intended for use in the audio output stages of radios, TV and phonographs.

Sylvania Electric Products, Inc., Sylvania Electron Tube Div., Dept. ED, Seneca Falls, N.Y.
Booth 3108-3110

CIRCLE 624 ON READER-SERVICE CARD

Carrier System

Amplitube modulated

Series 3000 amplitude modulated carrier system has solid state demodulator cirquitry and provides stable 3 kc transducer excitation at 20 v rms. The system offers series injection electrical calibration manually, automatically, or sequentially. Of modular design, it may have 2 to 12 channels.

Wiancko Engineering Co., Dept. ED, 255 N. Halstead, Pasadena, Calif.
Booth 2902-2904

CIRCLE 514 ON READER-SERVICE CARD

Circuit Breakers

Resist 100 g shock

Miniature series 500 circuit breakers are electromagnetic, inverse time delay units that resist 100 g shock. Their trip level is 125% of rated current, independent of ambient or operating temperature. Units are available for interrupting 50 v dc at 0.05 to 10 amp or 120 v rms, 60 to 400 cps at 1 to 10 amp. They are provided with a short delay for protecting electronic equipment or a long one for protecting devices with blowers and small motors. Because their toggle bushing is the same as that on conventional on-off switches, the units can replace switches or fuses on electronic equipment and provide circuit protection as well.

Airpax Electronics Inc., Cambridge Div., Dept. ED, Cambridge, Md.

Booth 521-523

CIRCLE 516 ON READER-SERVICE CARD

Mercury Cells

For transistor circuits

Sealed in steel, these mercury cells are designed for uniform operation over a wide temperature range in transistor circuits. They are made with insulated areas between cell terminals to eliminate accidental short circuits and have built-in, controlled venting to prevent pressure buildup. They also have silver contact connection between cells.

Burgess Battery Co., Dept. ED, Freeport, Ill.

Booth 510

CIRCLE 517 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Multiturn Potentiometers

Operate from —55 to +150C

Housed in anodized aluminum cases with a 3/16 in. wall thickness, these three and ten-turn precision wirewound potentiometers operate from —55 to +150 C in a 95% relative humidity. Both types are available with 7/8, 1, 1-5/16, and 1-13/16 in. diam. Standard units have resistance ranges to 400 K and 0.25% linearity, while special units may be supplied with resistance ranges to 1 meg and linearities to 0.02%. Up to 111 terminals can be added in the ten-turn series, and all types are available with non-linear functions. The units withstand 30 g shock and 20 g vibration from 55 to 2000 cps.

Spectrol Electronics Corp., Dept. ED, 1704 S. Del Mar Ave., San Gabriel, Calif.

Booth 2515-2517

CIRCLE 521 ON READER-SERVICE CARD

High Voltage Power Supply

Has stability of 0.005% per hr.

Power supply model 405 provides 600 to 3100 v dc at 0 to 15 ma and has 10 mv resolution, 0.5% calibration accuracy, and 0.005% per hr stability. Regulation is 0.01% for 105 to 130 v line change and 0.005% for 10 ma load change.

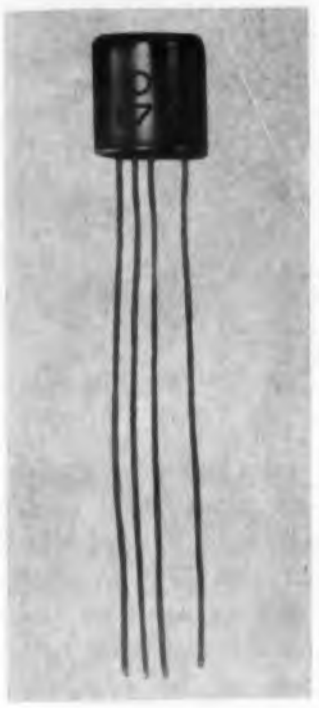
John Fluke Mfg. Co., Inc., Dept. ED, 1111 W. Nickerson St., Seattle 99, Wash.

Booth 2107-2108

CIRCLE 522 ON READER-SERVICE CARD

VHF Transistor

Has 70 mc average cut-off frequency



Model OC170 pnp germanium transistor with cut-off frequency of 70 mc, average β of 80, is made for use in the vhf band as a mixer oscillator or if and rf amplifier. Collector-to-base capacitance is 1.8 μμf with V_{cb} at −6 v; feedback base resistance is 40 ohms at 3 mc. It is miniature sized and hermetically sealed.

Amperex Electronic Corp., Special Purpose Tube and Transistor Div., Dept. ED, 230 Duffy Ave., Hicksville, N.Y.
Booth 122-124

CIRCLE 524 ON READER-SERVICE CARD

Toroidal Winding Machine

Handles coils with 1/32 in. residual ID

At rates to 500 turns per min, the Minitor toroidal winding machine winds coils to a residual ID of 1/32 in. and a maximum finished size of 3/4 in. In operation, the wire, which may be between 36 and 50 AWG, is loaded inside a hollow shuttle and the winding is spun out. The shuttles are loaded by a separate machine, the PW-100 loader, which services up to 20 winding machines and also loads needles for hand winding.

Boesch Mfg. Co., Inc., Dept. ED, Danbury, Conn.
Booth 920

CIRCLE 525 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Winding Machine

For heavy gage toroidal coils

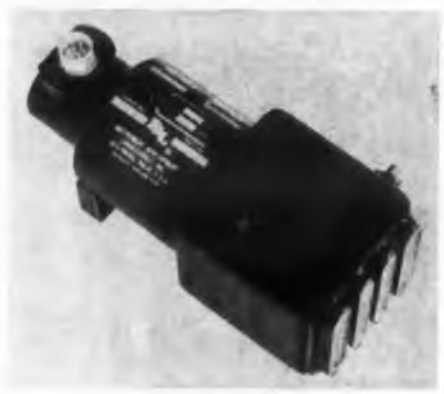
Designed to wind heavy gage wire on large toroidal forms, the Maxitor machine is available with three interchangeable heads. The HW-300 head winds AWG 20 to 7 wire on forms with finished OD's up to 14 in.; the HW-200 winds AWG 24 to 10 wire to a finished OD of 10 in.; and the HW-100 handles AWG 40 to 22, also to a maximum OD of 10 in. The machine has push-button drive ring and magazine positioning, micrometer brake settings, and knob-controlled, infinitely variable turn spacing selection.

Boesch Mfg. Co., Dept. ED, Danbury, Conn.
Booth 920

CIRCLE 529 ON READER-SERVICE CARD

Four-Pole FM/FM Commutator

Has 180 data channels



For application to fm/fm systems, this telemetering commutator has two poles with 30 make-before-break contacts and two with 60. With all 180 data channels available at hermetically sealed connectors, the unit may be externally wired for the sequencing required for each pole. Suited for missile environments, it has a 28 v dc ungoverned motor drive and weighs 3 lb. It is 6-1/2 in. long with a 2-3/4 sq in. header.

Instrument Development Labs, Inc., Dept. ED, 67 Mechanic St., Attleboro, Mass.
Booth 1519

CIRCLE 530 ON READER-SERVICE CARD

X-Band Magnetron

Mechanically tunable

Designed for jitter-free, pulsed-doppler and moving target indicator applications, the model MA-218 magnetron is mechanically tunable over the 9300 to 10,000 mc frequency range. Its tuning drive mechanism is such that individual tubes can be adjusted to specific frequencies without spectrum analyzer or frequency meter checks. Nominal peak rating is 7 kw with 4.5 amp, 6 kv peak input and 0.002 duty ratio. Pulse time jitter is less than 1.4 mμsec rms; pulse frequency jitter, less than 60 kc rms; and pulse amplitude jitter, less than 0.02 db. The tube is convection air cooled and couples to a modified UG-40/U flange.

Microwave Associates, Inc., Dept. ED, Burlington, Mass.
Booth 623

CIRCLE 531 ON READER-SERVICE CARD

Centrifuge

Remains within 0.05% of set speed

Designed to test components under simulated operational g-forces as required in MIL-E-5272A, the model A-1020 centrifuge has a range of 0.1 to 250 g at 24 in. radius. Constancy of boom rotation, including wow and long-term drift, is within 0.05% at any speed setting. The unit has a 10,000 g-lb centrifugal capacity and accommodates test packages that measure up to 12 cu in. and weigh up to 100 lb. Radius of gyration is 18 to 30 in. and speed range is 0 to 600 rpm.

Genisco, Inc., Dept. ED, 2233 Federal Ave., Los Angeles 64, Calif.
Booth 3732-3734

CIRCLE 532 ON READER-SERVICE CARD

Readout Instrument

Displays 12 characters

Built to MIL-E-5422D, this Readall precision readout instrument operates under high shock and vibration, in humidities to 100%, and at altitudes to 70,000 ft. The digital display includes characters in numerical sequence from 0 to 9 and two blank spaces for other symbols. Functional parts are assembled in compact modules which can be used individually or in groups to display multiple characters in a single case. The unit is 5-13/64 x 1-47/64 x 39/64 in. and has 7/32 in. characters that are red or white when illuminated. Operating temperature range is −54 to +71 C.

Union Switch & Signal, Div., of Westinghouse Air Brake Co., Dept. ED, Swissvale, Pa.

Booth 2613-2615

CIRCLE 533 ON READER-SERVICE CARD

Transistor Transformers

Weigh 4 g

Designed to MIL-T-27A, these epoxy molded, plug-in transformers have electrical ratings suitable for transistor, servo, and audio applications. They have tinned buss leads for dip solder printed circuit mounting and may be ordered for 125 C operation. They measure 1/2 in. in diam and 1/2 in. in height, weigh 4 g, and have a 10,000 hr life expectancy.

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

Booth 3803

CIRCLE 534 ON READER-SERVICE CARD

Miniature Connectors

Withstand environmental extremes

These miniature electronic connectors withstand extreme temperature and vibration conditions and meet MIL-C-26482 specs. Interchangeable with other miniature connectors, they are available in bayonet and double-stub coupling types. In addition to general purpose connectors, the Bantam line includes potting-boot open-wire seal and cable clamp types.

Burndy Corp., H. H. Buggie Div., Dept. ED, Toledo, Ohio.

Booth 3324-3326

CIRCLE 535 ON READER-SERVICE CARD

Automatic Slicing Machine

High speed

Designed mainly for transistor production, the model MTA-7 Microtom-atic slicing machine may be used to cut any hard or brittle material. Its cross feed mechanism is set with a handwheel graduated in tenths for any automatic index from 0 to 0.1 in. The high speed unit will cut as many slices throughout its 6 in. travel as wheel thickness and material characteristics will permit. A flat belt connects the spindle to a 1-1/2 hp dynamic eddy-current drive providing infinitely variable speeds from 5000 to 10,000 rpm.

The DoALL Co., Dept. ED, Des Plaines, Ill.

Booth 1214

CIRCLE 536 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Transistor Circuits

For beam switching tubes

These solid-state circuits drive regular, low-voltage, and miniature beam switching tubes. Included is a drive circuit for types 6700, BD-301 and MO10R tubes which uses two RCA 2N398 transistors to drive the tubes at 100 kc rates. Other circuits show how transistors can be used to amplify the constant current outputs of the beam switching tubes where additional current is desired.

Burroughs Corp., Electronic Tube Div., Dept. ED, P.O. Box 1226, Plainfield, N.J.
Booth 2919-2921

CIRCLE 539 ON READER-SERVICE CARD

Waveguides

Cover frequencies to 7050 mc

Measurement equipment and components for WR-159 and WR-229 waveguides include adaptors, detectors, impedance meters low power and sliding terminations, and slide screw tuners. These units cover frequency ranges from 3300 to 4900 mc and 4900 to 7050 mc respectively.

Narda Microwave Corp., Dept. ED, 118-160 Herricks Rd., Mineola, N.Y.
Booth 307-309

CIRCLE 540 ON READER-SERVICE CARD

Tracking Filter

Has minimum S/N ratio of —26 db

Model IV tracking filter improves signal-to-noise ratio of doppler signals by a reduction in circuit bandwidth. It is adaptable to cw doppler systems, including outer-space navigational and space positioning systems. It has an input frequency range of 100 to 20,000 cps, tracking bandwidths of 1.0, 2.5, 5.0, 10, 25, or 50 cps, and bandwidth minimum S/N of —43 to —26 db.

Interstate Electronics Corp., Dept. ED, 707 E. Vermont Ave., Anaheim, Calif.
Booth 2315-2316

CIRCLE 541 ON READER-SERVICE CARD

Switching System

For closed circuit TV

Model AVS-X switching system is capable of switching the signals from any number of TV cameras to any number of monitors. The entire network can be operated by a selector-switch panel located at a central control station or at each monitor. The system uses plug-in modules.

Kin Tel, Div. of Cohu Electronics, Dept. ED, 5725 Kearny Villa Rd., San Diego, Calif.
Booth 1719-1721

CIRCLE 542 ON READER-SERVICE CARD

Photojunction Cell

For sound-pickup-from-film applications

Used for sound-pickup-from-film and computer applications, the 7467 is a photojunction cell of the side-on type with a germanium pn alloy junction. Signal output is proportional to the intensity of the incident radiation. Illumination sensitivity is 0.7 μa per ft-c; spectral response range is 3500 to 19,000 A.

Radio Corporation of America, Electron Tube Div., Dept. ED, Harrison, N.J.
Booth 507-509

CIRCLE 543 ON READER-SERVICE CARD

Transponder Tester

Performs confidence level tests

ATC transponder ramp tester performs confidence level tests from a ramp or in the shop. Test indication is a go/no-go direct read-out. The antenna is a permanently attached vertically-polarized directional type; an additional coaxial connector is provided for optional antenna systems or umbilical operation. The tester can perform radiation tests from 10 to 50 ft into a —75 dbm receiver. The decoder circuit can process 64 combinations of a coded pulse train.

Packard Bell Electronics Corp., Dept. ED, 12333 W. Olympic Blvd., Los Angeles 64, Calif.
Booth 1304-1305

CIRCLE 544 ON READER-SERVICE CARD

Trigger Generators

For use with MPG-OA pulse generator

Trigger generator MTG-4A adaptor unit is used to make precise time measurements with an external marker generator. It will add no more than 5 mμsec jitter to the signals obtained from the external marker generator. Trigger generator MTG-2B is used where operation with internally and externally generated triggers is required. Its internally generated trigger is continuously variable from 40 cps to 40 kc. Both units are used with MPG-4A pulse generator.

PCA Electronics, Inc., Dept. ED, 16799 Schoenborn St., Sepulveda, Calif.

Booth 3404

CIRCLE 545 ON READER-SERVICE CARD

Portable Oscilloscope

In kit form or wired

Model WO-33A portable oscilloscope is available in kit form or as a factory-wired and calibrated instrument. It has a three-inch tube, weighs 14 lb, and measures 6-1/2 x 8-3/4 x 10-1/4 in. On narrow-band position for the vertical amplifier, it has a sensitivity of 3 mv rms per in. and a bandwidth within —3 db of 20 cps to 150 kc.

Radio Corporation of America, Electron Tube Div., Dept. ED, 415 Fifth St., S. Harrison, N.J.

Booth 507-509

CIRCLE 546 ON READER-SERVICE CARD

Silicon Capacitors

Have high Q

These silicon voltage-variable capacitors combine wide tuning range and high Q. Quality factors of 50 and 100 at 4 v dc and at 50 mc permit a new approach to the design of electronic tuning, automatic frequency control, and harmonic generation.

Pacific Semiconductors Inc., Dept. ED, 10451 W. Jefferson Blvd., Culver City, Calif.

Booth 2801-2802

CIRCLE 547 ON READER-SERVICE CARD

Television Cameras

For closed circuit operation

Used for observation of hazardous mechanical, chemical or nuclear operations, these television cameras are remotely focused and aimed. The zoom-type lens allows remote control of exposure and focal length. For closed circuit use, they are available as a color system or as a very-high-resolution monochrome system.

Interstate Electronics Corp., Dept. ED, 707 E. Vermont Ave., Anaheim, Calif.

Booth 2315-2316

CIRCLE 548 ON READER-SERVICE CARD

Gearhead

Size 11 tubular type

The X-1135 female-type size 11 gearhead is used to obtain gear reduction between motors and potentiometers. Maximum overall length of the assembly is 3.78 in. An anti-backlash arrangement may be provided on the potentiometer shaft by first assembling the gearhead to standard BuOrd mounting holes on the motor.

Bowmar Instrument Corp., Dept. ED, 8000 Bluffton Rd., Fort Wayne, Ind.

Booth 2912

CIRCLE 549 ON READER-SERVICE CARD

Gain Changer

Weighs 18 oz

This gain changer contains seven components in a package 6 in. long and 1.375 in. in diam and weighs 18 oz. Type 9805-12 consists of a 115 v 400 cps synchronous motor with phase shifting capacitor coupled through a 24,000:1 ratio gear train, magnetic clutch with associated dc power supply and spring reset mechanism to drive a two-gang potentiometer.

John Oster Mfg. Co., Avionic Div., Dept. ED, One Main St., Racine, Wis.

Booth 619-621

CIRCLE 550 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Shaft Collars

Used for shafts 1/16 and 3/32 in. in diam

These miniature steel collars are for shafts 1/16 and 3/32 in. in diam. They are used to take up thrust, and for locking, spacing and positioning shafts.

Standard Pressed Steel Co., Dept. ED, Jenkintown, Pa.
Booth 820-822

CIRCLE 553 ON READER-SERVICE CARD

Electromechanical Limit Stops

Control mechanical motions

Limit stop BP-522 provides electrical and mechanical operation limits by de-energizing the drive before the mechanical limit is reached. It is manually adjustable to limits between 1 and 100 revolutions of the input shaft. Limit stop BP-525 is cam operated to provide circuit make-or-break points over any desired rotational arc. Cam assemblies are available to cover a combined range in degrees of valley of either 0 to 180 or 180 to 270 deg.

Beckman Instruments, Inc., Helipot Div., Dept. ED, 2500 Fullerton Rd., Fullerton, Calif.
Booth 2007-2008

CIRCLE 554 ON READER-SERVICE CARD

Environmental Tester

Occupies 4 sq ft of floor space

For testing small components, the Tenney-mite STRAT environment chamber has a 14 cu in. test space and takes up 4 sq ft of floor. It simulates altitudes to 200,000 ft and temperatures from −100 to +350 F. The unit may be mounted on casters and receives its power from a 220 v outlet with a plug-in cord.

Tenney Engineering, Inc., Dept. ED, Union, N.J.
Booth 326

CIRCLE 555 ON READER-SERVICE CARD

Nickel-Cadmium Batteries

Rechargeable

Hermetically sealed in steel cases, these nickel-cadmium batteries provide high energy output and require no maintenance or addition of liquids. They can be recharged many times, responding equally well to a trickle or a quick charge. Long idle periods do not affect either charged or uncharged units.

Burgess Battery Co., Dept. ED, Freeport, Ill.
Booth 510

CIRCLE 557 ON READER-SERVICE CARD

Metal Film Resistors

Have range of 1 meg

This line of metal film resistors consists of seven sizes and three styles: full cylindrical, semi-cylindrical, and rectangular.

Ohmite Mfg. Co., Dept. ED, 3625 Howard St., Skokie, Ill.
Booth 1703-1705

CIRCLE 558 ON READER-SERVICE CARD

Silicon Rectifiers

Operate reliably at 200 C

The TK series of silicon rectifiers operates reliably at 200 C and has a forward current capacity of 1 amp at 100 C.

Transitron Electronic Corp., Dept. ED, Wakefield, Mass.
Booth 3002-3004

CIRCLE 559 ON READER-SERVICE CARD

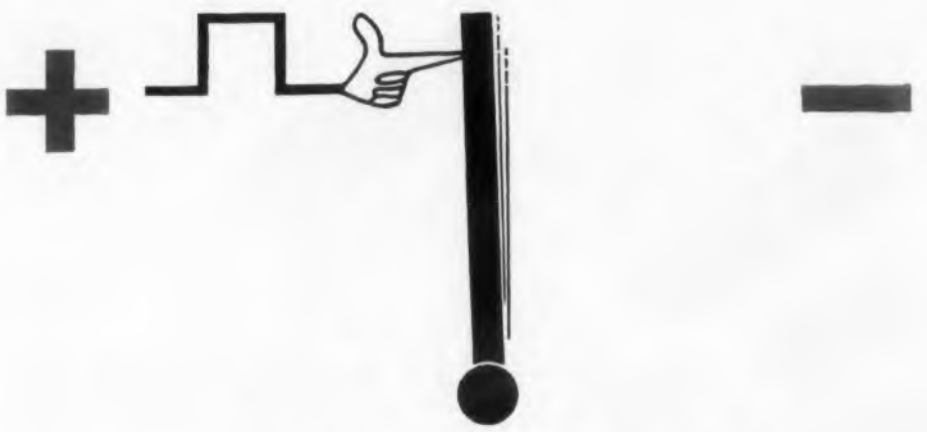
Ceramic-Metal Trimming Potentiometers

Operates from −50 to +200 C

Incorporating a conductive resistance element fused to a steatite frame, these Helitrim ceramic-metal trimming potentiometers are insensitive to shock and vibration. They have an ambient temperature range of −50 to +200 C.

Beckman Instruments Inc., Helipot Div., Dept. ED, 2500 Fullerton Rd., Fullerton, Calif.
Booth 2007-2068

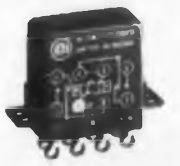
CIRCLE 560 ON READER-SERVICE CARD



How to trip a relay*

WITH A WEE PULSE

The technique of operating relays by direct application of pulses is nowhere near as widely used as (we think) it should be. This method lets you keep relay energy consumption and power supply drain down to a bare minimum — particularly if bi-stable polar relays are used. When you combine pulse operation with magnetic latching, no continuous coil current is needed to keep the relay contacts closed. Of course we have an ax to grind in that there are now no less than six* series of Sigma polarized, magnetic latching (Form Z) relays which can operate on single pulses. The newest of these is the subminiature Series 32 — which, when operated in this power-pinching way, could be just what you've been looking for.



Series 32

Here are some of the "high spots" in the technique of transferring the armature from one contact to the other with minimum energy. Ideally, the armature should arrive at the center of the air gap with zero velocity, whereupon the magnetic field can take over. A current pulse that starts out at trip value and decreases linearly to zero as the armature reaches the midpoint could do this (fig. 1), but the inductive relay coil makes such a pulse circuit impossible.

Fig. 1

However, similar waveforms can be approximated by a capacitor-stored pulse discharged into the relay coil. Although there are several fundamentally similar ways of doing this, one circuit (fig. 2) wastes no energy in a resistor and permits the relay to take a round trip operation on a single slug of energy from the source.

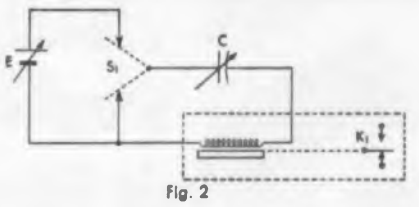


Fig. 2

As you get deeper into this business, it turns out that at least two quantities must be known to apply this method: the "pulse constant" in microjoules per mw. of relay sensitivity, and the "matching constant" in microseconds. A technical paper discussing all of the foregoing in some detail (presented at the recent NARM Conference), pulse application data, Series 32 bulletin, etc. are available on request. Ask for the special "Pulse Packet", handsomely bound in a manilla envelope.

*Sigma Series 6, 7, 32, 61, 72 & 73

SIGMA

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

AN AFFILIATE OF THE FISHER-PIERCE CO. (since 1938)

At WESCON — Booths 1901 & 1903

CIRCLE 562 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Function Generators

Have 0.3% full scale accuracy

Series DLI-202 function generators are modular devices that provide such functions as the square, the square root, the natural logarithm, or the absolute value of the input voltage. Functions are achieved by adding the proper 10 segment fixed diode plug-in module to the basic package of two of the company's DLA-41 dc operational amplifiers.

Electro Precision Corp., Dept. ED, P.O. Box 669, Arkadelphia, Ark.

Booth 110

CIRCLE 564 ON READER-SERVICE CARD

Mercury-Zinc Carbon Cell

Has stable output at low current drain

This mercury-zinc carbon cell has high capacity, long life, and stable output at low current drain. The voltage rating at no load is 1.36 v, and capacities are 4000 and 8000 ma-hrs for the C and D size cells, respectively. AA size is also available. Applications include portable transistor radios, and portable military and commercial communications equipment.

Mallory Battery Co., Application Engineering Dept., Dept. ED, 60 Elm St., N. Tarrytown, N.Y.

Booth 601-602

CIRCLE 565 ON READER-SERVICE CARD

Epoxy Compound

For encapsulation by dipping

Hysol 10-80 epoxy compound is used to encapsulate, by dipping, small electrical components such as wafer capacitors, resistors and small transformers. This black thixotropic material produces an even non-dripping coat on pieces up to one cubic in.

Houghton Laboratories, Dept. ED, Olean, N.Y.

Booth 1206

CIRCLE 566 ON READER-SERVICE CARD

Digital Data Link

Transmits data at rates up to 33,000 bps

The DL-100 Digital Data Link transmits digital data over standard communication channels at rates up to 33,000 bits per sec, and is capable of sending or receiving over 20,000 pages of printed matter in one 8-hr shift.

Epsco, Inc., Dept. ED, 275 Massachusetts Ave., Cambridge, Mass.

Booth 3710

CIRCLE 568 ON READER-SERVICE CARD

Potentiometer Tapping Kit

For field and laboratory use

Designed for installing potentiometer taps in laboratory or field, this kit includes a tap setting fixture, two screw drivers, and a pair of tweezers. These items plus a quantity of basic potentiometer and tap assemblies make it easy to prepare a variety of potentiometers to meet any on-the-spot requirements. With tap brackets available in many shapes and sizes, potentiometers can be tapped at any selected angle. Up to three taps can be installed 0 deg apart.

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

Booth 402B

CIRCLE 569 ON READER-SERVICE CARD

Comparison Bridge

Has accuracies from 2.5 to 0.1%

Model E-2 comparison bridge is used for fast, accurate measuring and matching of resistors, capacitors, and inductors. Ranges include 1 ohm to 5 meg resistance, 500 μμf to 2000 μf capacitance, and 3 mh to 10,000 h inductance at accuracies from 2.5 to 0.1%.

Southwestern Industrial Electronics Co., Dept. ED, 10201 Westheimer Rd., P.O. Box 13058, Houston 19, Tex.

Booth 420-422

CIRCLE 570 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Power Rheostats

Explosionproof

Series 25G and 50G are 25 and 50 w power rheostats, respectively, and encased in metal to meet the explosionproof requirements of MIL-E-5272A, Par 4.13.2.

Clarostat Mfg. Co., Inc., Dept. ED, Dover, N.H.

Booth 2211

CIRCLE 574 ON READER-SERVICE CARD

Insulating Tubing

Has silicone coating

Turbo 117 silicone rubber insulating tubing has a silicone coating capable of withstanding abnormally rough handling. This coating meets MIL-I-3190, NEMA and ASTM specs. The tubing is tough, has low-temperature flexibility, and is resistant to heat and abrasion.

William Brand & Co., Inc., Dept. ED, Willimantic, Conn.

Booth 1119

CIRCLE 622 ON READER-SERVICE CARD

Helical Antenna

Covers 215 to 265 mc

For the 215 to 265 mc band, the Quad-Helical antenna is a high gain, circular polarized unit for missile tracking and telemetry reception.

Andrew Corp., Dept. ED, 363 E. 75th St., Chicago 19, Ill.

Booth 2001

CIRCLE 575 ON READER-SERVICE CARD

Adhesives

Kit for evaluation of resins

Select-A-Pak allows prospective users of epoxy adhesives to evaluate a range of resins and hardeners. The kit includes two clear resins and one filled resin, two one-component systems (liquid and thixotropic non-flow paste), one Hysol epoxi-patch kit, five hardeners, and instructions.

Houghton Laboratories, Dept. ED, Olean, N.Y.

Booth 1206

CIRCLE 576 ON READER-SERVICE CARD

Splice Cases

Are made of polyvinyl chloride

Made of polyvinyl chloride, these cases are used to strengthen, protect and insulate wire splices. They are made in two sleeve-like parts, one of which slides over the other. When splices are completed, a copper clamping ring is applied to the case to keep the assembly free from moisture and dust.

Avnet Corp., Dept. ED, 5877 Rodeo Rd., Los Angeles 16, Calif.
Booth 2417

CIRCLE 578 ON READER-SERVICE CARD

Modular Enclosures

Have 24 and 30 in. widths

Frames and components with panel space of 24 and 30 in. widths supplement the 19 in. panel width units of the firm's modular enclosure system.

Elgin Metalformers Corp., Dept. ED, 630 Congdon Ave., Elgin, Ill.
Booth 1819-1821

CIRCLE 623 ON READER-SERVICE CARD

Backward Wave Oscillator

Covers the X band

Packaged permanent magnet focused backward wave oscillator covers the X band. It provides a minimum of 1 mw power output.

Menlo Park Engineering, Dept. ED, 711 Hamilton Ave., Menlo Park, Calif.
Booth 311

CIRCLE 579 ON READER-SERVICE CARD

Counting Dials

For control panels

This series of multiturn counting dials was designed to conform with panel layouts of current electronic equipment. Called Microdials, their mechanical features include smoothness of operation, absence of noise, no jumping or step-action and clear reading.

Amphenol-Borg Electronics Corp., Borg Equipment Div., Dept. ED, 120 S. Main St., Janesville, Wis.
Booth 703-705

CIRCLE 580 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Miniature Differentials

Hollow shaft and face gear

These miniature hollow shaft and face gear differentials are designed to Class I or II tolerances. The hollow shaft units are stainless steel with 1/16 and 1/8 in. shaft sizes, 0.58 and 0.79 in. clearance diam, four to eight precision ball bearings, and 6, 12, or 15 min displacement arcs.

Dynamic Gear Co., Inc., Dept. ED, 20 Merrick Rd., Amityville, N.Y.

Booth 2523

CIRCLE 584 ON READER-SERVICE CARD

Amplifiers

Three types available

Model 456A ac current amplifier permits measurement of current on indicating meters such as an ac vtvm or oscilloscopes. Its range is 1 ma to 2 amp; accuracy is 2%. Transistorized amplifier model 466A is a general purpose instrument amplifier providing standard gains of 20, 40, and 60 db ±0.2 db from 5 cps to 1 mc. Model 154A voltage-current dual channel amplifier measures current on an oscilloscope to permit direct viewing of ac current wave.

Hewlett-Packard Co., Dept. ED, 275 Page Mill Rd., Palo Alto, Calif.

Booth 1724, 1826-1828

CIRCLE 585 ON READER-SERVICE CARD

Precision Capacitors

Have a tolerance of ±0.1%

This line of precision capacitors has a tolerance of ±0.1% and a long term operating stability of ±0.05%. They are hermetically sealed. Type CPM capacitors have silvered mica dielectric; voltage rating is 500 wvdc and temperature range is −55 to +125 C. Type CPP have polystyrene dielectric; voltage rating is 400 wvdc and temperature range is −55 to +85 C.

Arco Electronics, Inc., Dept. ED, 64 White St., New York 13, N.Y.

Booth 302

CIRCLE 586 ON READER-SERVICE CARD

Waveguide Quick-Disconnect Coupler

Is compact and simple to operate

Model 3419 waveguide quick-disconnect coupler is used in making quick connections on all types of waveguide components. It adds little to the size of the connection and is easily attached to a standard choke flange with two screws. The coupler is available in two sizes, one for K-band waveguide (model 3419K), one for X-band (model 3419X). This coupler is also used to make a connection of two cover flanges as well as one of a choke and cover flange.

Aircraft Armaments, Inc., Dept. ED, Cockeysville, Md.

CIRCLE 588 ON READER-SERVICE CARD

Foam Material

For encapsulation

For encapsulating electronic components that are exposed to strong vibration, the Hathane 1650 series products are polyurethane resin systems packaged in kit form. These liquid systems produce rigid, room temperature curing, white, tough foams of controllable densities. Shrinkage upon foaming is negligible and tensile strength is from 78 to 178 psi.

Hastings Plastics, Inc., Dept. ED, 1551-12th St., Santa Monica, Calif.

CIRCLE 589 ON READER-SERVICE CARD

Geared Motors

Have high starting torques

This line of subfractional horsepower induction and synchronous geared motors offers 17 gear ratios each with output speeds from 300 to 1 rpm. Corresponding full load torques for the induction motor are from 1.2 to 15 lb-in.; torque for synchronous motors ranges from 0.5 to 15 lb-in. They have high starting torques: 100 to 120% of full load for induction motors and 350% of "pull-into-synchronous" torque for synchronous motors.

Merkle-Korff Gear Co., Dept. ED, 217 N. Morgan St., Chicago 7, Ill.

CIRCLE 590 ON READER-SERVICE CARD

NEW PRODUCTS

Insulation Wafers

Come in many shapes

In diamond, round and square shapes to suit all bases, these aluminum, hard-anodized wafers are installed between a power transistor and chassis, heat sink or other surface on which the transistor is mounted. The wafers insulate the transistors from the chassis and dissipate the heat generated by the transistors. They have high abrasion and corrosion resistance.

Monadnock Mills, Dept. ED, San Leandro, Calif.

CIRCLE 594 ON READER-SERVICE CARD

Recording Thermometer

Operates to 1100 F

Designed to sense and record temperatures up to 1100 F, model TRH dual recording thermometer has either electric or spring-driven chart drives. It is equipped with two thermal sensing elements and two pen mechanisms in the same body. The pens operate on a 2 hr differential to prevent interference when both sensed temperatures are the same. Charts are 10 in. in diam.

The Partlow Corp., Dept. ED, 525 Campion Rd., New Hartford, N.Y.

CIRCLE 595 ON READER-SERVICE CARD

Solid State Power Supply

Provides 3 amp at 130 v dc

Providing an output up to 3 amp at 130 v dc, model 738-001 operates at an efficiency above 80% under full load conditions when the input supply voltage is 125 v ac. The unit provides a ±2% regulation at primary power inputs of 105 to 125 v ac, 50 to 60 cps. Ripple is less than 1% rms and can be held to 1/4%. For line or load changes of 1.5 amp, the output voltage transient remains ±3 v of the steady value.

U. S. Industries, Inc., Western Design Div., Dept. ED, Santa Barbara, Calif.

CIRCLE 596 ON READER-SERVICE CARD

Laminated Insulating Material

Plain and copper clad available

The Mark Ten 10-01, the first grade in the Mark Ten cold punch laminate series, is available both plain and copper clad. Its rigidity and flexural strength are high; intricate shapes can be punched at room temperature or lower. As a copper clad laminate, it has high resistance to organic cleaning compounds, withstands blistering in solder at 500 F for 40 to 60 sec, and averages 7 to 9 lb bond strength. This laminate exceeds NEMA XXXP and MIL-P-3115B Type PBE-P specs.

Richardson Co., Dept. ED, 2830 Lake St., Melrose Park, Ill.

CIRCLE 598 ON READER-SERVICE CARD

FM Signal Generator

Covers six rf bands

Model T1034-A fm signal generator covers six rf frequency bands between 25 and 960 mc. The ranges are 25 to 32, 32 to 41, 41 to 54, 140 to 175, 400 to 470 and 890 to 960 mc. Each range is individually calibrated to an accuracy of ±0.5%.

Motorola Inc., Communications and Industrial Electronics Div., Dept. ED, 4501 W. Augusta Blvd., Chicago 51, Ill.

CIRCLE 599 ON READER-SERVICE CARD

Band Pass Filter

Variable

Model S-305 variable band pass filter is designed for disc, tape and other uses requiring the reduction of the audio bandwidth to predetermined limits. Rack mounted, it has two separate key switches that permit the insertion of the low frequency and the high frequency filter sections simultaneously or independently at any desired cut-off frequency. There are 15 low frequency cut-off points, from 30 to 200 cps, and 15 high frequency points from 2 to 15 kc.

Studio Electronics Corp., Dept. ED, 711 S. Victory Blvd., Burbank, Calif.

CIRCLE 616 ON READER-SERVICE CARD

NEW PRODUCTS

Infrared Radiation Source

Calibrated from 200 to 1000 C

The model RS-8B OptiTherm infrared radiation source is designed to emit black body radiation over a 200 to 1000 C range. The source temperature, selected with a precisely calibrated single control dial, is maintained within ±0.3% despite ambient temperature changes, line voltage variations and transients, tube aging, and individual component replacements.

Barnes Engineering Co., Dept. ED, 30 Commerce Rd., Stamford, Conn.
Booth 3717

CIRCLE 619 ON READER-SERVICE CARD

Airborne Amplifier

Has gain of 400 to 1000

Model D-7 airborne amplifier for thermocouple and strain gage amplification and telemetering applications operates over broad temperature, altitude, and vibration ranges. Input characteristics include −5 to +5 mv dc at over 20 K input impedance. Gain is 400 to 1000; bandwidth is dc to 1000 cps; output impedance is less than 10 K. It operates on 28 v dc, 25 ma (±10%) or 6.3 v ac 400 cps, 55 ma (±10%).

Southwestern Industrial Electronics Co., Dept. ED, 10201 Westheimer Rd., P.O. Box 13058, Houston 19, Tex.
Booth 420-422

CIRCLE 620 ON READER-SERVICE CARD

Sweep Generator

Plots frequency responses

Sweep frequency generator model SG-1R plots tape and disc recorder and pickup frequency responses. Amplitude vs. frequency is displayed on specially calibrated CRT screen of a companion oscilloscope. A 3 or 5 in. screen is furnished. Linear and 40 db log amplitude scales are provided.

Panoramic Radio Products, Inc., Dept. ED, 514 S. Fulton Ave., Mount Vernon, N.Y.
Booth 204, 301

CIRCLE 604 ON READER-SERVICE CARD

Differential Transformer

Is 0.468 in. long, has 0.313 in. OD

Subminiature variable differential transformer DT-401 is used as a displacement transducer in accelerometer, pressure gage, and surface finish gage applications. It provides a null of less than 100 μv with an input of 3 v at 400 cps. Sensitivity is 2.7 mv per mil-deflection with 3 v 400 cps input.

Universal Mfg. Co., Inc., Dept. ED, 1168 Grove St., Irvington, N.J.

Booth 1121

CIRCLE 606 ON READER-SERVICE CARD

Digital Voltmeter

Measures voltages 500 times per sec

Model V44 digital voltmeter measures voltages from ±0.001 to ±999.9 v dc at the rate of 500 times per sec. Its high input impedance (10 meg) permits measuring the output of low power circuits without harmful effects. Measurements are displayed directly in illuminated numerical form, and can be read visually or automatically recorded.

Non-Linear Systems, Inc., Dept. ED, Del Mar, Calif.

Booth 1416-1417

CIRCLE 607 ON READER-SERVICE CARD

Electrical Connectors

Have softening point of 1250 F

Made of boron-free ceramic, these connectors have a softening point of 120 F. The thermal coefficient of expansion is 5 x 2 x 10^{-6} in./in./F, and capacitance of one pin to ground is 2 μμf. Both case and pins are 303 stainless steel (silver plating is optional). They are available in subminiature, miniature, and standard configurations.

Technical Industries Corp., Dept. ED, 389 N. Fair Oaks, Pasadena, Calif.

Booth 1304-1305

CIRCLE 608 ON READER-SERVICE CARD

Digital Millivoltmeter

Reads 1 mv full scale to 0.1% accuracy

This portable ratio digital millivoltmeter measures low level dc voltages on potentiometers, thermocouples, and bonded and unbonded strain gages. It reads 1 mv full scale to 0.1% accuracy; and weighs 23 lb.

Technical Industries Corp., Dept. ED, 389 N. Fair Oaks, Pasadena, Calif.

Booth 1304-1305

CIRCLE 621 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Silicon Capacitors

Have 0.5, 1.0 μμfd capacitance

For uhf use at temperatures up to 10 C, these capacitors have a minimum Q of 40 at 100 mc. SCH-51 and SCH-51-A have a capacitance of 0.5 μμfd at −4 v, and a maximum working voltage of 10 v; SCH-52 and SCH-52-A have a capacitance of 1.0 μμfd at −4 v, and a maximum working voltage of 7 v.

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

Booth 3002-3004

CIRCLE 611 ON READER-SERVICE CARD

Solid State Power Supplies

Transient and short circuit proof

Series TR6R and TR32R solid state power supplies are available for outputs 6, 12, 18, 24, and 32v dc at 0 to 2 amp. A multioutput unit providing a selection of all these voltages can also be furnished. The miniaturized supplies are transient and short-circuit proof and have 105 to 125 v ac, 60 to 400 cps input, 0.05% line or load regulation, and less than 1 mv ripple. Typical dimensions are 4-3/4 x 4 x 5-7/8 in.

Electronic Research Associates, Inc., Dept. ED 67 Factory Place, Cedar Grove, N.J.

Booth 3218-3220

CIRCLE 612 ON READER-SERVICE CARD

HV Power Supply

Has high resolution

With a resolution of 100 mv at any output setting, the model 404M power supply delivers 500 to 200 v dc at 0 to 5 ma. It has zero overshoot, 0.01% regulation, 0.5% calibration accuracy, 0.5% per day stability, and less than 5 mv rms ripple at any output in either polarity.

John Fluke Mfg. Co., Inc., Dept. ED, 1111 W. Nickerson St., Seattle 99, Wash.

Booth 2107-2108

CIRCLE 613 ON READER-SERVICE CARD

Word Generators

Are fully transistorized

Models 5500A and 5510A variable-length word generators are fully transistorized units providing arbitrarily coded serial word outputs of up to 80 bit content for entry to or control of serial logic. The coded output is variable in width and amplitude, or can be furnished in non-return-to-zero format.

Electro-Pulse, Inc., Dept. ED, 11861 Teale St., Culver City, Calif.
Booth 1911-1913

CIRCLE 625 ON READER-SERVICE CARD

Welding Head, Power Supply

Head has 2 to 50 lb electrode pressure

Heavy duty welding head, model 1029, has 2 to 50 lb adjustable electrode pressure and a swing-type foot pedal. Model 1026C, 80 w/sec power supply, has built-in meter, continuously adjustable heat range. It is used in conjunction with model 1029 welding head.

Weldmatic, Div. of Unitex Corp., Dept. ED, 380 N. Halstead, Pasadena, Calif.
Booth 3214-3216

CIRCLE 626 ON READER-SERVICE CARD

Trimmer Potentiometers

Have hermetically sealed plastic housing

These box type trimmer potentiometers are available with wirewound or deposited metallic film resistance elements. Types RTW and RTF have hermetically sealed plastic housing and are offered with printed circuit lugs, wire leads, or Teflon insulated wire leads. Type TPC is a microminiature trimmer for printed circuits. It is 1/8 in. thick and 1 in. long.

Servotrol Inc., Dept. ED, 10130 W. Pacific Ave., Franklin Park, Ill.
Booth 2013-2014

CIRCLE 627 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Wire Stripper

Has seven-stop gage

Strip-Er-Clip 760 will strip and clip all wi from 14 to 26 gage. A seven-stop gage adju instantly to the correct wire size to prevent da age. Made of heat-treated steel, it has a hea insulated grip and streamlined jaws for use i cramped quarters.

General Cement Mfg. Co., Dept. ED, 400 Wyman St., Rockford, Ill.
Booth 1712B

CIRCLE 631 ON READER-SERVICE CARD

Oscillating Rate Table

Tests rate gyros and angular accelerometers

Model 60A angular oscillating table is used fo rapid frequency response testing of rate gyros an angular accelerometers. Frequency coverage i 0.1 to 150 cps; it takes loads in excess of 100 l (with decreased performance). If the associate dc servo power amplifier is used, natural fre quency will exceed 150 cps.

Micro Gee Products, Inc., Dept. ED, Box 100 6319 W. Slauson Ave., Culver City, Calif.
Booth 3613

CIRCLE 632 ON READER-SERVICE CARD

Tube Magnetic Shield

Protects against g effects

This permanently effective Netic Co-Netic magnetic shield reduces the effects of high g stresses imposed on electron beam structures. Shielding effectiveness is not degraded with time, shock or exposure to strain. Because the shields never require annealing, the potting tech nique is possible.

Perfection Mica Co., Dept. ED, 1322 N. Elston Ave., Chicago 22, Ill.
Booth 2214

CIRCLE 633 ON READER-SERVICE CARD

Trimmer Potentiometers

Sizes from 3/8 to 5/8 in. diam.

These miniature rotary type single turn trimmer potentiometers have diameters from 3/8 to 5/8 in. They are available with threaded bushings, split bushings, printed circuit lugs, or plug-in arrangements. Types RV04, RV05 and PC05 will withstand temperatures from −55 to +150 C. They have resistances to 25 or 50 K.

Tuscon Instrument Corp., Dept. ED, Tuscon, Ariz.
Booth 2013-2014

CIRCLE 634 ON READER-SERVICE CARD

Transistorized Oscilloscope

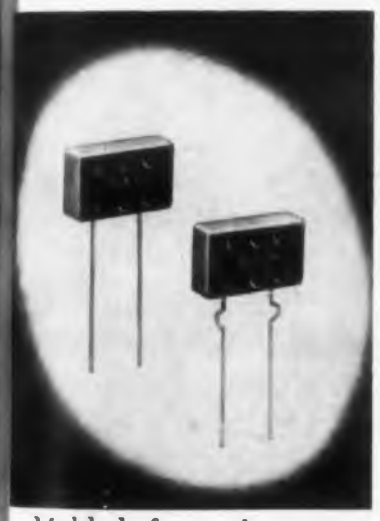
Battery operated

Transistorized portable oscilloscope type 321 will operate up to 3 hr on ten high current, size D flashlight cells or up to 6 hr on rechargeable cells. It will also operate on 11 to 35 v dc, and on 110 to 125 or 220 to 250 v, 50 to 800 cps. Vertical passband is dc to 5 mc; rise time, 0.07 μsec; and deflection factor, 10 mv per division. Sweep range is 0.5 μsec to 0.5 sec per division in 19 calibrated steps and accelerating potential is 4 kv on a 3 in. crt. The amplitude calibrator is 500 mv peak-to-peak 2 kc square wave. Triggering is fully automatic or preset with amplitude level selection.

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

Booth 1801-1802

CIRCLE 635 ON READER-SERVICE CARD



Molded Mica Capacitors

Rated at 300 and 500 wvdc

Molded from the company's Humiditite II material, type PR-20 silvered mica capacitors are rated at 300 or 500 wvdc and operate from −55 to +85 or +125 C. Working voltages to 3000 v dc are available on request. The units exceed MIL-C-5A requirements and have capacitance ranges from 5 to 3300 μμf. Standard tolerances are ±20, ±10, ±2, and ±1%, and leads may be straight, bent, or kinked to form stops. Dimensions are 0.713 x 0.46 x 0.2 in.

Sangamo Electric Co., Dept. ED, Springfield, Ill.

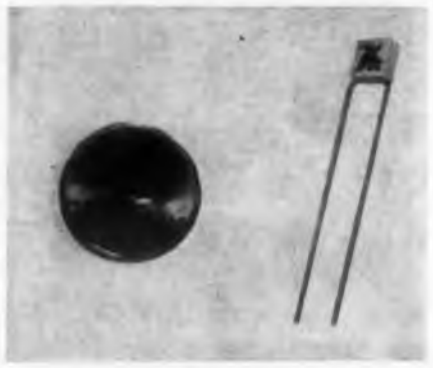
Booth 1605

CIRCLE 636 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Miniature Capacitors

Operate from −55 to +150 C



Rated at 200 wvdc, series VK 20 and VK 30 have maximum dimensions of 0.2 x 0.2 x 0.1 and 0.3 x 0.3 x 0.1 in. Respectively, they have capacitances from 47 to 1000 μμf and 1200 to 10,000 μμf. Designed to MIL-C-11015A, the units withstand 2000 cps 20 g vibration and acceleration and do not derate at altitudes to 100,000 ft. Temperature coefficient deviates a maximum of ±15% from 25 C over the −55 to +150 C operating range. At 125 C and 200% of rated voltage, the units have a life of 1000 hr. Available in ±10 and ±20% tolerances, they have a dissipation factor of less than 0.015 at 1 kc and 150 C.

Vitramon, Inc., Dept. ED, P. O. Box 544, Bridgeport, Conn.
Booth 1413

CIRCLE 639 ON READER-SERVICE CARD

Microwave Modulator

Covers range from 3200 to 35,000 mc

Microwave modulator model 10001 is used for magnetrous covering the range from 3200 to 35,000 mc with peak outputs from 6 to 120 kw. High voltage power supply is 0 to 4 kv at 100 ma; magnetron filament supply is 0 to 13 at 3 amp; repetition rate generator frequency range is 180 to 3000 pps. Pulse width is 1 μsec, rise time is 0.15 μsec. It is 38 x 22 x 18 in.

Narda Microwave Corp., High Power Electronics Div., Dept., ED, 118-160 Herricks Rd., Mineola, N.Y.
Booth 307-309

CIRCLE 640 ON READER-SERVICE CARD

Wirewound Trimmer Potentiometer

Has 3/8 in. diam

Wirewound trimmer potentiometer model RV04 is a 3/8 in. diam, linear function unit with standard resistance ranges to 25 K. Made to withstand the severe environments in missile and military applications, it operates from −55 to +150 C. It has a locating pin that provides positive positioning and is available with either a split or solid threaded bushing. The terminals are on the back of the housing.

Technology Instrument Corp., Dept. ED, 531 Main St., Acton, Mass.

Booth 2013-2014

CIRCLE 641 ON READER-SERVICE CARD

Digital Controller Counter

Bidirectional

A pulse actuated bidirectional counter with contact closures, the model F 195 can be preset to any number from 0 to 99,999. With contact closures at both zero and the variable preset point, the counter adds or subtracts within predetermined limits, thus acting as a digital pulse controller. With additional and integral relays, it can operate as an automatic batching counter, continuously oscillating between zero and the preset point with no count loss between batches of a predetermined number. The device is 4 in. cubed and has a continuous duty counting rate of 15 per sec for dc operation. As model F 160, it is offered as a bidirectional counter with push-button reset and a front panel size of 3-1/2 x 2 in.

Presin Co., Dept., ED, 2014 Broadway, Santa Monica, Calif.

Booth 3606

CIRCLE 642 ON READER-SERVICE CARD

TWELVE IMPORTANT CHOICES!

PRECISION TRIMMER POTENTIOMETERS by TIC are standard in twelve different styles and each in a wide range of resistance values. The extensive use of trimmers in such applications as airborne, shipborne and ground based military electronic equipment for navigation, flight control, fuel control, radio transmission and reception, telemetering, computers, fire control and many others demands reliability and stable operation under severe environmental conditions. TIC quality-control procedures and environmental testing assure the user of the ultimate in dependable trimmer potentiometers.

TWELVE IMPORTANT CHOICES — six box type and six rotary type multiturn and single turn with wirewound or metallic film resistance elements, high temperature-resistant construction, varied mounting methods, and sizes ranging from micro-miniature to the size of a quarter in diameter, permit the design engineer optimum freedom to select the unit best suited to his application. Special designs may be readily accommodated by TIC engineers.

For new catalog of the trimmers illustrated above write, wire or call

TECHNOLOGY INSTRUMENT CORPORATION

Subsidiaries: Technology Instrument Corp. of Calif., North Hollywood, Calif.
Acton Laboratories, Inc., Acton, Mass.
Tucson Instrument Corp., Tucson, Ariz.
Servotrol, Inc., Chicago, Ill.
Altomac Corp., Canton, Mass.

555 MAIN STREET
ACTON, MASS.

CIRCLE 644 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Silicon Rectifiers

Provide up to 99% efficiency

Available with positive and negative bases, these K-M type miniaturized silicon rectifiers afford efficiencies up to 99% at standard power frequencies. Models 40-K7 and 40-M7 are rated at 400 piv and 25 and 35 amp, respectively. Maximum rated junction temperature is 190 C and thermal impedance is 1.5 C per w. Typical applications include battery chargers, welding equipment, plating equipment, and medium power industrial power supplies. The units are 11/16 in. in diam and 5/8 in. deep.

Audio Devices, Inc., Rectifier Div., Dept. ED, P.O. Box 895, Santa Ana, Calif.
Booth 111

CIRCLE 645 ON READER-SERVICE CARD

S-Band Isolator

Operates at 5 megawatts peak

This liquid-cooled, high power ferrite load isolator, model MA-154, is used in radar systems operating in the 2700-2900 mc range. It operates at 5 megawatts peak and 400 w average power. Insertion loss is less than 0.4 db; isolation is 10 lb minimum. It weighs 50 lb and is 12 x 8 x 3-1/2 in. Ratings apply over an ambient temperature range of 0 to 65 C.

Microwave Associates, Inc., Dept. ED, Burlington, Mass.
Booth 623

CIRCLE 646 ON READER-SERVICE CARD

HOT BOX?

KEY MICROMINIATURE WIRE WOUND RESISTORS *may be operated at 125°C full rated load*

SMALL BOX?

KEY MICROMINIATURE WIRE WOUND RESISTORS, *Series 20, are only 0.1" Dia, 150K max. value*

BEAT-UP BOX?

KEY MICROMINIATURE WIRE WOUND RESISTORS

— new ruggedized construction insures freedom from failure due to severe physical environment.

Send for data on the full KEY line — MIL and miniature types.

KEY RESISTORS

KEY RESISTOR CORP.
321 W. Redondo Beach Blvd.
Gardena, California

FAculty 1-4980, DAvis 3-5000

See Us At Booth #223 at the WESCON SHOW

CIRCLE 647 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Silicon Power Rectifier

Rated at 150 amp

The 150 amp type 8A silicon power rectifier is a heavy duty unit that can carry a full 150 amp in half-wave circuits and up to 450 amp in bridge circuits. Hermetically sealed, it has good shock and vibration resistance and performs in ambient temperatures to 165 C. The unit is available for operation at voltages ranging from 50 to 400 v in 50 v multiples. It mounts in any position and withstands storage temperatures from −65 to +200 C.

Fansteel Metallurgical Corp., Dept. ED, 2200 Sheridan Rd., North Chicago, Ill.
Booth 220-222

CIRCLE 653 ON READER-SERVICE CARD

Pressure Scanner

Cuts required transducers

With the SP-105 pressure scanner, up to 160 individual pressures can be read with 16 transducers. The unit consists of four rotors, four stators, switching mechanisms, and electrical and pressure connections. Each of the four rotors has provision for mounting four flush diaphragm transducers, and each of the four stators has 40 pressure line inputs. The scanner is designed for pressures from 0 to 100 psia on the reference pressure lines, and from 0 to 75 psia on the vent lines. Suited for wind tunnel applications, it is 20 x 6 x 4 in. and has a 1/10 hp motor that operates on 115 v ac, 400 cps.

Datex Corp., Dept. ED, 1307 S. Myrtle Ave., Monrovia, Calif.
Booth 513

CIRCLE 654 ON READER-SERVICE CARD

Size 8 Gearhead

Has maximum length of 3/4 inch

Maximum overall length of this size 8 gearhead is 3/4 in. Through screws from the front of the unit secure it to three No. 0-80 equally spaced tapped holes in the servo motor. Of solid, postless construction. the gearhead is resistant to shock and vibration. It is made of immunized stainless steel with ABEC Class 5 or better ball bearings. Gear tolerances are precision Class 2 or better per AGMA specification 236.04.

Bowmar Instrument Corp., Dept. ED, 8000 Bluffton Rd., Ft. Wayne, Ind.

Booth 2912

CIRCLE 655 ON READER-SERVICE CARD

Miniature Thyratrons

Switch 67.5 kw and 5 megawatts

Miniature model HY-1 and 632 ceramic-metal hydrogen thyratron tubes have respective ratings of 5 megawatts, 20 kv, 500 amp peak and 67.5 kw, 3 kv, 45 amp peak.

Edgerton, Germeshausen & Grier, Inc., Dept. ED, 160 Brookline Ave., Boston, Mass.

Booth 3211-3213

CIRCLE 656 ON READER-SERVICE CARD

CIRCLE 657 ON READER-SERVICE CARD ➤

NEW PRODUCTS AT WESCON

Potentiometers

Miniature

Series 48M and 49M potentiometers are 0.2 w carbon and 1.5 w wirewound units, respectively. The 48M is 5/8 in. in diam and comes in linear resistances from 200 ohms to 5 meg or tapered resistances from 1500 ohms to 2.5 meg. In linear units, tolerance is ±10% below 100 K and ±20% above; in tapered units, it is ±20% for all models. The 48M is available with a 1/8 in. shaft or a slotted shaft with a split locking bushing. The wirewound series 49M is 25/32 in. in diam and comes in linear resistance values from 1 ohm to 20 K. It has ±5% tolerance.

Clarostat Manufacturing Co., Inc., Dept. ED, Dover, N.H.

Booth 2211

CIRCLE 659 ON READER-SERVICE CARD

Coaxial Ratio Transformer

Is 2-1/2 in. in diam

Subminiature coaxial ratio transformer CRT-3 is 2-1/2 in. in diam. Accurate to 0.001%, it has high input impedance, low effective output impedance, and a phase shift of 0.05 milliradians in normal operation. The unit has a 140 v maximum input voltage at 400 cps, and operates over a frequency range of 50 to 10,000 cps. It has a five-place resolution obtained by a three-decade ratio transformer and a one-turn interpolating potentiometer, and meets military specs for vibration, salt spray, fungus and humidity.

Gertsch Products Inc., Dept. ED, 3211 S. La-Cienega Blvd., Los Angeles 16, Calif.

Booth 1502-1504

CIRCLE 660 ON READER-SERVICE CARD

Infrared Radiometer

Resolves small targets from background

A precision infrared contrast radiometer, the model R-4K1 OptiTherm distinguishes small, remote targets from a variety of sky backgrounds and makes radiometric contrast measurements of them. The device, which consists of an optical head and an electronic unit connected by a single cable, achieves target discrimination with a space-filtering chopping reticle that has a large number of blades. Targets smaller than the spaces between the blades are chopped and result in a high frequency output signal that corresponds to the speed and the number of blades. Details larger than the spaces are not chopped and produce no output signal. The instrument has a uniform sky rejection ratio of 10,000 to 1 and incorporates a germanium lens that provides a 4 deg field of view and filters out radiation of wavelengths shorter than 1.8 microns.

Barnes Engineering Co., Dept. ED, 30 Commerce Rd., Stamford, Conn.

Booth 3717

CIRCLE 661 ON READER-SERVICE CARD

Crystal Filters

Have 30 mc center frequency

Models 30 MH, 30 MJ, 30 MK, and 30 MP crystal filters have center frequencies of 30 mc and 6 db bandwidths of 125, 40, 25, and 5 kc respectively. Maximum insertion loss is 3 db. Case sizes are 3-1/32 x 1-7/16 x 1 in. for model 30 MH and 2-3/8 x 1 x 1-1/32 in. for the remaining three.

Hermes Electronics Co., Dept. ED, 75 Cambridge Parkway, Cambridge 42, Mass.

Booth 2821-2823

CIRCLE 662 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Aluminum Wire

Has boron-free ceramic insulation

This 1000 F aluminum wire uses a flexible boron-free ceramic insulation with matching coefficient of linear expansion. It can be wound around a mandrel five times its own diameter. Stripping may be accomplished chemically or mechanically. Voltage rating is 400 v. Wire sizes range from 4 to 100 mils.

Technical Industries Corp., Dept. ED, 389 N. Fair Oaks, Pasadena, Calif.
Booth 1304-1305

CIRCLE 664 ON READER-SERVICE CARD

Bit Rate Unit

Provides pulse-height, pulse-width signal

Retarded bit rate unit, model 220, operates in conjunction with timing generator models 201, 270 and 206A. It provides a pulse-height, pulse-width signal for recording time on equipment other than tape recorders.

Hermes Electronics Co., Dept. ED, 75 Cambridge Parkway, Cambridge 42, Mass.
Booth 2821-2823

CIRCLE 665 ON READER-SERVICE CARD

Subminiature Fuses

Have 0.205 in. in diam

The Microfuse line of subminiature fuses are 0.205 in. in diam and 0.270 in. long. Available from 1/500 through 5 amp, they can be used in circuits with voltages up to 125 v and currents up to 200 amp with the same quick blowing characteristics as larger units. Series 278000 has pigtail leads; series 272-000 is used with subminiature fuse holder.

Littelfuse, Inc., Dept. ED, Des Plaines, Ill.
Booth 2201

CIRCLE 666 ON READER-SERVICE CARD

Phase Shifter

May be used as secondary standard

From a 400 cps ±5% input frequency, the type 714A phase shifter produces known phases at the output terminals. A ±0.1 deg unit with one output voltage precisely in phase with the input, it may be used as a secondary standard or as a calibrator for phase measuring or phase shifting equipment. The phase angle control provides a choice of 0, 30, 60, 90, 120, 150, and 180 deg in standard units, and no external calibrating or zeroing controls are required. Input voltage amplitude is 0 to 10 v rms and input impedance is 100 K. Nonstandard frequencies and phases can be provided on special order.

Acton Labs, Inc., Dept. ED, 533 Main St., Acton, Mass.

Booth 3508

CIRCLE 668 ON READER-SERVICE CARD

Oscilloscope Modules

Plug-in

These plug-in oscilloscope modules include high and low frequency amplifiers, a differential low frequency amplifier, a combination sweep generator and horizontal amplifier a horizontal-vertical amplifier, a dual beam switching unit and crt and power supply modules. They can be combined in a wide range of standard signal gun oscilloscopes, portable or rack mounted multigun oscilloscopes, or special purpose multichannel instruments for production, laboratory, or missile testing applications.

Advanced Electronics Mfg. Corp., Dept. ED, 2116 S. Sepulveda Blvd., Los Angeles 25, Calif.

Booth 3708

CIRCLE 669 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Crystal Oscillator

Has 0.0005% frequency stability

Available at any frequency from 3 to 100 mc, the DFO-10 transistorized crystal oscillator is 1 x 1 x 1-1/8 in. and provides 0.0005% frequency stability from −55 to +90 C. The circuit is completely encapsulated with Silastic RTV 501 for operation under extreme vibration and shock. Output power is 0.1 mw minimum; load impeddance is 50 ohms standard and up to 600 ohms on special order; and supply voltage is 20 to 30 v as specified.

Delta-f, Inc., Dept. ED, 113 E. State St., Geneva, Ill.
Booth 212B

CIRCLE 672 ON READER-SERVICE CARD

Delay Line

Four in one

In a single 3 x 2-7/8 x 1 in. unit, the model 71-30 incorporates four separate delay lines, each with a 1 μsec delay and a 1 K characteristic impedance. The device is cased in molded epoxy and has a glass melamine board with gold plated pins. Suite dfor printed circuit applications, it is particularly adaptable to dip soldering techniques.

ESC Corp., Dept. ED, 534 Bergen Blvd., Palisades Park, N.J.
Booth 1513

CIRCLE 673 ON READER-SERVICE CARD

Oscilloscope

Has 0.7 mμsec rise time

Model 185A oscilloscope provides a steady display of pulses requiring resolution up to 500 mc. It uses a five-in. cathode ray tube, and no optical magnification is required. It has a 0.7 mμsec rise time and calibrated sweeps from 1 to 100 mμsec per cm. A sweep delay control and magnifier provide a convenient means for synchronizing through an external trigger.

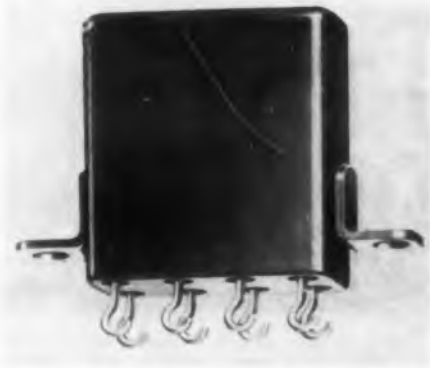
Hewlett-Packard Co., Dept. ED, 275 Page Mill Rd., Palo Alto, Calif.

Booth 1724, 1826-1828

CIRCLE 674 ON READER-SERVICE CARD

Crystal Can Relay

Has low level to 5 amp contact rating



Crystal can relay model JH-6D measures 1 x 0.8 x 0.4 in. and weighs a maximum of 0.8 oz. Its contact ratings are low level to 5 amp at 29 v dc, noninductive; low level to 2 amp at 115 v ac, noninductive; and 1 amp at 29 v dc and 115 v ac, inductive. Available with plug-in, printed circuit, and hook type solder terminals, the hermetically sealed dpdt unit operates from −65 to ±125C under 50 g shock and 20 g, 2000 cps vibration. At rated voltage and 25 C, operating time is 10 msec and release time is 5 msec. The unit can be adjusted to pull in at 100 mw with a maximum contact rating of 2 amp, noninductive, at 29 v dc or 115 v ac.

Allied Control Co., Inc., Dept. ED, 2 East End Ave., New York 21, N.Y.

Booth 3316

CIRCLE 675 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Molded Composition Potentiometers

Rated at 2 w

Designed to operate in extreme environments, these 2 w, molded composition-element potentiometers are suited for test equipment, military gear, computers, servo systems, and industrial metering. They are made according to MIL-R-94, Style RV4 and have one-piece wiper assembly construction, stainless steel shafts, and gold plated terminals. Carbon-to-carbon contact insures a low noise level. The units are available in two versions. The series 53C1 is a shaft type, while the 53C2 has a screw driver slotted shaft with split locking bushing. Tolerance is ±10% for values to 1 meg and ±20% for those above.

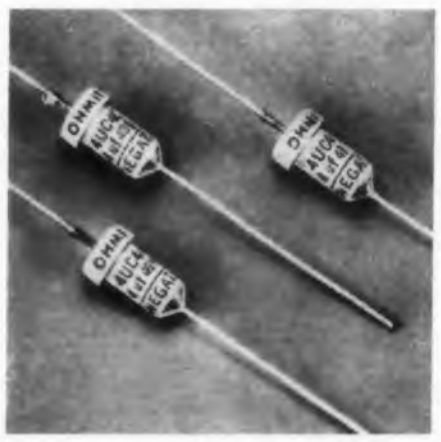
Clarostat Manufacturing Co., Inc., Dept. ED, Dover, N.H.

Booth 2211

CIRCLE 678 ON READER-SERVICE CARD

Tantalum Slug Capacitor

Operates at 125 C



Style UC tantalum slug electrolytic capacitors are rated for operation at ambient temperatures of 125 C; style UB is rated for 85 C ambient. They exceed maximum vibration requirements of MIL-C-3965B and meet the 50 g shock test in accordance with MIL-STD-202A.

Ohmite Manufacturing Co., Dept. ED, 3638 Howard St., Skokie, Ill.

Booth 1703-1705

CIRCLE 679 ON READER-SERVICE CARD

Crystal Can Relays

Have 50 to 250 mw sensitivity

Type MQA, MQB, and MQC crystal can relays have sensitivities of 250, 100, and 50 mw, operating voltages from 1 to 110 v, and coil resistances from 35 ohms to 10 K. Rated up to 3 amp resistive at 28 v dc or 115 v ac, they measure 0.875 x 0.8 x 0.396 in. and weigh 0.5 oz. They are hermetically sealed and operate under 50 to 100 g shock and 30 g, 2000 cps vibration. Temperature range is —65 to ±125 C. The dpdt units are designed for 0.1 in. grid printed circuits with two rows of equally spaced terminals 0.2 in. apart. They are available with 3 in. leads or with solder hook or plug-in terminals and can be furnished in any crystal can mounting arrangement.

Elgin National Watch Co., Electronics Div., Dept. ED, 2435 N. Naomi St., Burbank, Calif.
Booth 1701

CIRCLE 682 ON READER-SERVICE CARD

Attenuator

Ranges from 5 to 120 db

Variable precision attenuator, model 393A, ranges from 5 to 120 db. It comes equipped with removable 50 ohm, 0.5 w terminating resistors, and measures up to 200 w with higher power terminations. The instrument also serves as a four-terminal network for sampling power or coupling-isolating arrangements.

Hewlett-Packard Co., Dept. ED, 275 Page Mill Rd., Palo Alto, Calif.
Booth 1724, 1826-1828

CIRCLE 683 ON READER-SERVICE CARD

Silicon Diodes

Subminiature

These subminiature silicon circuit diodes have a forward drop from 0.7 to 0.74 v at 10 ma. The guaranteed forward matching characteristics of this series, types STC 101 through 108, makes them ideal for applications requiring ultimate reliability.

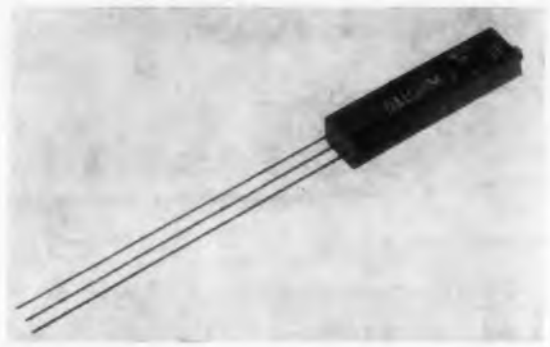
Silicon Transistor Corp., Dept. ED, Carle Place, N.Y.
Booth 1403

CIRCLE 684 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Trimmer Potentiometer

Has full humidity protection



Trimmer potentiometer type 1000W is completely sealed against humidity and meets MIL-STD-202A and MIL-E-5272A requirements. Rated at 2.5 w to 70 C, it has resistances from 10 ohms to 50 K. Temperature coefficient is 50 ppm per deg C; resolution is 0.1 to 1.5%; and linearity is below ±3% on all values. Standard tolerance is ±5% and special tolerances to ±1% are available. A screw adjustment provides 25 ±2 revolutions with a clutch arrangement to permit overtravel in each direction without internal damage. The adjustment is self-locking and will not shift under severe acceleration, shock, and vibration.

Dale Products, Inc., Dept. ED, Columbus, Nebr.

Booth 2714-2716

CIRCLE 687 ON READER-SERVICE CARD

Oscilloscope

Has 15 mc bandwidth

Model 160A oscilloscope has a 15 mc bandwidth and a sensitivity of 20 mv per cm. Built to military standards, it provides dual trace operation on alternate sweep or at a 1 mc chopping rate. Applications include checkout consoles and field tests.

Hewlett-Packard Co., Dept. ED, 275 Page Mill Rd., Palo Alto, Calif.

Booth 1724, 1826-1828

CIRCLE 688 ON READER-SERVICE CARD

Electronic Counter

Has speeds up to 3000 counts per min

Model D electronic counter will operate with absolute accuracy at speeds up to 3000 counts per min. Completely transistorized, it is equipped with separate photohead and has a heavy-duty, totally enclosed cabinet. With the proper input device, the counter also can be used to measure lengths, flow, and position.

Veeder-Root, Inc., Dept. ED, Hartford 2, Conn.

Booth 3601

CIRCLE 689 ON READER-SERVICE CARD

Programmer

For tape search unit

Tape input programmer, model 230, is used to automatically program model 202 tape search unit in searching for several sequential start and stop times. The input may be from any digital programming device such as a paper tape reader or computer.

Hermes Electronics Co., Dept. ED, 75 Cambridge Parkway, Cambridge 42, Mass.
Booth 2821-2823

CIRCLE 691 ON READER-SERVICE CARD

Rack Cabinet

Features easy access to equipment

Vertical rack cabinet frames have access to equipment through any of the four sides. Hinged side panels are mounted to two sides of the cabinet. A louvered face-mounted door encloses the rear, while a face-mounted door filtered at top and bottom offers entrance from the front. They are mounted on caster dollies.

Elgin Metalformers Corp., Dept. ED, 630 Congdon Ave., Elgin, Ill.
Booth 1819-1821

CIRCLE 692 ON READER-SERVICE CARD

Centrifuge

Tests aircraft and missile components

Model A902 centrifuge tests aircraft and missile components under positive and negative g-effects and high ramp functions. It has two outboard rotating tables mounted on the boom. One table is spun by an independent power source (0 to 1800 rpm) to produce a sinusoidal g field. It may be spatially-oriented while the boom is rotating. The opposite table is actuated electropneumatically. It is used to generate a high acceleration ramp function.

Genisco, Inc., Dept. ED, 2233 Federal Ave., Los Angeles 64, Calif.
Booth 3732-3734

CIRCLE 693 ON READER-SERVICE CARD

CIRCLE 694 ON READER-SERVICE CARD ➤

NEW PRODUCTS AT WESCON

Carcinotrons

Uses wideband sole tuning

These carcinotrons use wideband sole tuning without frequency or power holes when a tube is operated into as much as a 2-to-1 mismatch. With wideband rf output couplers, they minimize other components such as antennas, waveguide plumbing, and isolators.

Litton Industries, Electron Tube Div., Dept. ED, 960 Industrial Rd., San Carlos, Calif.
Booth 1623-1625

CIRCLE 697 ON READER-SERVICE CARD

Dielectric Tester

Provides up to 60,000 v dc

Combination dielectric tester and tracer set, model 2146, tests cables at voltages up to 60,000 v dc and up to 250 ma at voltages of 30,000 v and below. It automatically supplies tracer current to a faulted cable. Peak power pulses of up to 80 kw are available for tracing. Direct current is obtained from separate three-phase full-wave bridge rectifier circuits. The tracing section high-voltage is controlled by manually operated variable autotransformer.

Sorenson & Co., High-Voltage Systems Lab., Dept. ED, S. Norwalk, Conn.
Booth 2102-2103

CIRCLE 698 ON READER-SERVICE CARD

Coaxial Switches

Have negligible insertion loss

These mechanical coaxial switches consist of two spdt switches coaxially mounted in a metal frame. Isolation between an open and closed contact is more than 50 db at 250 mc. They have a vswr of less than 1.05 from 0 to 250 mc. Model CS-250 has BNC type connectors at 50 ohm impedance; model CS-275 has F series connectors at 75 ohm impedance.

Jerrold Electronics Corp., Dept. ED, 15th and Lehigh Ave., San Jose, Calif.
Booth 3831-3833

CIRCLE 699 ON READER-SERVICE CARD

Microminiature Relay

Has 250 mw operating power

Series KXI microminiature relays have dpdt 2 amp contacts rated to carry any load from dry circuit to full rating. They have a 1/10 in. grid spaced heater, and a nominal operating power of 250 mw. Capable of withstanding 50 g shocks, they are available in three voltages and four styles.

Kurman Electric Co., Dept. ED, 191 Newel St., Brooklyn 22, N.Y.
Booth 3516

CIRCLE 704 ON READER-SERVICE CARD

Microsource

Produces small, controlled test signals

Model K-1 microsource is designed for use with any standard oscillator within its frequency range to produce small, known, controlled test signals. An internal battery and associated polarity-reversing switch permit the testing of high-gain dc amplifiers. A spring-loaded, momentary-on position in the dc on-off switch allows generation of positive or negative test pulses. Output is continuously variable from 0 to 10 v.

Southwestern Industrial Electronics Co., Dept. ED, 10201 Westheimer Rd., P.O. Box 13058, Houston 19, Tex.
Booth 420-422

CIRCLE 705 ON READER-SERVICE CARD

Traveling Wave Tube

Uses no magnetic focusing fields

Model HA-27 traveling wave tube amplifier has a frequency range of 1.0 to 2.0 kmc. It is electrostatically focused and is relatively insensitive to changes in ambient temperature. Small signal gain is 30 db min; saturated power output is 5 dbm-min. Its construction eliminates much of the amplitude modulation in the presence of vibration common to other traveling wave tubes. It is 15-7/8 in. long and weighs 1.5 lb.

Huggins Laboratories, Dept. ED, 999 E. Arques, Sunnyvale, Calif.
Booth 1918-1920

CIRCLE 706 ON READER-SERVICE CARD

ADVERTISERS' INDEX
August 5, 1959

...versatile, precision ...OHMMETERS you need. ...multi-purpose!

hp 400D
10 cps to 4 MC

Regarded by many as finest ac VTVM ever built. Covers all frequencies 10 cps to 4 MC, extremely sensitive, wide range, accurate within 2% to 1 MC. Measures 0.1 mv to 300 v (max. full scale sensitivity 1 mv), 12 ranges. Direct reading in v, db. 10 megohm input impedance with 15 $\mu\mu$f shunt insures negligible loading to circuits under test. $225.00.

hp 400L
Log VTVM—10 cps to 4 MC

Covering 10 cps to 4 MC, this new hp VTVM features a true logarithmic scale 5" long plus a 12 db linear scale. The log voltage scale plus long scale length provides a voltmeter of maximum readability, with **accuracy a constant percentage of the reading.** Accuracy is ±2% of reading or ±1% of full scale, whichever is more accurate, to 500 KC, ±5% full range. Range 0.3 mv to 300 v, 12 steps, (max. full scale sensitivity 1 mv). $325.00.

hp 400H
1% accuracy VTVM

Here's extreme accuracy of 1% in a precision VTVM covering 10 cps to 4 MC. Big 5" meter has exact-reading mirror-scale, measures voltages 0.1 mv to 300 v (max. full scale sensitivity 1 mv). 10 megohm resistance with 15 $\mu\mu$f shunt minimizes circuit loading. Amplifier with 56 db feedback insures lasting stability. $325.00.

hp 410B
ac to 700 MC, also dc

Time-tested standard all-purpose voltmeter. Covers 20 cps to 700 MC, full scale readings 1 to 300 v. Input capacity 1.5 $\mu\mu$f, input resistance 10 megohms. Also serves as dc VTVM with 122 megohms input impedance, or ohmmeter for measurements 0.2 ohms to 500 megohms. $245.00.

...models! Also, inquire about ...multipliers and shunt resistors.

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Field representatives in all principal areas

5489

NEW!
hp 412A Precision Volt-Ohm-Ammeter

At last a true, precision multi-purpose instrument. Measures dc voltage 100 μv to 1,000 v (max. full scale sensitivity 1 mv), 1% accuracy full scale. Measure currents 1 μa to 1 amp with ±2% accuracy full scale. 13 ranges. As ohmmeter measures 0.02 ohms to 5,000 megohms. Extremely low noise, drift. Recorder output provides 1 v full scale. $350.00.

NEW!
hp 425A Microvolt-Micromicroammeter

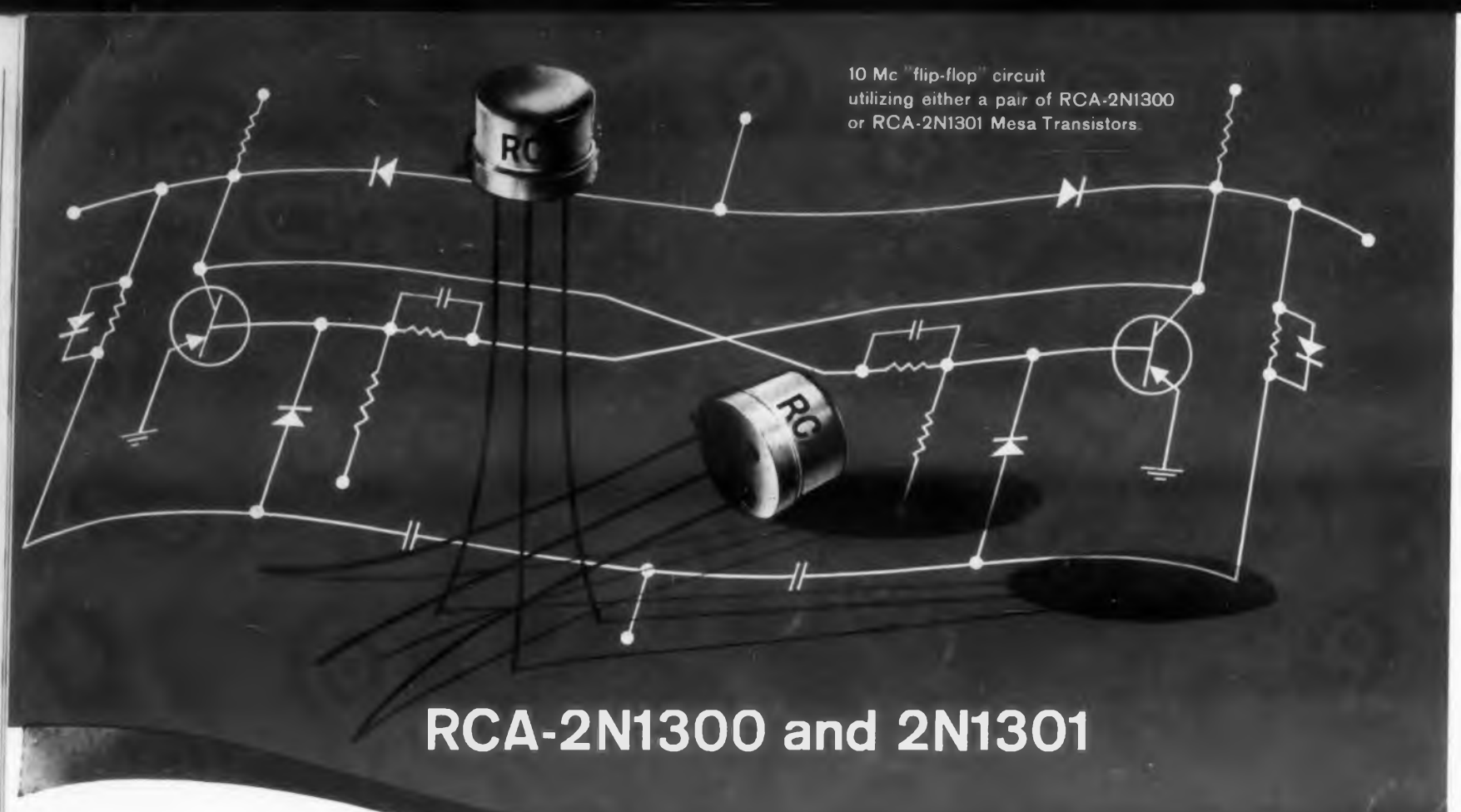
New, high sensitivity, high stability instrument reading end scale voltages of 10 μv to 1 v in 11 ranges, or currents of 10 $\mu\mu$a to 3 ma in 18 step, 1-3-10 sequence. Accuracy ±3% on all ranges. Drift less than 2 μv under all conditions; very much less under lab conditions. Input impedance 1 megohm ±3% on all ranges. Also usable as 100 db amplifier with up to 1 v output from signals as small as 10 μv. $500.00.

NEW!
hp 428A Clip-On Milliammeter

Employs radical new approach to current measurement which eliminates breaking leads, soldering connections or loading of circuit under test. Revolutionary "current sensing" probe **clips around** wire under test, measures the magnetic field around the lead. Easily measures dc current in presence of strong ac. Covers 0.3 ma to 1 amp in 6 steps; full scale sensitivity 3 ma. Accuracy ±3%, probe inductance less than 0.5 μh. $475.00.

...unique value, traditional -hp- dependability

CIRCLE 724 ON READER-SERVICE CARD



10 Mc "flip-flop" circuit
utilizing either a pair of RCA-2N1300
or RCA-2N1301 Mesa Transistors

RCA-2N1300 and 2N1301

LOW-COST MESA COMPUTER TRANSISTORS

Now in quantity production . . . and available!

RCA-2N1300 and 2N1301 Germanium P-N-P Mesa Transistors offer these 10 major benefits to designers of switching circuits. And they're ready for you now!

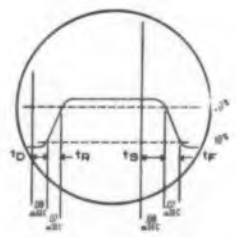
- rugged Mesa structure—permits extremely small base width to insure top performance at high frequencies
- fast switching times with low values of base input current—made possible by high frequency response and low total stored charge
- high current gain—permits high fan-out ratios (number of paralleled similar circuits per driver-stage output)
- high breakdown voltage and punch-through voltage ratings—the result of the diffusion process
- high power dissipation—150 milliwatts at 25°C—aids in the design of reliable circuits
- high current ratings—improve overall system speed
- rugged overall design—units have unusual capabilities to withstand severe drop tests and electrical overloads
- electrical uniformity—a result of the diffused-junction process used by RCA in the manufacture of Mesa Transistors
- especially well suited for use at pulse repetition rates up to 20 Mc
- exceptionally well suited to applications in saturation-type switching circuits

Information on RCA-2N1300 and 2N1301 Low-Cost Mesa Transistors is available from your RCA Field Representative. For technical data, write RCA Commercial Engineering, Section H-18-NN1, Somerville, N. J.

RCA TYPE	Maximum Ratings* Absolute-Maximum Values						Characteristics: Common-Emitter Circuit, Base Input Ambient Temperature of 25° C		
	Collector-to-Base Volts	Emitter-to-Base Volts	Collector Milli-amperes	Transistor Dissipation—mw			Minimum DC Current Gain		Gain Bandwidth Product• Mc
				at 25°C	at 55°C	at 71°C	at collector ma = −10	at collector ma = −40	
2N1300	−13	−1	−100	150	75	35	30	—	40
2N1301	−13	−4	−100	150	75	35	30	40	60

*Maximum collector-to-emitter voltage rating = −12 volts

• For collector ma = −10 and collector-to-emitter volts = −3.



Oscilloscope wave form shows typical delay, rise, storage, and fall times achieved with 10-ma inverter circuit utilizing the RCA-2N1301 MESA TRANSISTOR.

RCA Field Offices

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◀ CIRCLE 725 ON READER-SERVICE C