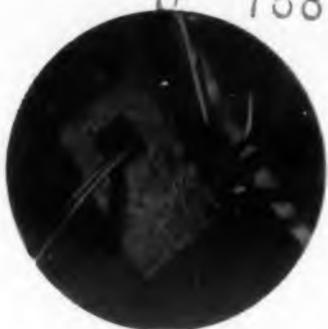


ELECTRONIC DESIGN

AUGUST 5, 1959

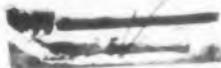
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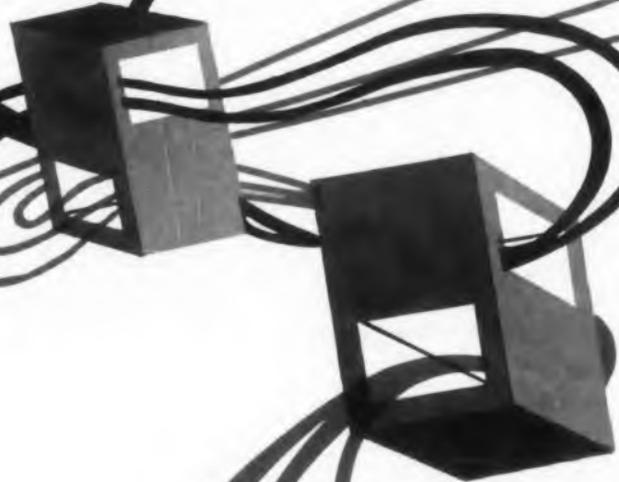


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CONGRESS
SERIAL RECORDS

SEP 4 - 1959



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



advanced PRECISION COMPUTING RESOLVERS for Cascaded Resolver Systems

SIZE 8 FEEDBACK WINDING RESOLVERS

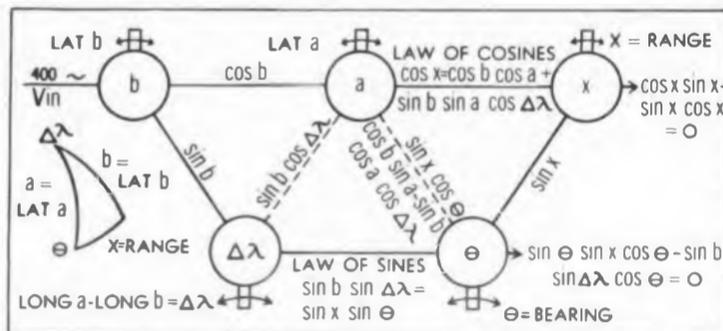


These resolvers are designed for use with transistorized amplifiers and permit the solution of spherical triangles in a size 8 cascaded resolver chain.

Functions of the spherical triangle which can be produced are indicated in the schematic below. More complex trigonometric functions, as well as systems involving coordinate axis transformation, can be generated with the use of these resolvers.

Accuracy: Functional error .1% or less; winding perp. $\pm 5'$. Electrical

characteristics: Input voltage 15v400~ (stator); output voltage 13.7v (rotor); phase shift (stator as primary) 20.5°; output voltage 13.7v (compensator); Zro 234 + j596; Zso 244 + j548; Zcompensator 237 + j553; max. null voltage 1 mv/v.



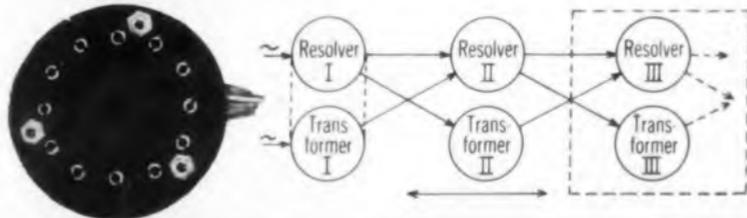
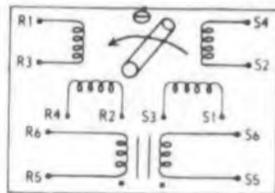
SIZE 11 AMPLIFIERLESS RESOLVER FOR ANGULAR DATA TRANSMISSION



These size 11 resolvers incorporate an integral transformer which simulates a resolver function at maximum coupling. They are used in the typical chain application indicated below for angular data transmission. In this particular application, the output information can be served at either end of the chain.

Quick disconnect allows ease in harnessing.

Accuracy: $\pm 5'$ of arc or less; winding perp. $\pm 5'$. Electrical characteristics: Input to EITHER rotor or stator. Input voltage 115v1600~; output voltage 110v both stator and rotor as primary; phase shift (stator primary) 1.1°; phase shift (rotor primary) 1.9°; Zso (nom.) 990 + j13500; Zro (nom.) 1150 + j13500.



SIZE 11 RESOLVER TRIMMED FOR ZERO PHASE SHIFT CONTAINS ALL COMPENSATION IN 2 1/4" LENGTH



The YZC-11-E-1 precision computing resolver has been developed for use in a cascaded, amplifierless resolver system at 900~.

These units have been trimmed to provide zero phase shift and compensated for transformation ratio stability, under temperature, when working into their iterative impedance.

Accuracy: Functional error .1% or less; winding perp. $\pm 5'$. Electrical characteristics: Input voltage (stator) 40v900~; output voltage (rotor) 33.2v; phase shift 0; max. null voltage 1 mv/v.

Also ready for delivery is an equivalent, compatible pancake resolver. By its use, differential information from an inertial platform may be obtained and introduced into the system.

ENGINEERS — Join the leader in the rotating components field. Write David D. Brown, Director of Personnel, Dept. E8

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CLIFTON HEIGHTS, PENNSYLVANIA

Sales Office: 9014 W. Chester Pike, Upper Darby, Pa. — Hilltop 9-1200, TWX Flanders, Pa. 1122 — or our Representatives

CIRCLE 1 ON READER-SERVICE CARD

HIGHLIGHTS OF ISSUE



Magnetic Memory Element Shrinks and Speeds Computers (Cover) 28

Memories built with these devices, called Biaxes, will work with less power and at higher temperatures than any built using cores, twistors, and transfluxors. The unit uses orthogonal magnetic fields for non-destructive readout, measures 50 x 50 x 85 mils, and has been operated at 125 C with no loss of performance.

What Electronic Designers Should Know About Meter Relays 24

Because meter relays simplify and stabilize electronic circuits, they are being used more and more. The types of meter relays available, their characteristics, and how they work are areas covered by this article.

Problems in Selecting Ferrite Modulators 32

"How ferrite modulators work, and how to work with them" is just the first part of this double feature. The second part compares eight basic types for application, advantages and disadvantages, and electrical characteristics.

New Products At The WESCON Show 122

This issue of *ELECTRONIC DESIGN* contains more than 200 descriptions of new products that will be shown for the first time at the WESCON Show. Just about every kind of electronic product is covered, including: semiconductor units, testing devices, basic components, and microwave equipment.

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- Problems in Selecting Ferrite Modulators 32
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Tracking down eyelet failures in printed circuits are described
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WESCON show
AUGUST 18-21

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ITT'S COMMUNICATIONS DIVISION...**

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Today, Kellogg systems and components play expanding roles in remote control, data and voice transmission, telemetering, microwave—for Kellogg is the *communications* division of International Telephone and Telegraph Corporation, pioneer in communications developments.

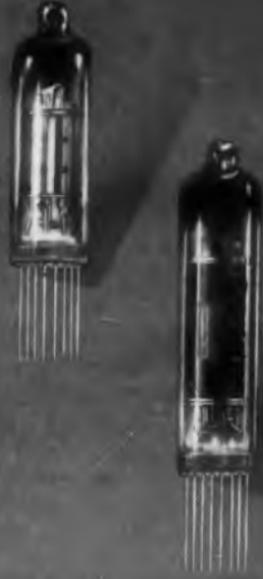
Whatever your needs, "call Kellogg"... whether for research, for technical know-how, or for the unparalleled facilities of invention and production for which Kellogg has been famous for 60 years. You'll find Kellogg uniquely qualified to tackle today's communications problems in industry and defense.



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CIRCLE 1 ON READER-SERVICE CARD

Now you can specify these popular submins for extra-severe duty — in new Raytheon Reliability-Plus types



CK6021WA
Twin Triodes

CK6111WA
Twin Triodes

CK6112WA
Twin Triodes

CK5639WA
Video & Power Amplifier

CK5902WA
Beam Power Pentode

Only Raytheon produces these improved-reliability button base subminiature tubes — electrically identical to and directly interchangeable with prototypes, and controlled throughout production to meet the following tests above and beyond military specifications:

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CIRCLE 3 ON READER-SERVICE CARD

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Digital Telemetry 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-telemetry 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.

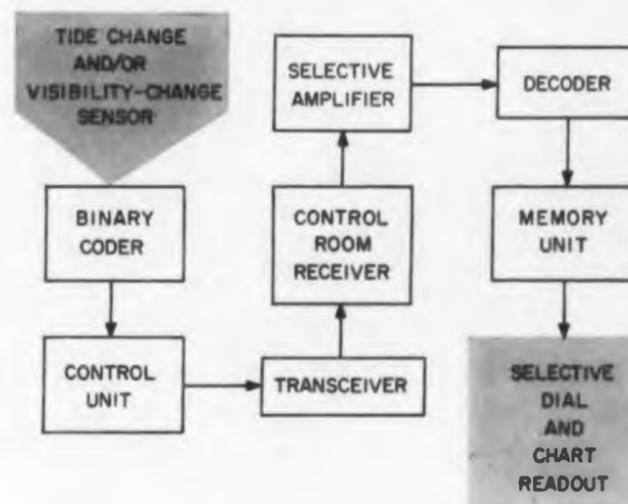
The system's control unit generates the "0" and "1" tones with two transistorized oscillators and houses the relays that switch the transmitters and receivers on and off.

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.

RELIABILITY
UP HERE

CONTROLLED
PRODUCTION
DOWN HERE

In new contaminate-free laboratory and production-facilities, U.S. Relay tests and produces complete lines of relays and "customerized" control systems. Here, under dust-free, electrostatically filtered conditions, the unkind extremes of temperature, humidity, altitude and random-noise vibrations are anticipated, and provided for, in highly dependable products for an ever-changing space age.

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Contact Load at 29 VDC . . . 15 Amp. Res.
Temperature . . . -65°C to +120°C
Hermetically sealed, potted leads.

TYPE TD 100 SERIES, SPDT, 2PDT and 3PDT
Transistorized Time Delay.

Time Delay . . . 30 milliseecs. to 3 mins. ±5%
Nominal voltage range . . . 28 VDC Standard,
other voltages on request.
Contact Load at 29 VDC . . . 2 Amp. Res.
Temperature . . . -65°C to +85°C
Reset Time . . . Instantaneous for SPDT and 2PDT;
reset time for 3PDT depends upon delay period.
Hermetically sealed, potted leads optional.

TYPE M-101 and M-102, 2PDT

Magnetic latch or Standard.
Crystal case size.
Voltage . . . 28 VDC Standard;
other voltages on request.
Contact Load at 29 VDC-2 Amp. Res.
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For information write to
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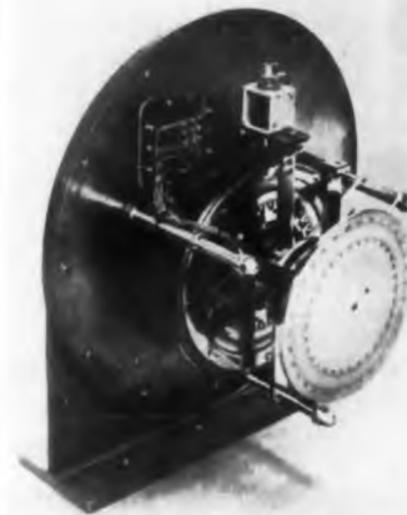
U.S. RELAY

CIRCLE 4 ON READER-SERVICE CARD

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.

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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)



THE HUGHES 21" TONOTRON[®] tube offers you greater viewing area for your radar read-out applications. This new 21" tube is especially suited to jet-age air traffic control. Its giant display area enables air controllers to locate and track high-speed aircraft with an accuracy never before attained.

This new TONOTRON tube provides high light output, integration abilities, full gray scale, controllable persistence, and a very large display area—all in one envelope!

Other applications for this advanced 21" storage tube include: combat situation plotting, radars, large-scale read-out, medical diagnosis, industrial television and slow-scan displays.

Available also from Hughes is a 21" character-writing TYPOTRON[®] storage tube, which gives you the *added* capability of high-speed character and spot writing displays in addition to the full gray scale. The Hughes 21" TYPOTRON tube is ideally suited for any of your complex digital read-out requirements.

Both the 21" TONOTRON tube and the 21" TYPOTRON tube are now available for delivery. For additional information regarding these tubes please write: Hughes Products, Electron Tubes, International Airport Station, Los Angeles 45, California.

For Export information write: Hughes International, Culver City, California.

THE BIG PICTURE FOR RADAR DISPLAYS



See the new Hughes 21" TONOTRON tube in action at WESCON (Booths 3012-3018)

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JUPITER . . . POLARIS . . .

VANGUARD AND LA CROSSE

MISSILE PROGRAMS



SPECIFICATIONS

A.C. INPUT: 208/230/460 volt $\pm 10\%$,
3 phase, 60 cycle.

RIPPLE: Less than 1% RMS.

RESPONSE TIME: A special control internally mounted in the Power Supplies handles adjustment of response time. The "load on" response time is adjustable from 20 to 200 milliseconds, and the "load off" from 40 to 400 milliseconds. An important advantage of this adjustable response is when used with inductive loads, such as inverters; recovery can be adjusted to avoid interaction between inductive load and power supply.

RATINGS AVAILABLE:

Model Number	D.C. Output		Regulation		Dimensions W" x H" x D"	Weight Lbs.
	Volts	Amps	Static-Line or Load	Dynamic-Load*		
MRST28-100	24-32	100	$\pm 0.1\%$	$\pm 6V$	22"x36"x22"	430
MRST28-200	24-32	200	$\pm 0.1\%$	$\pm 6V$	22"x36"x22"	550
MRST28-300	24-32	300	$\pm 0.1\%$	$\pm 6V$	22"x46"x22"	700
MRST28-400	24-32	400	$\pm 0.1\%$	$\pm 6V$	28"x58"x24"	1250
MRST28-500	24-32	500	$\pm 0.1\%$	$\pm 6V$	26"x68 1/2"x32"	1650
MRST28-600	24-32	600	$\pm 0.1\%$	$\pm 6V$	26"x68 1/2"x32"	1650
MRST2440-250	24-40†	250	$\pm 0.1\%$	$\pm 2V$	26"x68 1/2"x32"	1650

*FOR FULL LOAD CHANGE
†IN 2 RANGES



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CIRCLE 6 ON READER-SERVICE CARD

TECHNICAL DESCRIPTION

These units use silicon power rectifiers for increased reliability and efficiency. Silicon rectifiers provide constant efficiency and exhibit no aging characteristics as is more common in other type rectifiers. Magnetic components utilize grain oriented silicon steel and Class B insulation for compact design and efficient operation. The power section consists of a 3 phase magnetic amplifier with extremely high gain. Preamplifier is fully transistorized and utilizes silicon zener diodes as a reference element.

ADDITIONAL FEATURES

Output of units can be shorted without damage to the silicon rectifiers.

Units can withstand 400% overload for periods up to 1 second without damage to Power Supply components.

Remote sensing low output impedance

*Militarized versions
of above units
are also available.*

*For additional data
contact factory or sales
offices below:*

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Canada
AXminster 3-7011
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PARKway 3-9000
Syracuse
Gibson 6-0220
Tucson
EAst 6-3543
Washington
JUniper 5-7550

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.



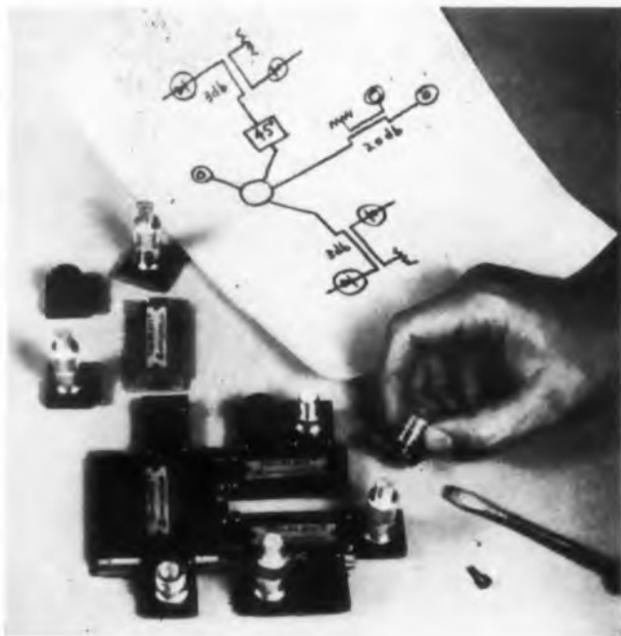
Video integrating equipment minimizes unwanted information on radar displays. Cabinets house (from left to right) velocity canceling and anti-jamming equipment, static storage facilities (drum-shaped container houses quartz delay lines), canceling equipment for anti-jamming, and, at right, main control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



If you're looking for a high-performance crystal filter

At your service is a group of highly talented Hughes Crystal Filter engineers who specialize in solving difficult network problems. These men can design and produce a crystal filter to meet your most exacting requirements! In addition, Hughes offers you tremendous production capacity—over 10,000 filters per month of a single type. With Hughes Crystal Filters you get:

Precise Selectivity—Eliminates cross talk between channels, makes new systems possible.

Small Size—Reduces overall equipment size, makes filter more reliable by eliminating air space, results in higher stress factor.

High Frequency—Saves circuit costs, eliminates the need for double conversion. Center frequencies 30 kc to 40 mc.

Low Passband Ripple—Eliminates errors in information, enables end equipment to be more precise.

Wide Temperature Stability—Provides flexibility of use, contributes to high reliability.

Low Insertion Loss—Enables system to operate on low signal level—thereby combating noise and cutting circuit costs.

To avail yourself of the Hughes applications engineering service, or for additional information concerning performance levels please write: HUGHES PRODUCTS, Industrial Systems Division, Marketing Dept., International Airport Station, Los Angeles 45, California. For Export, write: Hughes International, Culver City, California.

See Crystal Filters and other Hughes Products at WESCON: Booths 3012-18.

Creating a new world with **ELECTRONICS**

HUGHES PRODUCTS

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CIRCLE 7 ON READER-SERVICE CARD



Enlarged photograph of raw crystal



BULOVA CRYSTAL CONTROLLED ULTRA-STABLE SHIFT OSCILLATORS

Bulova shift oscillators are all that any electronics engineer could ask for in miniature crystal controlled packages!

Consider this new Bulova custom designed 18.5mc shift oscillator. Here's an assembly of two oscillators operating at 18.5mc. One is fixed, with a 1 pp 10⁷ stability. The other is a variable with equal stability, 1 pp 10⁷. The shift is accomplished by means of a variable air capacitor. How-

Department A-1361, Electronics Division, Bulova, 40-06 62nd Street, Woodside 77, New York



CIRCLE 8 ON READER-SERVICE CARD

ever, the same shift, at the same frequency, can be affected with a varicap.

This new ultra-stable shift oscillator is only one of many recent advances made by Bulova Electronics. For information on these specific units, or on how Bulova experience, in mastering component and system reliability, can help your program, write—

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.



Order off-the-shelf quantities of HIGH VOLTAGE HUGHES RECTIFIERS at factory low prices from the following exclusive distributors:

Akron Electronic Supply
107 South Arlington; Akron 6, Ohio

Allied Radio Corporation
100 North Western Avenue; Chicago 80, Illinois

Arrow Electronics, Inc.
525 Jericho Turnpike; Mineola, Long Island, N.Y.

East Coast Radio and TV Co.
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Elmar Electronics, Inc.
140 Eleventh Street; Oakland 7, California

Radio Shack Corporation
167 Washington Street; Boston 8, Massachusetts

Radio Specialties and Appliance Corporation
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Radio Specialties Co.
456 Charlotte Avenue; Detroit 1, Michigan

Radio Specialties Co., Inc.
209 Pennsylvania Ave.; Alamogordo, New Mexico

Terminal Radio Corporation
85 Cortlandt Street; New York 7, New York

Western Radio and Television Supply Company
1410 India Street; San Diego, California

Federated Purchaser, Inc.
11275 West Olympic Blvd.; Los Angeles 64, Calif.

Federated Purchaser, Inc.
1021 U.S. Route 22; Mountainside, New Jersey

Gifford Brown, Inc.
618 First Street, N.W.; Cedar Rapids, Iowa

Graybar Electric Company, Inc.
1107 Foch Street; Fort Worth, Texas

Graybar Electric Company, Inc.
717 Latimer Street; Dallas, Texas

Hudson Radio and TV Corp.
48 West 48th Street; New York 19, New York

Kann-Ellert Electronics, Inc.
9 South Howard Street; Baltimore, Maryland

Kann-Ellert Electronics, Inc.
2414 Reddie Drive; Silver Spring, Maryland

Kieruff Electronics, Inc.
820 West Olympic Blvd.; Los Angeles 15, Calif.

Morris Distributing Co., Inc.
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Morris Distributing Co., Inc.
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HIGH VOLTAGE RECTIFIERS

in reliable, subminiaturized packages

You'll find Hughes silicon rectifiers ideally suited to design problems which combine high voltage with small size. In fact, Hughes rectifiers can handle more voltage than any rectifiers of comparable size.

You also get high reliability. Packaged in the Hughes glass envelope—proven dependable throughout many years of testing and use—this rectifier will stand up

under highly adverse operating conditions.

Hughes silicon rectifiers are also packaged in modules in various configurations, such as: ring modulators, matched pairs and quads, etc.

The complete line of Hughes rectifiers... with 50 to 1000 volt ratings at 50 to 200 mA... is available for immediate delivery—and in large volume quantities. For addi-

tional information, you are invited to write or phone the Hughes Semiconductor sales office or distributor nearest you. Or write: Hughes Products, Marketing Department, SEMICONDUCTOR DIVISION, NEWPORT BEACH, CALIFORNIA.

For export write: Hughes International, Culver City, California.

RATINGS AND SPECIFICATIONS: Absolute Maximum Ratings at 25° C.

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 20 μ A.

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

Creating a new world with *ELECTRONICS*

HUGHES PRODUCTS

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CIRCLE 9 ON READER-SERVICE CARD

NEW IDEAS IN PACKAGED POWER

for lab, production test,
test maintenance, or as a
component or subsystem
in your own products

Look how Sorensen equipment blankets the controlled power field:



A-c regulators

- Completely tubeless—transistorized and mag-amp to 5 kva
- Tubeless for peak, rms or average voltage
- Electronic—to 15 kva
- Fast-response, low-distortion
- High-precision ($\pm 0.01\%$ rms regulation)
- Hermetically sealed and MilSpec versions
- 400-cycle regulators
- Three-phase
- A-c meter calibrators and voltage reference sources
- "Constant voltage transformers" for line and filament regulation

NOBATRON® regulated d-c supplies

- B supplies
- Tubeless low-voltage, high-current—to 500 amps out
- Wide range—electronic, transistor or mag-amp controlled
- Electronically regulated d-c supplies
- Miniature transistor-regulated supplies
- And also unregulated d-c supplies



Frequency changers, inverters, converters (no moving parts in these)

- Single-phase, 60 cps to single-phase 400 cps or any f in range 45-2000 cps—adjustable f or $\pm 0.001\%$ regulated; powers to 1000 va
- Single-phase 60 cps to three-phase 400 cps
- Miniature transistorized inverters—6, 12, or 28 vdc to 115 vac, 60 or 400 cps
- Miniature transistorized converters—6, 12, or 28 vdc to d-c voltages from 50 to 1000 vdc

Model R5010 Tubeless AC Line Regulator (top)
Model 610B Nobatron DC Supply (center)
Model FCR 250 Frequency Changer (bottom)

Although Sorensen originally made its name as the foremost producer of electronic a-c line-voltage regulators, we've come a long way since then. Today, Sorensen standard units, as outlined above, fill almost all the requirements of the controlled power field—and you can add to these Sorensen's high-voltage equipment (up to 600 kv). Today's Sorensen engineer is equally at home in designing with vacuum tubes, semiconductors, and the latest magnetic devices and materials to produce better, lighter, faster controlled power equipment than ever before. Sorensen engineers are always glad to discuss your special power requirements with you—whether for a new unit or for a complete power system. Write us or see your Sorensen representative.

8.44



SORENSEN & COMPANY, INC.

Richards Avenue, South Norwalk, Connecticut

WIDEST LINE OF CONTROLLED-POWER
EQUIPMENT FOR RESEARCH AND INDUSTRY

IN EUROPE, contact Sorensen-Ardag, Zurich, Switzerland. IN WESTERN CANADA, ARVA.
IN EASTERN CANADA, Bayly Engineering, Ltd. IN MEXICO, Electro Labs, S. A., Mexico City.

CIRCLE 10 ON READER-SERVICE CARD

NEWS

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.

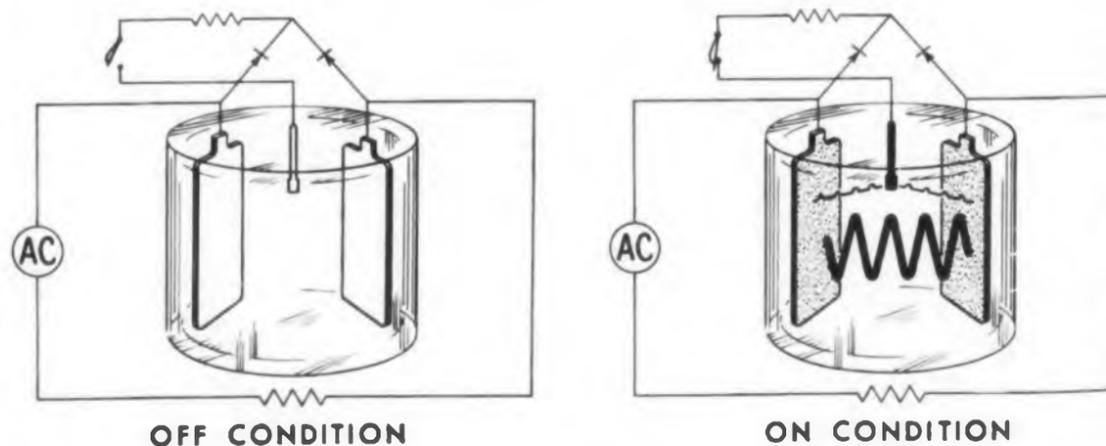
A small signal on the acid-resistant platinum grid element makes the two load electrodes permeable to ions and instantaneously changes the state of the electrodes from nonconducting to conducting. Large quantities of ac current can then flow from one electrode to the

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



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.

Chemist
1.5-inch
with no

ap
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the
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sili
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cu
loa
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fila
lat

rat
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cla
—
sho

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ELECT



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.

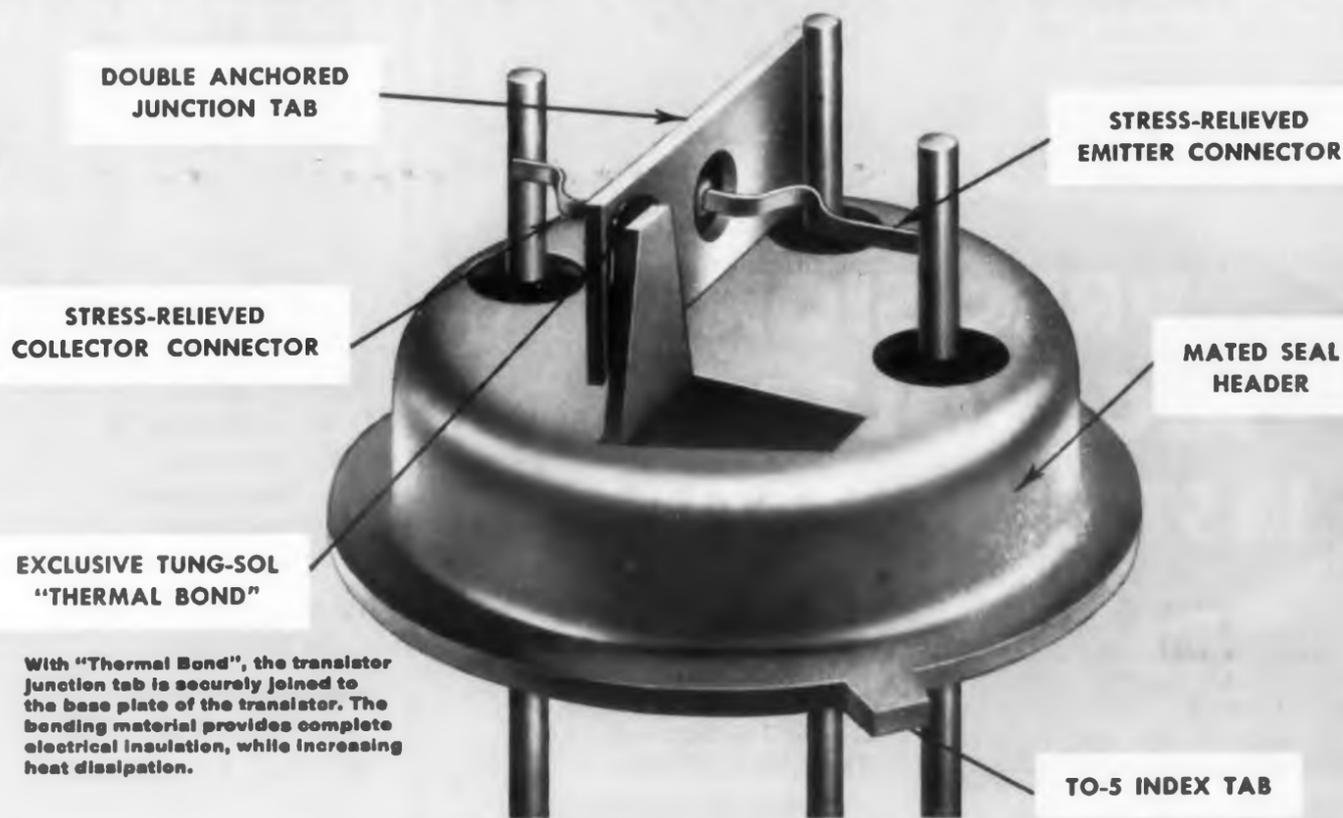
Available in sample quantities is a unit rated at 4-amp, 3-v-min to 70-v-max, with a rated temperature rise of 55 C. Ovitron claims relatively stable operation from -10 to +150 C regardless of vibration, shock, impact or position.

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 electrolyte. ■ ■

"THERMAL BOND"

EXCLUSIVE TUNG-SOL CONSTRUCTION

MEANS NEW STANDARDS OF TRANSISTOR PERFORMANCE IN COMPUTER APPLICATIONS



With "Thermal Bond", the transistor junction tab is securely joined to the base plate of the transistor. The bonding material provides complete electrical insulation, while increasing heat dissipation.

From Tung-Sol, originator of the Cold Weld Seal, comes a new design approach to greater mechanical reliability in computer switch transistors.

TS1000 is a PNP germanium alloy junction transistor which is designed for use in high current, high speed switching applications. This new transistor provides an ideal balance of the most wanted characteristics as revealed by survey of computer designers.

1. Withstands 20,000 G centrifuge.
2. Exceeds all MIL environmental specs—shock—vibration—salt spray—centrifuge—moisture resistance, etc.
3. Excellent current gain linearity (low beta fall-off).
4. Thermal resistance derating is lowest for electrically insulated devices (.350° C/mW, typical).
5. Sensibly priced.

Immediate availability

Certainly, more information is available. Write: Tung-Sol Electric Inc., Newark 4, New Jersey



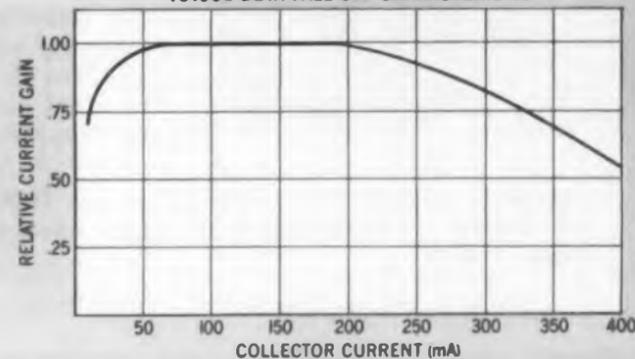
MAXIMUM RATINGS

V_{CBO}	-30V
V_{EBO}	-20V
V_{CEX} ($V_{BE} = 0.1V$)	-20V
V_{CEO}	-12V
I_C (continuous)	400mA
I_C (peak)	1.0 A
T_J	-65°C to +85°C
P_C	175mW

TYPICAL CHARACTERISTICS (25°C)

f_{ab}	12 Mc
C_{ob}	12 $\mu\mu\text{f}$
h_{FE} ($I_B = 1mA$)	60
h_{FE} ($I_C = 400mA$)	40
$(t_r + t_d)$ (rise plus delay)	0.45 μsec
t_s (storage)	0.30 μsec
t_f (fall)	0.20 μsec
Thermal Resistance	0.350° C/mW
I_{CBO} @ -12V	2.5 μA
25°C	2.5 μA
65°C	25 μA

TS1000 BETA FALL-OFF CHARACTERISTIC



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MODEL AVS 321
Precision AC Power Supply
1 volt to 1000 volts AC
35 cycles to 10 KC
Digital set voltage to $\pm 0.1\%$



MODEL AVS 320
Fixed voltage regulator. Four fixed voltages between 1 volt and 300 volts at all frequencies 35 cycles to 20 KC. Will make any power amplifier. A precision voltage supply.

PRECISION A.C. VOLTAGE INSTRUMENTATION



MODEL 30 Power Amplifier
30 Watts 0.1% Distortion
Output 1 to 300 volts AC
35 cycles to 20 KC

MODEL AVA 500 Power Amplifier
500 Watts 2% Distortion
Output 115 - 230 volts
300 cycles to 2 KC



MODEL AO .1 Audio Oscillator
20 cycles to 20 KC
1 volt RMS Output with short term stability of 0.05%
frequency stability $\pm 1\%$
Distortion 0.1%
The ideal oscillator for A.C. voltage measurements

Complete details and specifications on HOLT Precision AC Voltage Instrumentation are yours upon request . . . Write Today.

See these instruments in Booth No. 112 at the WESCON SHOW.



CIRCLE 12 ON READER-SERVICE CARD

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 \$									
consumer	2600	3500	4400	5000	5100	5500	6100	7800	7940
replacement	1500	1400	1300	1400	1400	1500	1600	1700	1600
industrial	250	350	400	500	650	750	850	900	860
military	350	450	500	600	650	750	950	1300	1380
total	500	1300	2200	2500	2400	2500	2700	3900	4100
TV set production¹ 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, mfg⁴ 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 millions 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: 207 (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



utmost
in
performance

TYPE 33M

MOLDED
mylar*
CAPACITOR

applications | *computers • instrumentation • test equipment*
filter networks • transistor circuitry • amplifiers

Sangamo Type 33M molded mylar* capacitors combine the excellent electrical performance characteristics of mylar* dielectric material with a molded case of high moisture resistant thermosetting plastic.

Temperature Range: "The Type 33M is designed to operate over the temperature range of $-55^{\circ}\text{C}.$ to $+85^{\circ}\text{C}.$ Satisfactory performance at $125^{\circ}\text{C}.$ can be obtained by derating the voltage to 50% of the $85^{\circ}\text{C}.$ value."

Dissipation Factor: The dissipation factor of the Type 33M capacitor does not exceed 1% at normal equipment operating temperature over the complete audio frequency range.

Tolerances: Available in capacitance tolerance values of $\pm 5\%$, $\pm 10\%$, $\pm 20\%$.

Life Test: These units will withstand a life test of 250 hours at 125% of rated voltage at $85^{\circ}\text{C}.$ Life tests at $125^{\circ}\text{C}.$ should be made at 125% of the derated voltage.

Dielectric Absorption: Dielectric absorption of Type 33M capacitors is less than half that of oil impregnated paper capacitors.

Moisture Resistance: Type 33M capacitors will successfully withstand the moisture resistance tests specified in Spec. MIL-C-91A.

Insulation Resistance: The insulation resistance of these capacitors will exceed 5,000 meg/mfd. over the normal operating temperature range.

• Write for engineering bulletin TSC-206A

*DuPont's trademark for polyester film.

SANGAMO ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

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SC-59-6



**YOU'RE
LOOKING AT
THE WORLD'S
SMALLEST TRIMMERS
FROM DAYSTROM PACIFIC**

Seeing'sbelieving! These are Daystrom Pacific Squaretrims...the smallest trimming potentiometers you can buy. They're half as large as competitive pots...with resolution characteristics that are twice as good. *And they cost no more!* Lightweight...exclusive square design for stacking as many as twenty 50K pots in just one cubic inch...and backed by five years of proved performance.

They answer the need for high resolution, minimum space requirements in airborne and missile instrument and systems applications...and in ground instruments and systems where stability is a requirement.

For complete specifications and resolution characteristics of the Daystrom Pacific Squaretrim line, write today for Data File ED-808-1.

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potentiometers / gyro instruments / airborne systems

CIRCLE 14 ON READER-SERVICE CARD

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. ■ ■



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Vibrations	2-2000 cps—15G	2-2000 cps—30G
Shock	100G	125G
Acceleration	Constant 17G	Constant 50G

In addition, the units were vibrated at resonant peaks between 2-2000 cps from 25G to 50G for 15 minutes without electrical or mechanical degradation.

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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



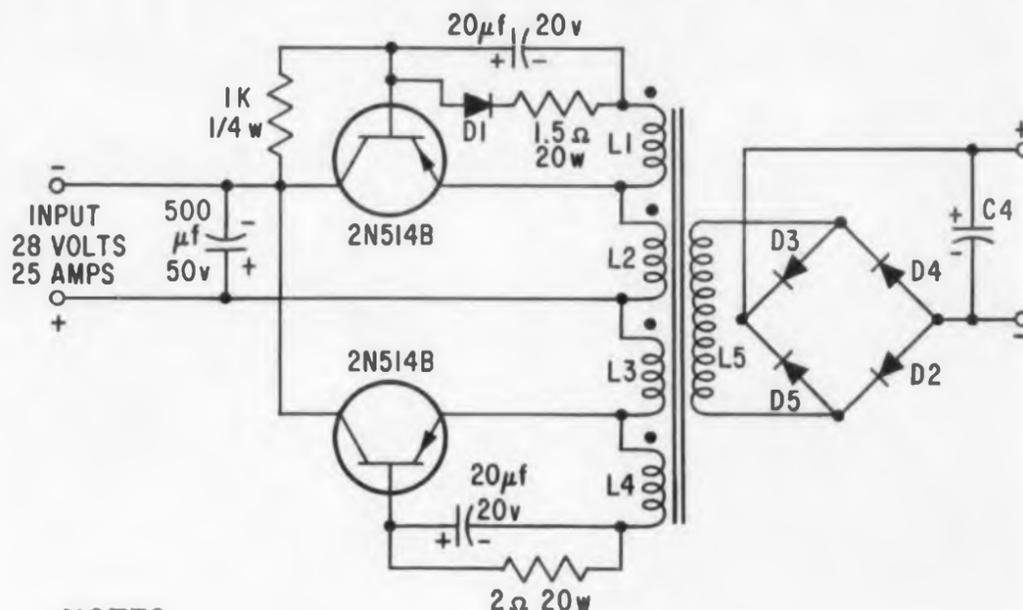
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Q1, Q2—2N514B 80 volt 25 amp each mounted on a minimum of 200 sq in. of 1/4" aluminum for operation up to 50°C.
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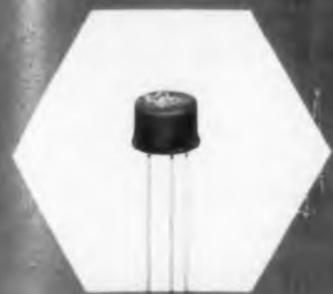
	2N511	2N511A	2N511B	2N512	2N512A	2N512B	2N513	2N513A	2N513B	2N514	2N514A	2N514B	unit	
V_{CBO}	Collector-to-Base Voltage ($I_C = -5\text{ma}$, $I_E = 0$)	-40	-60	-80	-40	-60	-80	-40	-60	-80	-40	-60	-80	v
V_{CEK}	Collector-to-Emitter Voltage ($V_{BE} = +0.2\text{v}$, $I_C = -5\text{ma}$)	-40	-60	-80	-40	-60	-80	-40	-60	-80	-40	-60	-80	v
V_{EBO}	Emitter-to-Base Voltage ($I_E = -5\text{ma}$, $I_C = 0$)	-	-30	-	-	-30	-	-	-30	-	-	-30	v	
I_C	DC Collector Current	-	-10	-	-	15	-	-	20	-	-	25	a	
I_E	DC Emitter Current	-	-	-	-	-	-	-	-	-	-	-	a	
I_B	Base Current	-	-	-	-	-	-	-	-	-	-	-	a	
	Total Dissipation	-	-	-	-	-	-	-	-	-	-	-	w	
T_J	Junction Temperature	-	-	-	-	-	-	-	-	-	-	-	°C	

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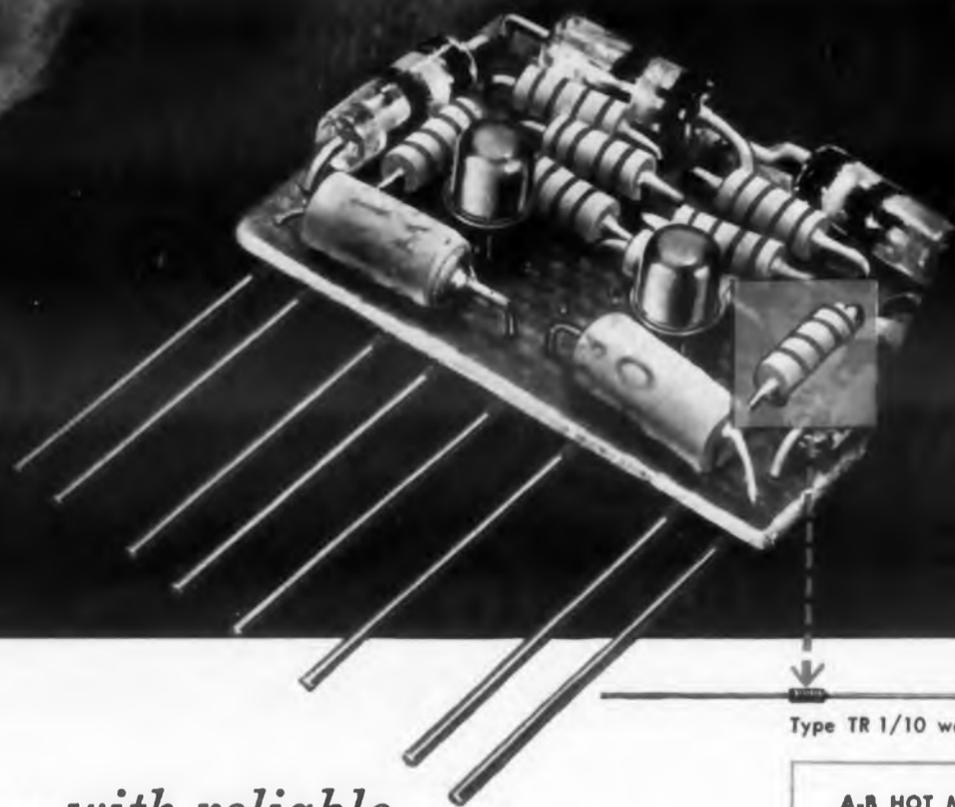
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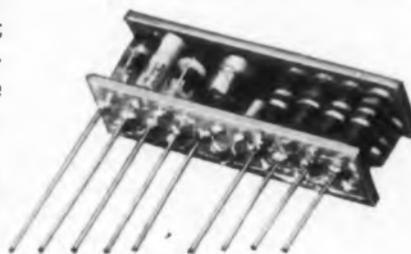
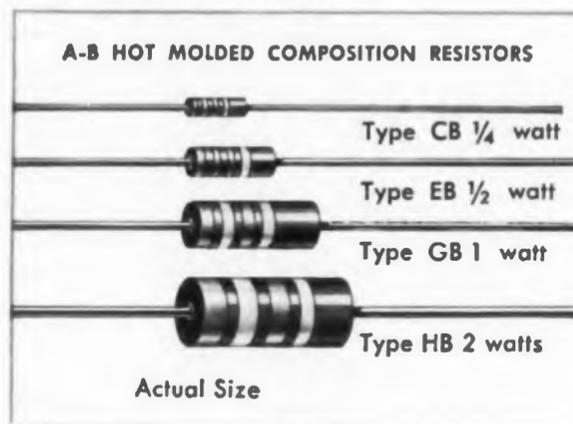
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This shows still another type module packaging which uses A-B Type CB 1/4 watt composition resistors.

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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.

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2N699—ELECTRICAL CHARACTERISTICS (25° C)

Symbol	Characteristic	Min.	Typ.	Max.	Test Conditions
h_{FE}	D.C. pulse current gain	40		120	$I_C = 150$ ma $V_C = 10$ v
$V_{BE(sat)}$	Base saturation voltage		1.0	1.3	$I_C = 150$ ma $I_B = 15$ ma
$V_{CE(sat)}$	Collector saturation voltage			5v	$I_C = 150$ ma $I_B = 15$ ma
h_{fe}	Small signal current gain at $f = 20$ mc	2.5	5.0		$I_C = 50$ ma $V_C = 10$ v
C_{ob}	Collector capacitance	$14\mu\mu f$		$20\mu\mu f$	$I_E = 10$ ma $V_C = 10$ v
I_{CBO}	Collector cutoff current			$2\mu a$ $200\mu a$	$V_C = 60$ v $T = 25^\circ C$ $V_C = 60$ v $T = 150^\circ C$

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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 Telemetry, 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.

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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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CIRCLE 41 ON READER-SERVICE CARD

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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 S. Roethly



Ingenuity Engineered



Let's not kid ourselves — *nothing* is perfect. But we think you'll agree that the x-band radar antenna shown is about as close as you'll ever get. For example, reliability has been *Ingeneered* into the scanner of this knee-high package simply by keeping the number of moving parts to a minimum: *one*.

That isn't the whole story, of course. We could talk about things like modular packages for az-el drives, how the feed exhibits circular symmetry to r-f, how we get high-speed nutation by rotation and on and on . . . But we figure your requirements are probably different than the next fellow's anyway, so why don't you write us if you want all the specs? 15330 Oxnard St., Van Nuys.



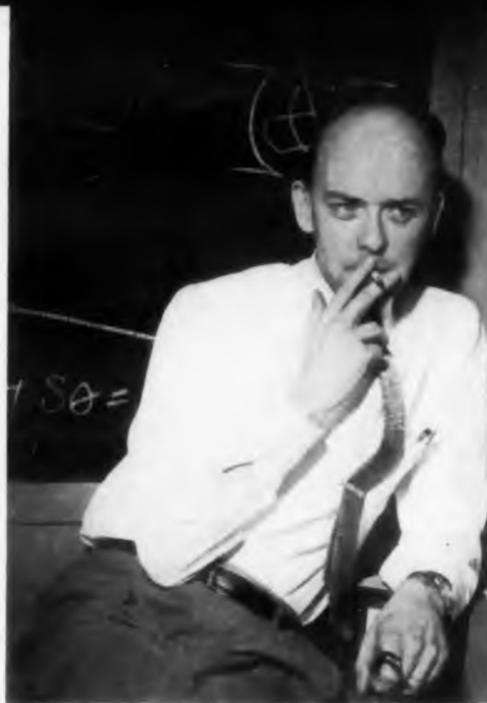
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CIRCLE 22 ON READER-SERVICE CARD

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 $0.2 \mu\text{a}$. 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 $10 \mu\text{a}$; (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 con-

tacts 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 $5 \mu\text{a}$ 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 μ a meter-relay having point of contact accuracy of 1 per cent, a change of 0.1 μ a 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 μ w 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 μ w can switch 30 w and thus realize a power gain of more than 10×10^6 .

Response Time Limited

Compared with the almost instantaneous 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



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.

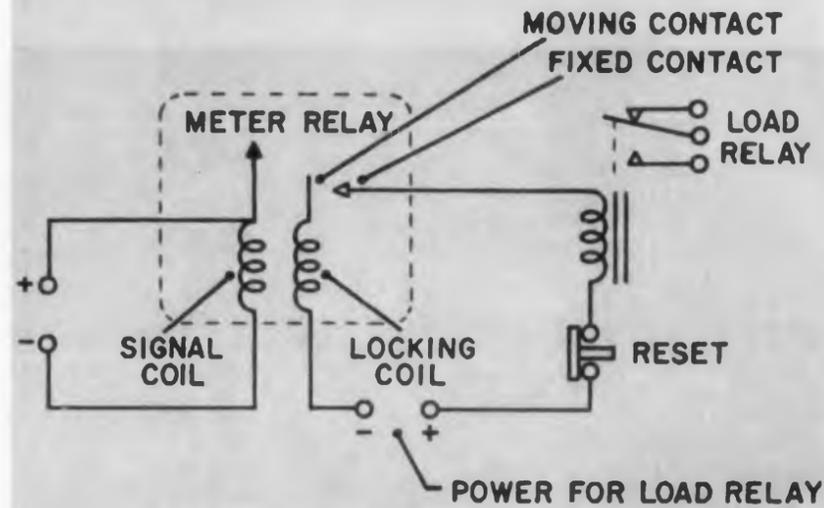


Fig. 2. Basic circuit for locking coil meter-relay. The best design for locking action involves an extra coil of about 100 turns of fine wire separately connected, but wound on the moving coil.

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 μ a and the signal reaches 80 μ a. In a recent case, a practical 75 msec speed was developed in a 1 ma meter-relay by using 670 μ w of power (for a 670 ohm coil). This compares with the standard consumption of 100 μ w 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

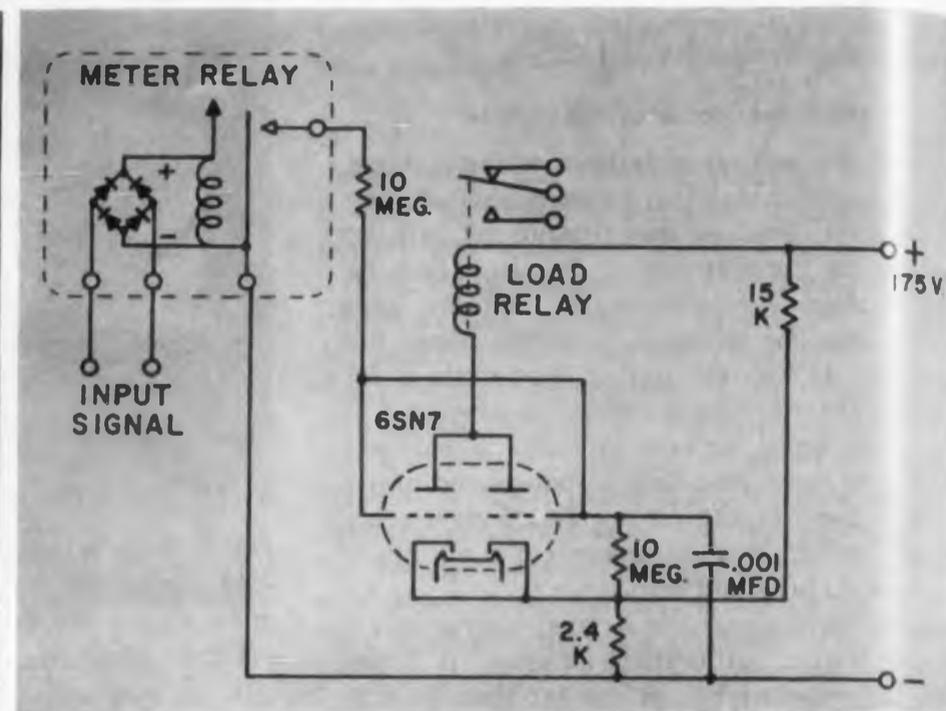
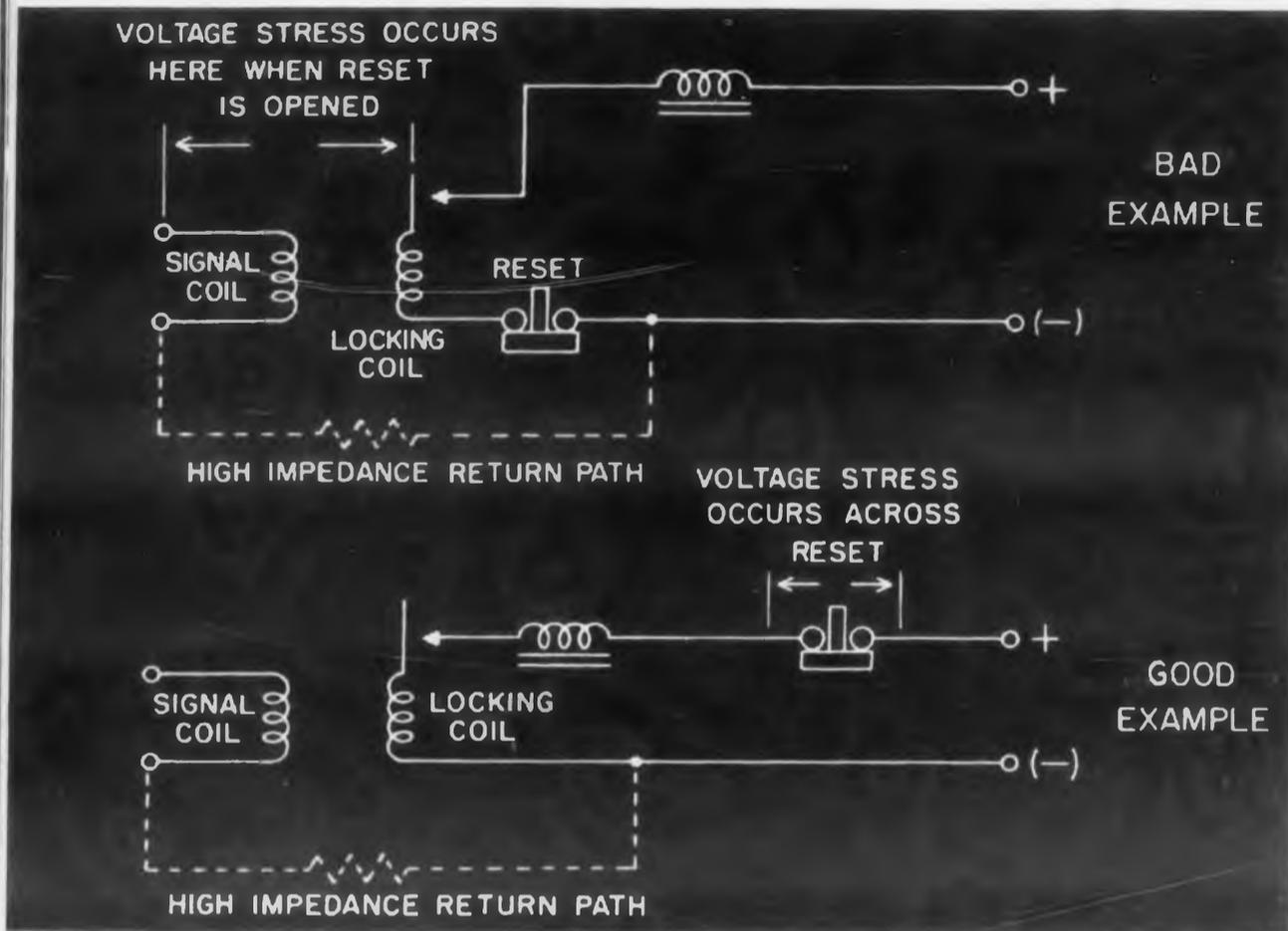


Fig. 4. (above) A highly successful application involving a non-locking, meter-relay and an electronic relay.

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 often 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 nega-

tive. 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 μ a, 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 electro-mechanical, 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 μ f 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.

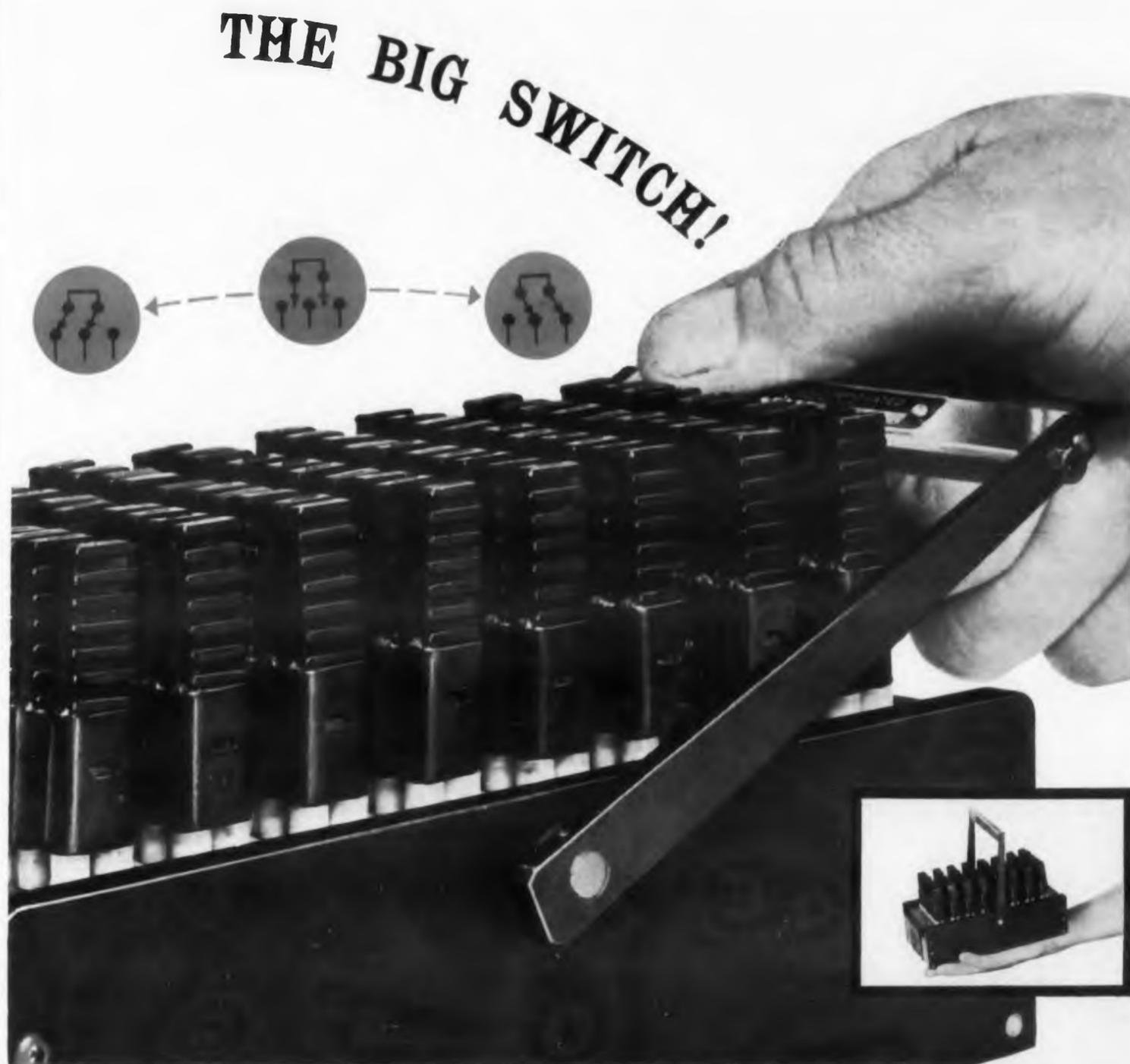
When the signal surges from the monitored motor the indicating pointer is free to move. Even if it reaches the high set point it will not energize the load relay because the high contact is temporarily disconnected. The movement of the indicating pointer from the low contact acts as a switch, and removes 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. ■ ■

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CIRCLE 23 ON READER-SERVICE CARD

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 μ sec 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



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 trans-

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

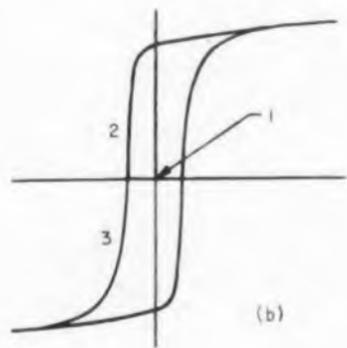
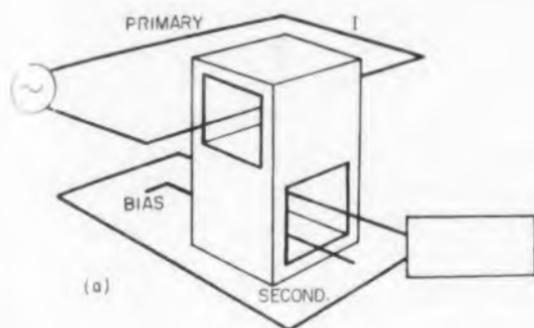


Fig. 2. No conventional magnetic coupling exists between upper and lower holes of basic two-axis Biax element in (a). The Biax hysteresis loop is shown in (b).

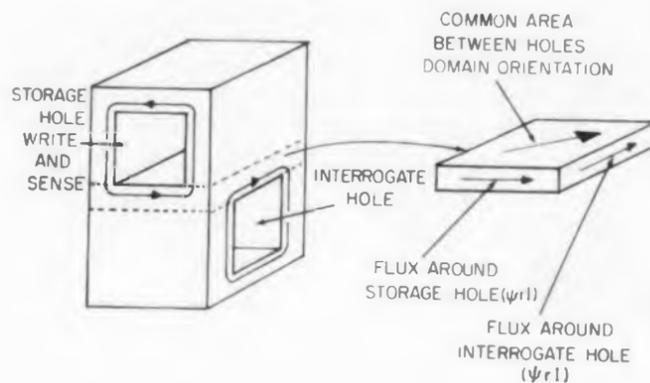


Fig. 3. Saturation of ferrite through one winding rotates shared magnetic domains, causes a decrease of secondary hole's magnetic induction. Rotation is elastic.

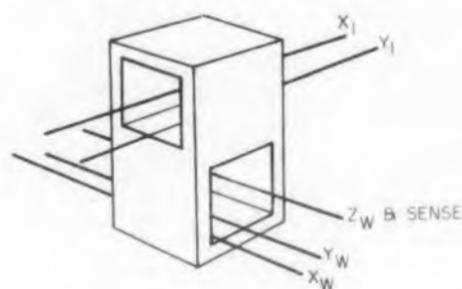


Fig. 4. Basis Biax memory element. Z winding is used for readout.

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.

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.



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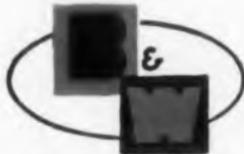
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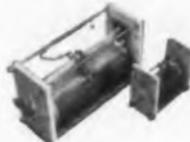
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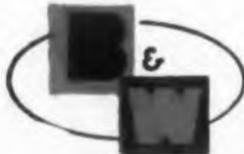
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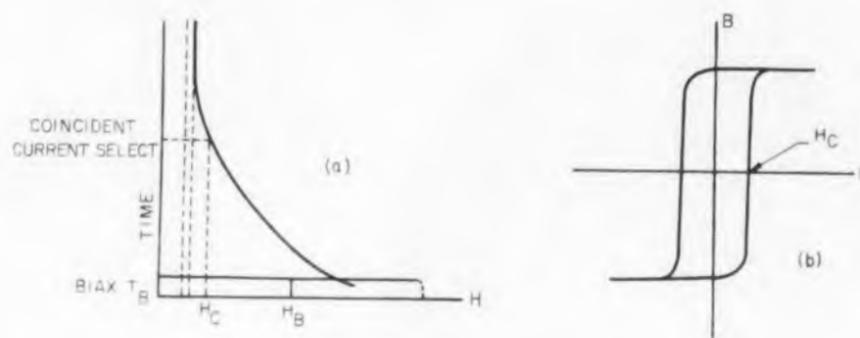


Fig. 5. Switching time vs applied field is shown in (a); when applied H-field crosses curve, ferrite is switched. A ferrite square hysteresis loop is shown in (b).

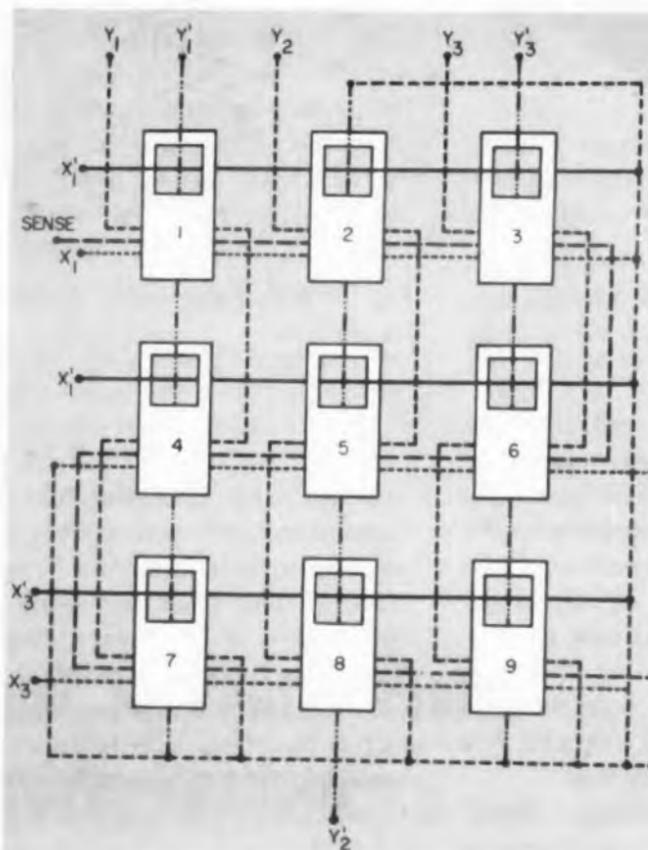


Fig. 6. A 3 x 3 Bixax memory array.

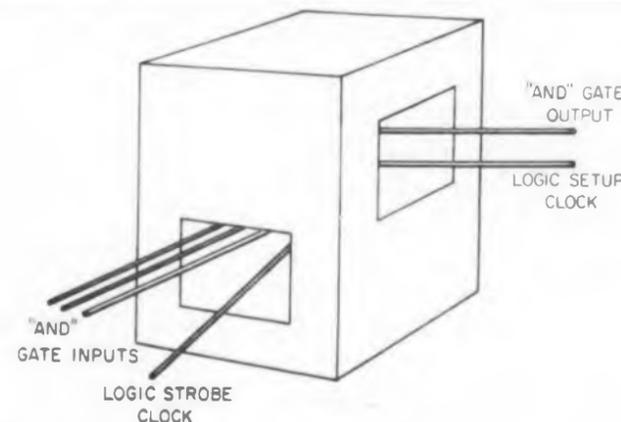


Fig. 7. Basic Bixax gate element. There is no shared ferrite between orthogonal holes. As many as 15 AND inputs are possible: only limitation is size of 20 x 20 mil hole.

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 is 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 ex-

ception 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.

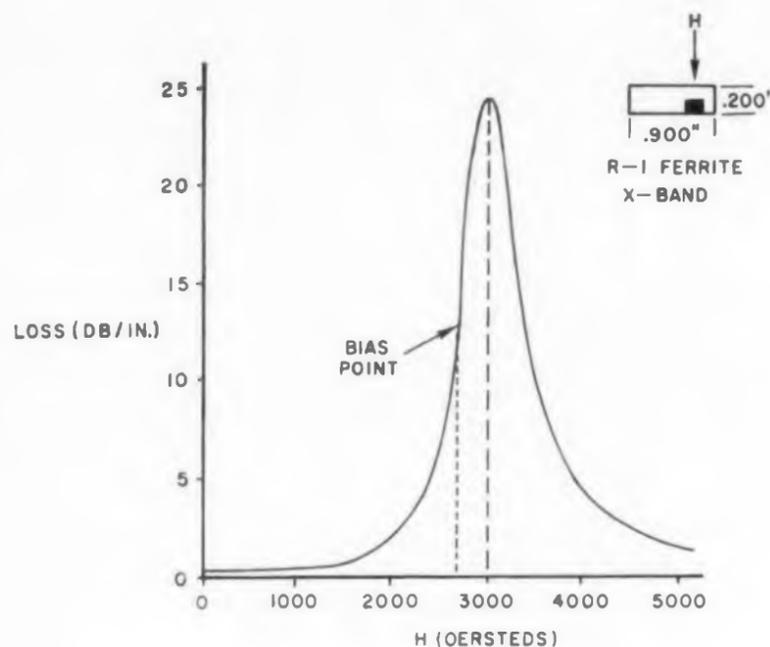


Fig. 1. (left) Loss characteristic of a ferrite-loaded circular guide.

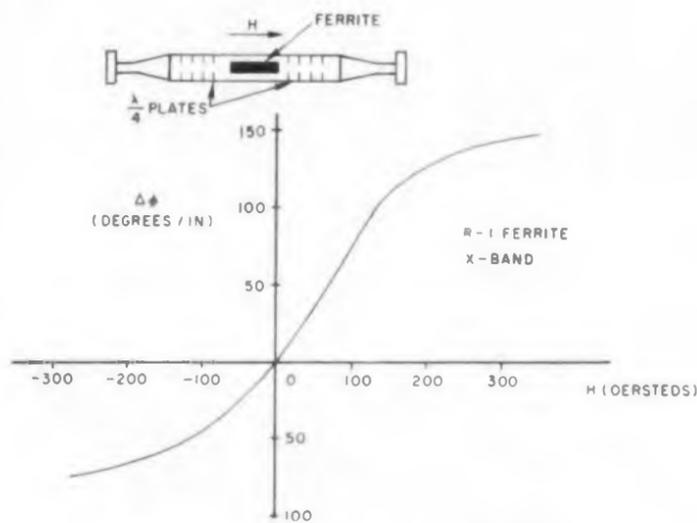


Fig. 2. (right) Phase characteristic of a ferrite-loaded circular guide.

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 modu-

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

lator 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.

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 output 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.

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)

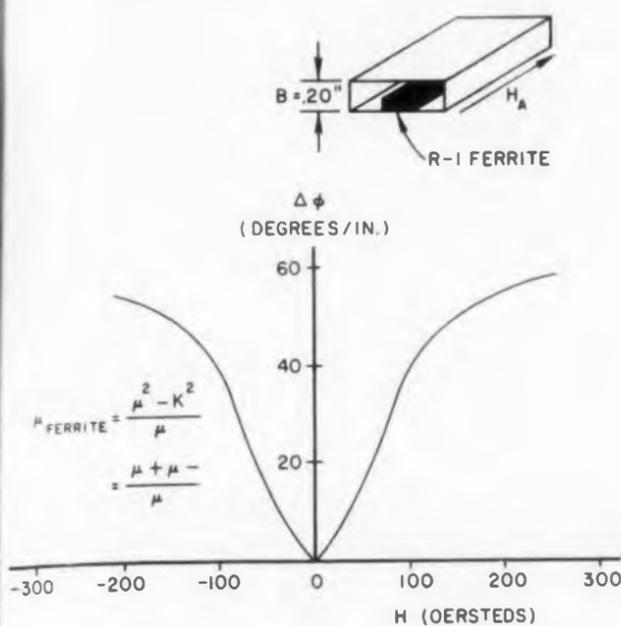


Fig. 3. Phase characteristic of a ferrite-loaded rectangular guide.

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)

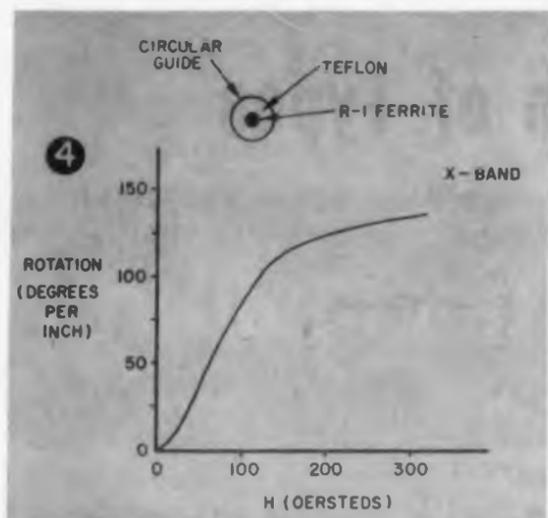


Fig. 4. Rotation characteristics of a ferrite-loaded circular guide.

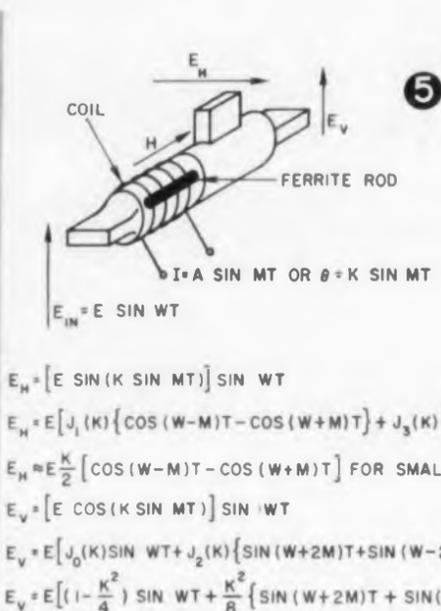
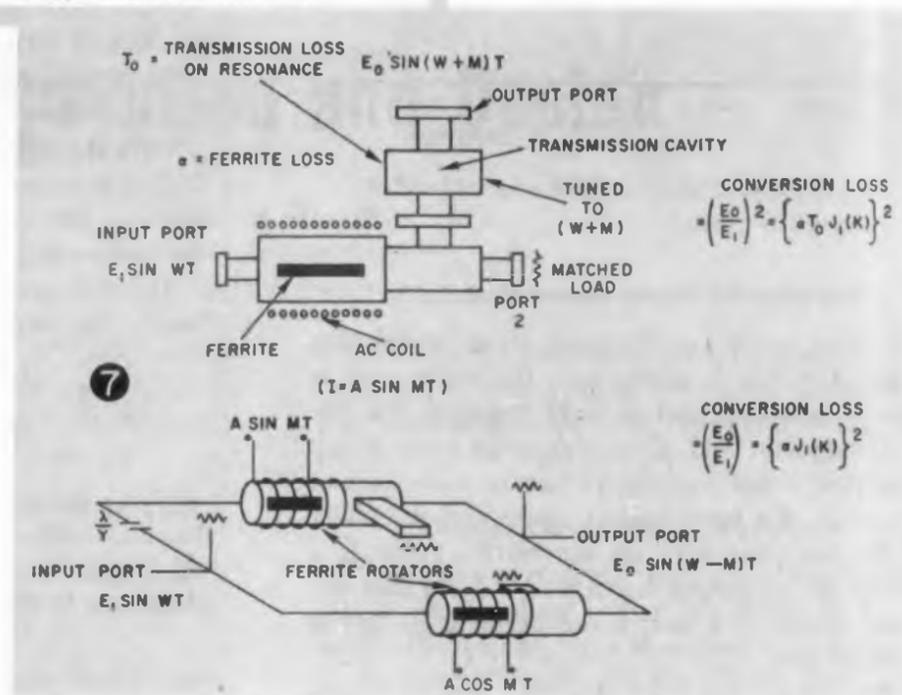
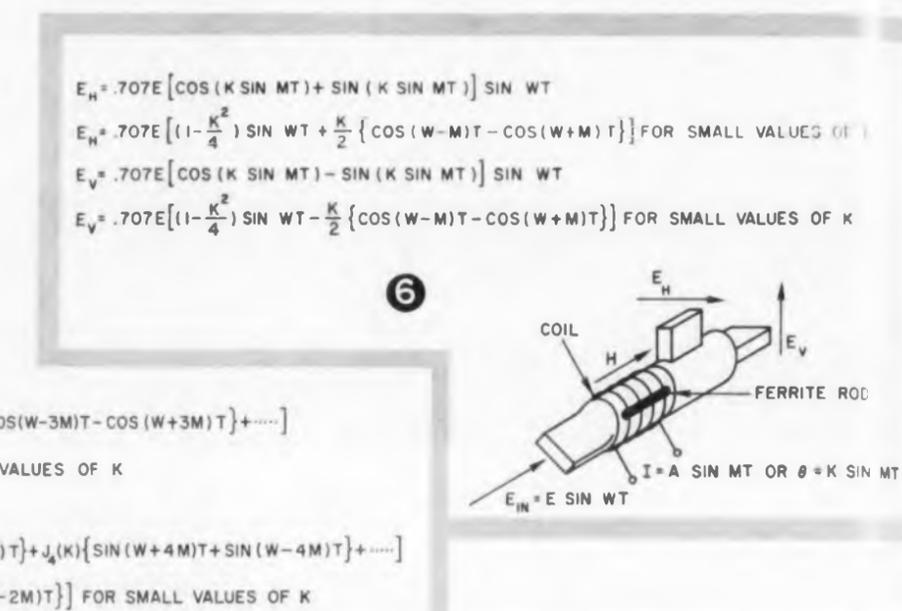


Fig. 5. A rotation type of amplitude modulator.

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 $E_{in} \sin \theta$, while the voltage at the vertically polarized port will be $E_{in} \cos \theta$. 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 $\sin \theta \approx \theta$). 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_0 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 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 Cacheris¹ uses a rotating magnetic field, while the one described by O'Hara and Scharfman³ 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 fre-

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 1 kw 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

quency 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. ■ ■

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.

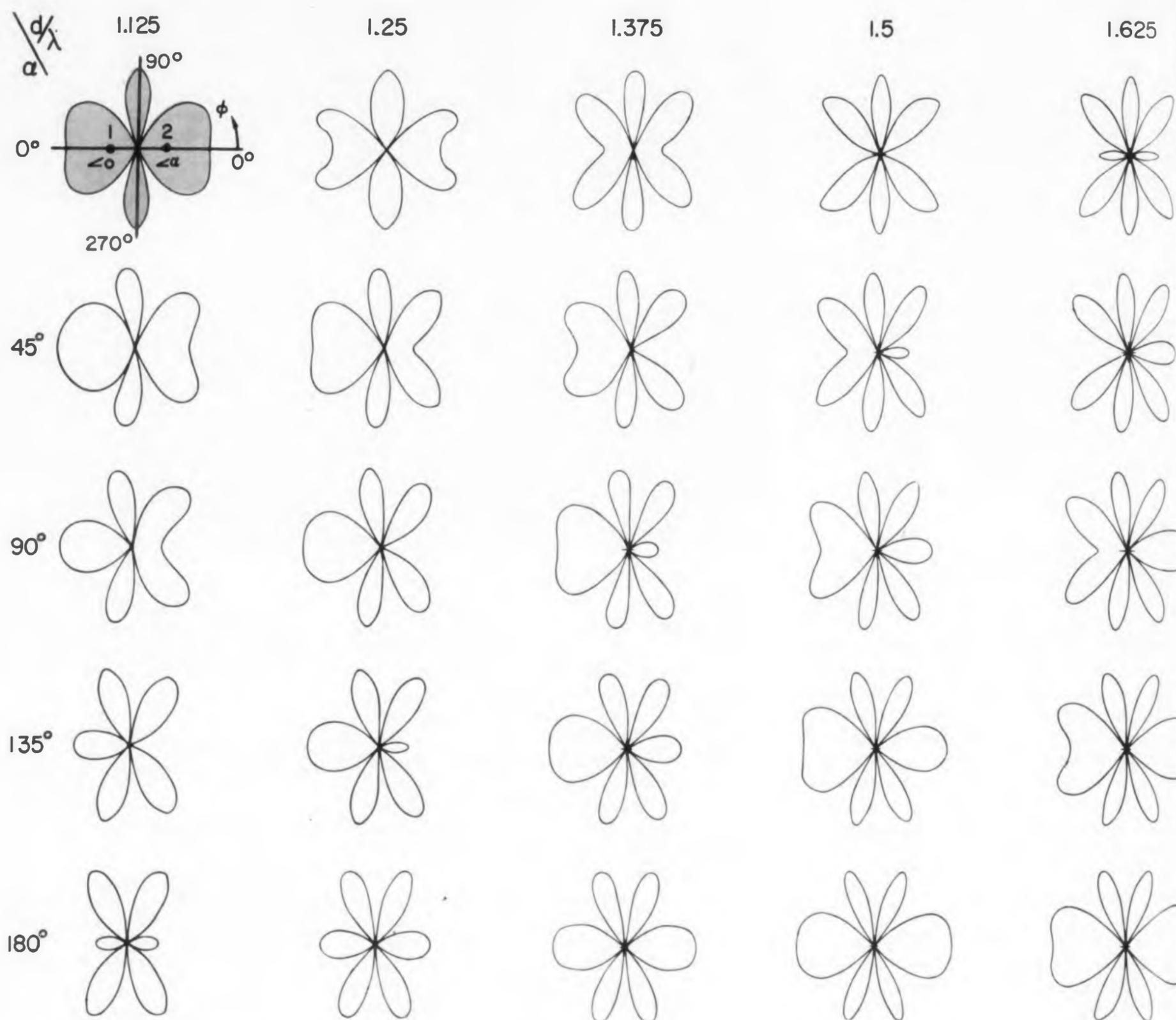
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Antenna Array Patterns for Many Beams

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.

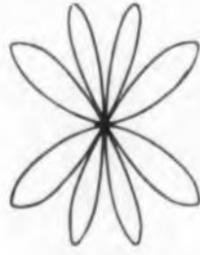
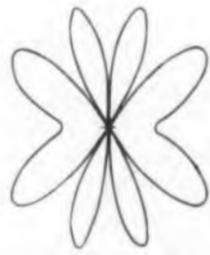
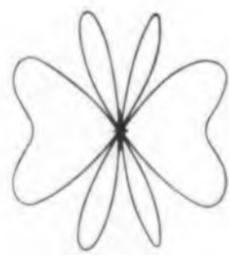
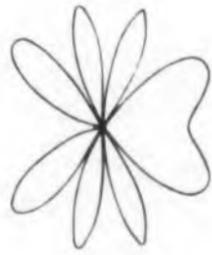
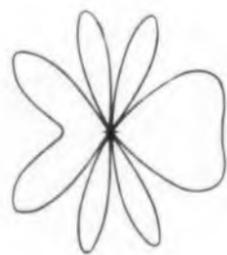
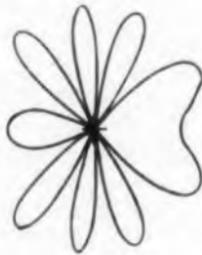
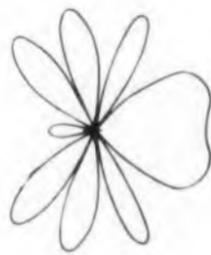
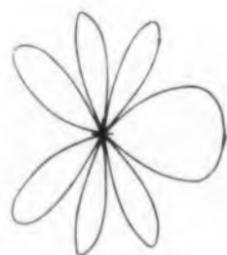
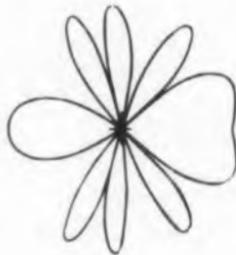
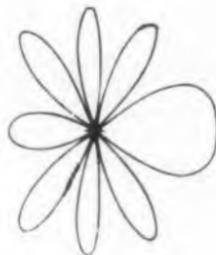
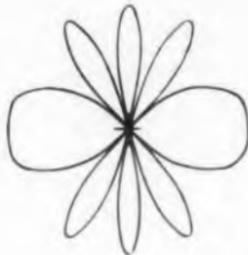
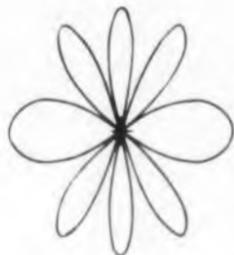
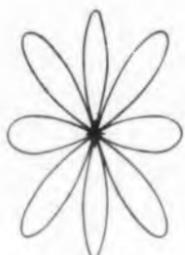
It shows patterns with as many as eight beams for antenna point-source spacings from 1.125 to 2.0 free space wavelengths.

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

1.75

1.875

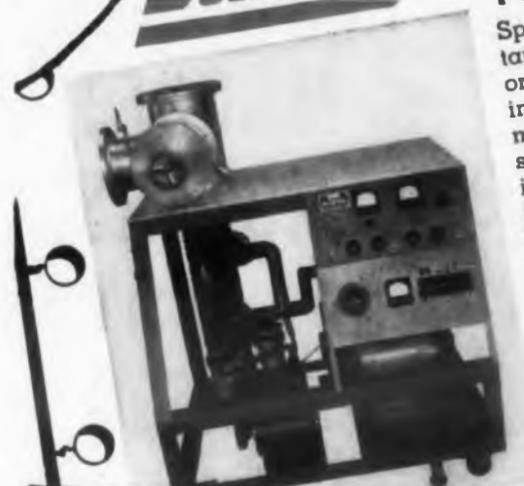
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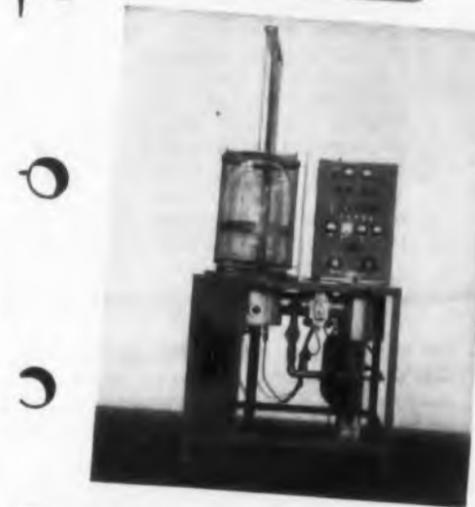


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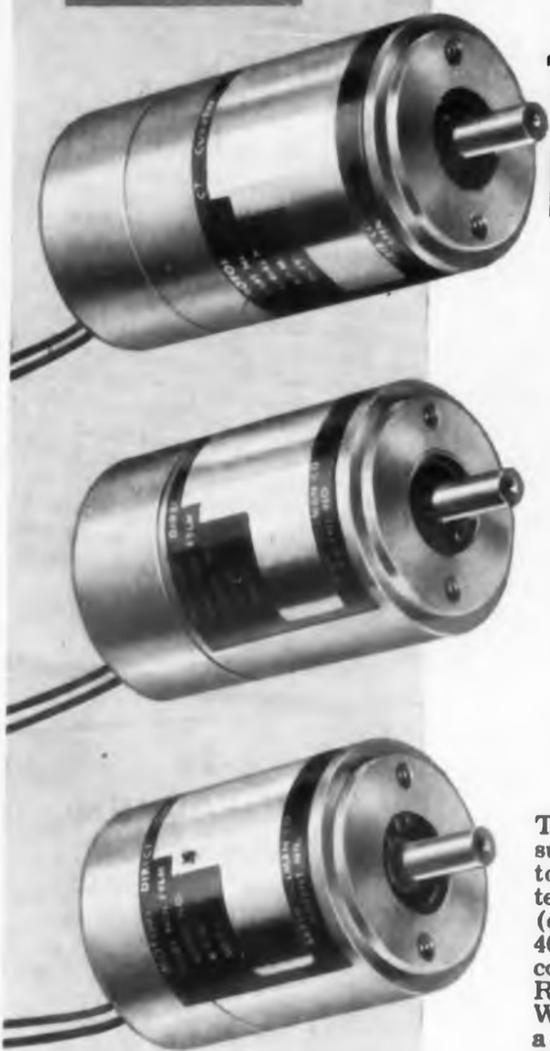
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article "Directional Antennas," which appeared in the January 1937 issue of *Proceedings of the IRE*.

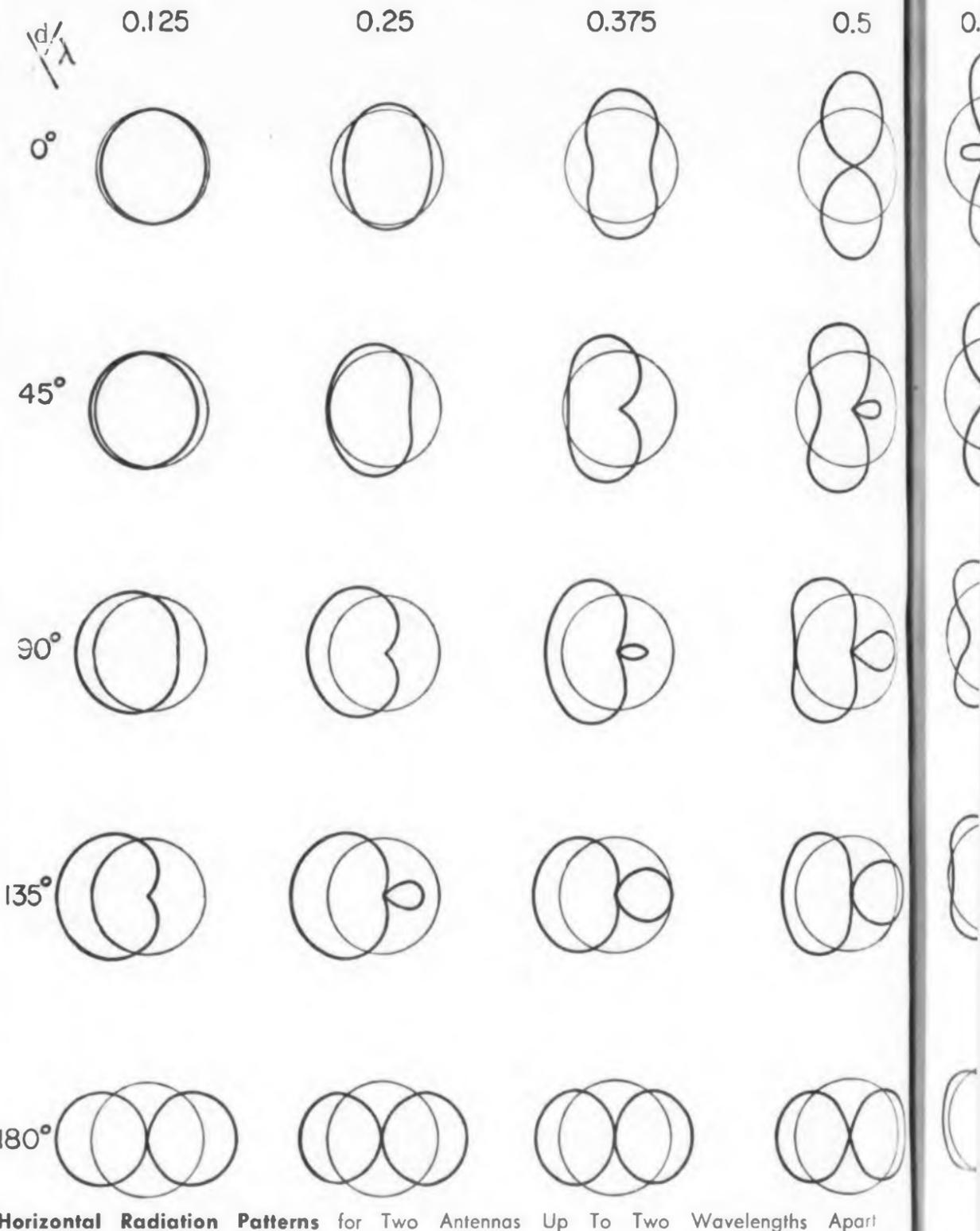
Both charts give array patterns as a function of the spacing $d\lambda$ between two isotropic point sources and of the phase of the currents delivered to each source.

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.

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 $1.0 < d/\lambda \leq 2.0$ in increments of $d/\lambda = 0.125$. This was done for phasings of zero to 180 deg in 45 deg steps.

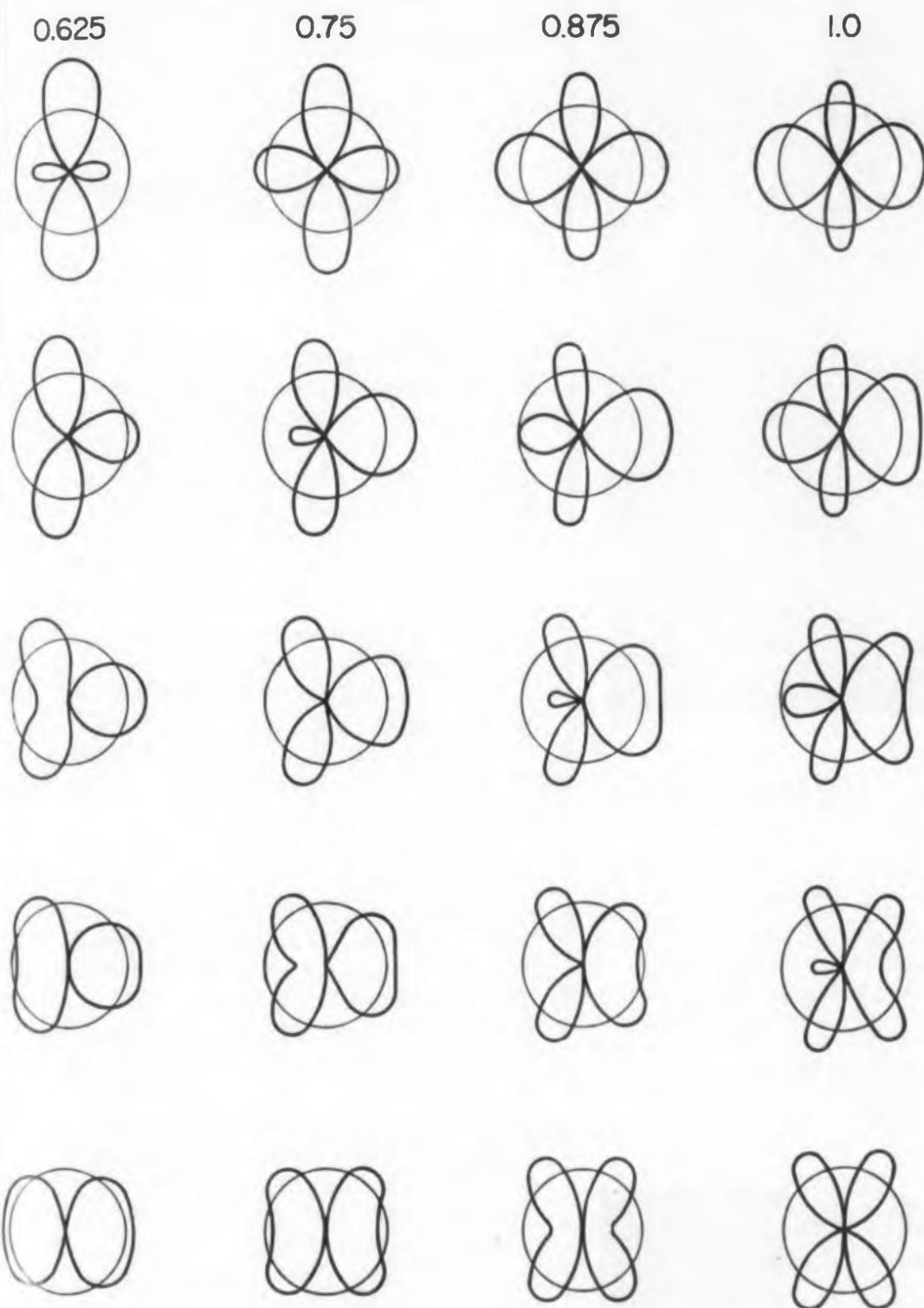
Phasings from 180 to 360 deg give the 180 to zero deg patterns, respectively, rotated about the vertical axis in the plane of the page.

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.

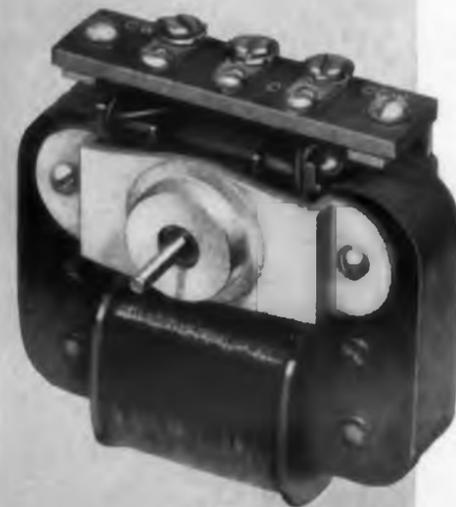
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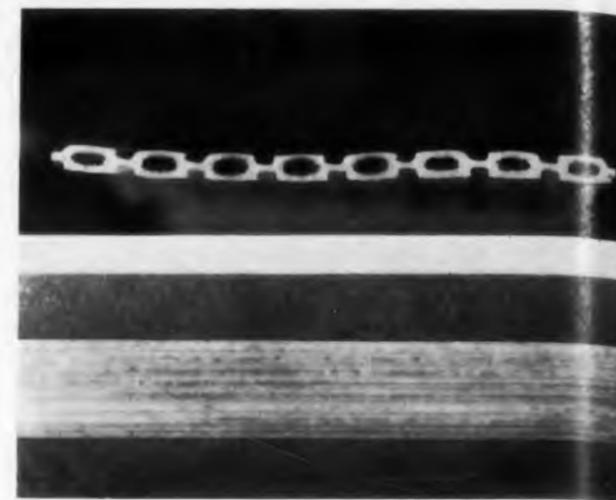
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Flat Cable Made In

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.

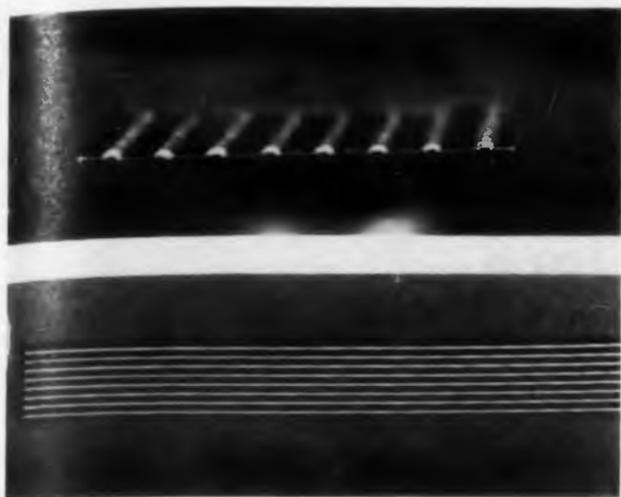
For uses where it is desirable to have controlled and low capacitance between conductors, one cable has its conductors separated by 0.15 in. This gives a measured capacitance of 3.5 μf per ft between conductors and 2.5 μf between every other conductor. The cable is now available with 18 conductors of 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

ELECTRONIC DESIGN • August 5, 1959



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

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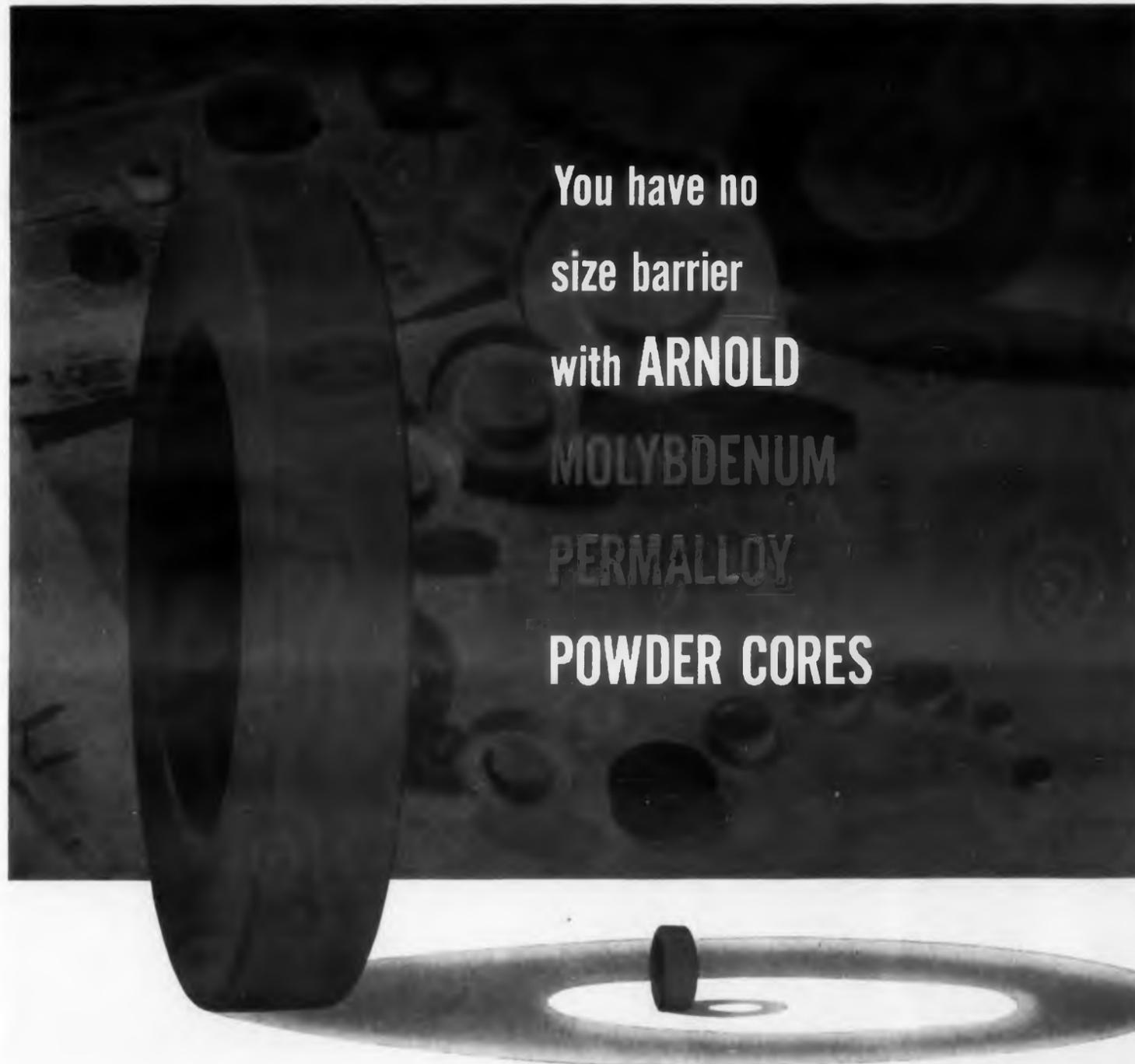
a silver-plated flat copper wire 0.002 to 0.003 in. thick around the individual conductors and then encapsulating them in Teflon to form a ribbon. This construction adds 3 to 6 mils to the diameter of the wire instead of the 20 mils obtained with conventional braided shield. Shielding coverage is from 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.

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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.

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DESIGN FORUM

Microphotography Solves

The Case of Eyelet Failure



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



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



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

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. Harikov 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

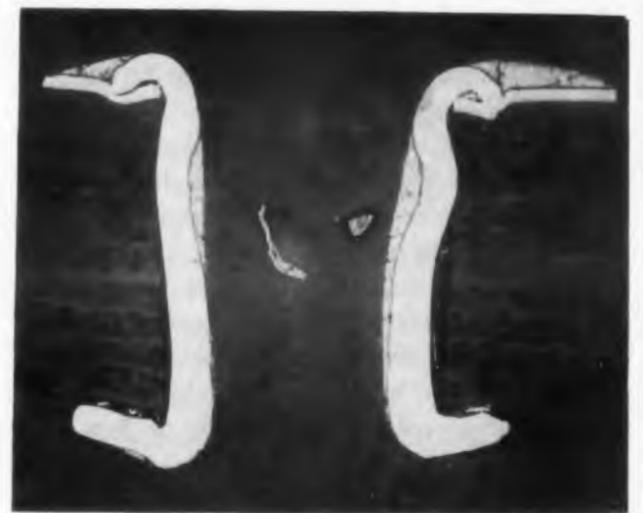
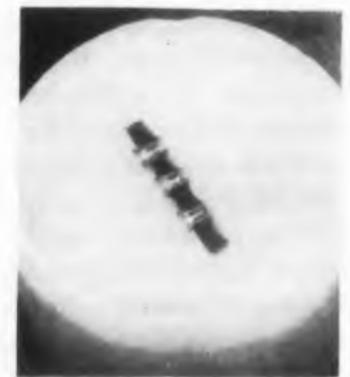


Fig. 4. Excessive pressures can also cause shearing of the conductor.

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 gold 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-

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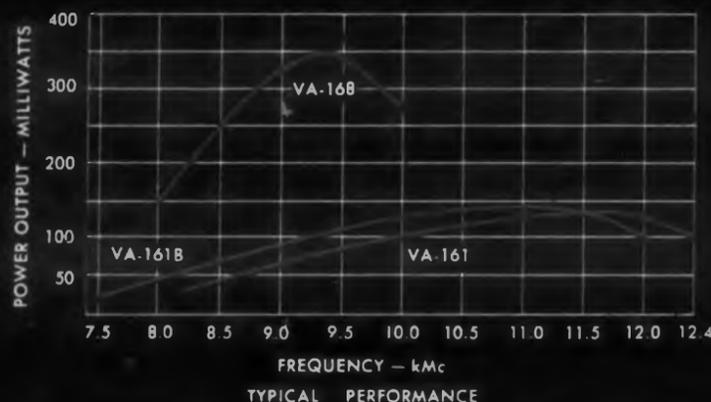
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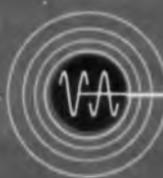
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Fig. 5. This shows an experimental eyelet of insufficient length, which caused delamination of the conductor.

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. ■ ■

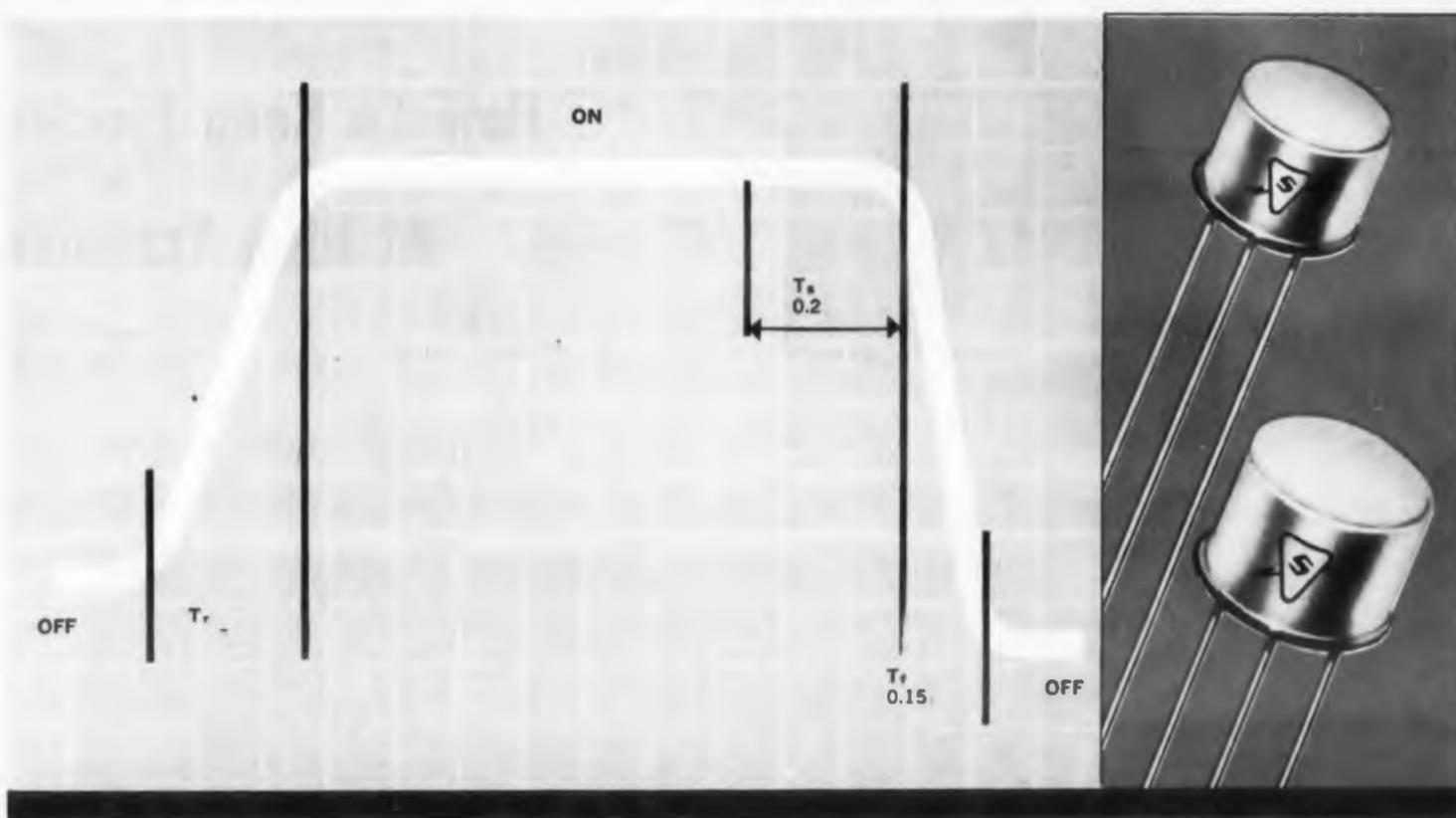


Fig. 6. Pictured here is an improved eyelet with greater length and larger fillet.



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

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2N377	25 v	15 v	150 mw	2.5 mc
2N385	25 v	15 v	150 mw	4 mc
2N388	25 v	15 v	150 mw	5 mc
2N438	25 v	25 v	100 mw	2.5 mc
2N438A	25 v	25 v	150 mw	2.5 mc
2N439	25 v	25 v	100 mw	5 mc
2N439A	25 v	25 v	150 mw	5 mc
2N440	25 v	25 v	100 mw	10 mc
2N440A	25 v	25 v	150 mw	10 mc
2N679	25 v	15 v	150 mw	2 mc
		PNP		V_{ce} = 5 I_e = 1 ma min.
2N404	-25 v	-12 v	120 mw	4.0 mc
2N425	-30 v	-20 v	150 mw	2.5 mc
2N426	-30 v	-20 v	150 mw	3.0 mc
2N427	-30 v	-20 v	150 mw	5.0 mc
2N428	-30 v	-20 v	150 mw	10.0 mc

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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_{e2} . 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:

$$Q = MC_p \frac{dT_c}{d\theta} + \psi (T_A - T_c) \quad (1)$$

$$\psi = hA$$

See the table for a definition of the symbols.

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

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

The final steady state temperature is:

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

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:

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

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 1 becomes:

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

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 convection breaks up into two regimes, laminar and turbulent.

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

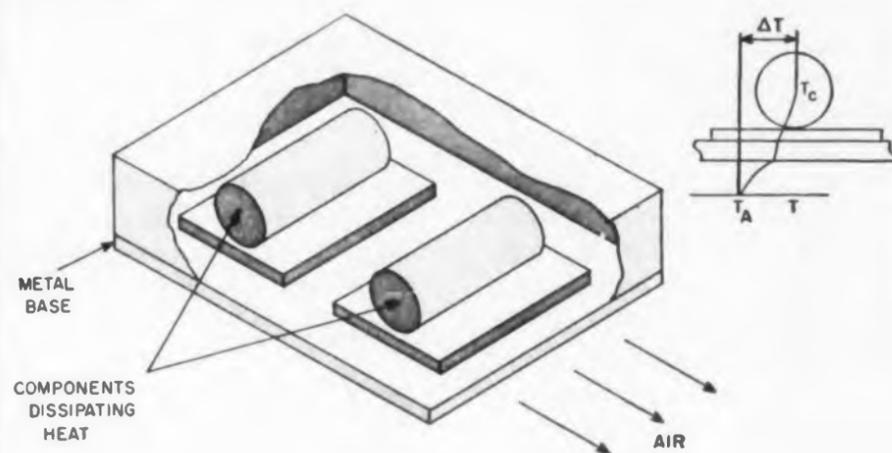
For laminar convection in the normal range of pressures:

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

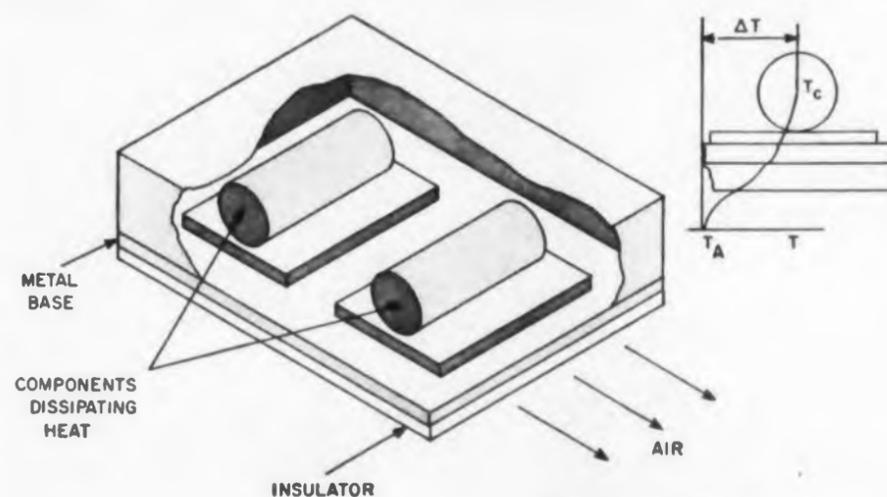
and for a perfect gas:

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

(Continued on page 48)



Configuration (1)



Configuration (2)

Fig. 1. Temperature gradients at steady state.

Nomenclature:

- η_t = Transient coefficient for forced convection, $\eta_t = (t_f - t)/(t_f - t_i)$
 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, $\eta_{ci} = (t_f - t_A)/(t_f - t_i)$
 n = viscosity
 R = Gas constant
 P = Pressure
 η_c = Transient coefficient for natural convection, $\eta_c = (t_f - t)/(t_f - t_A)$
 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

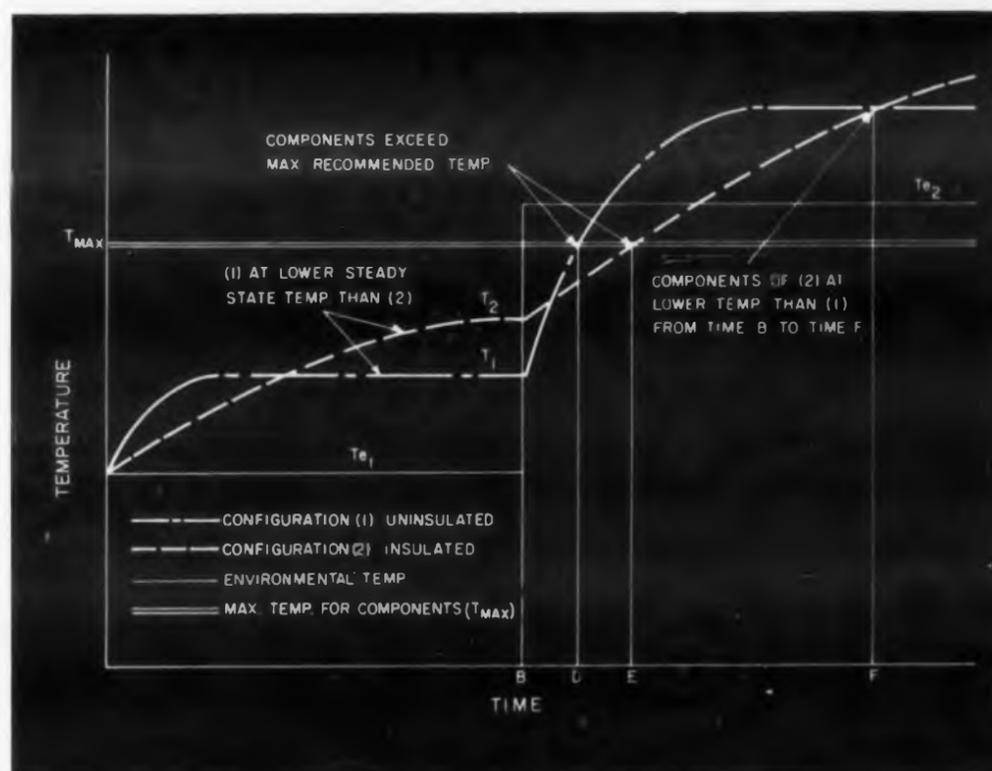


Fig. 2. Comparison of component temperatures for two packaging methods.

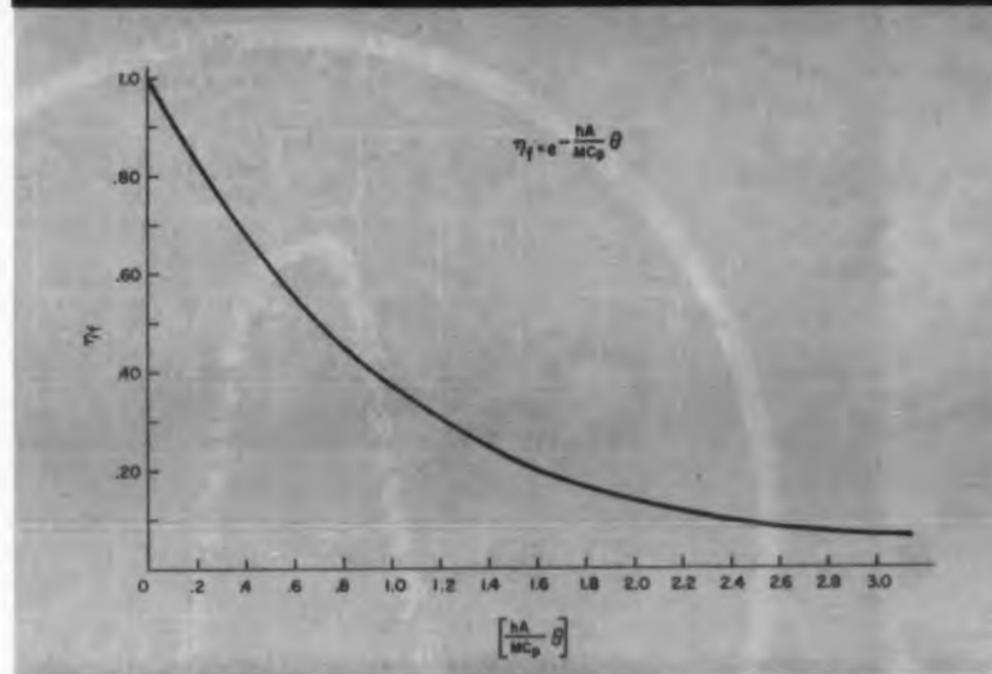


Fig. 3. Correction factor η_t for transient temperature rise with forced convection.

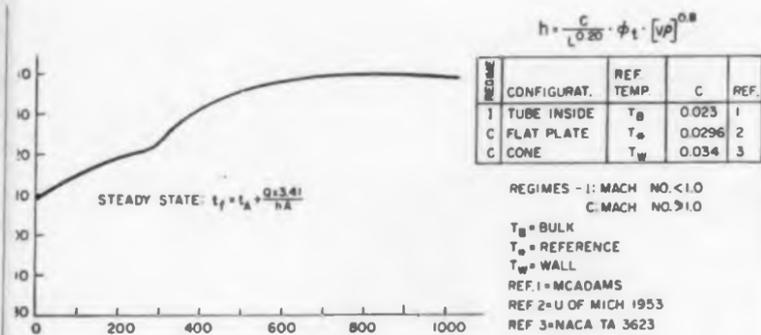


Fig. 4. Temperature function for convective heat transfer coefficient.

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

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

The final steady state value:

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

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

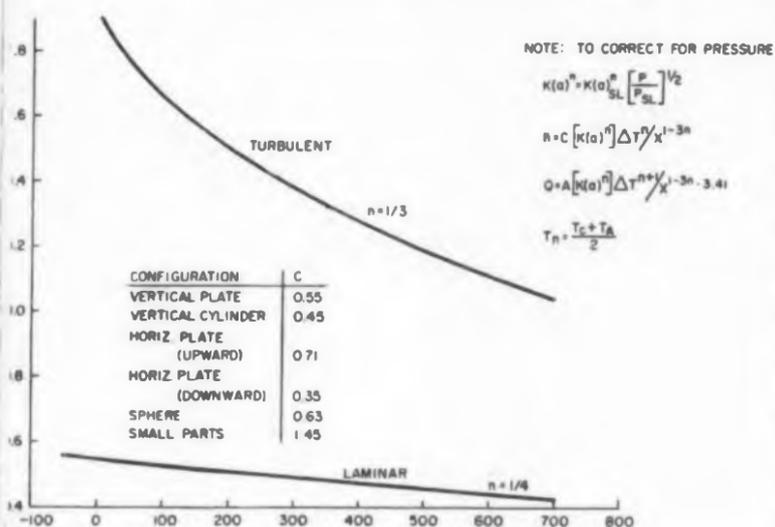
$$t = t_f - (t_f - t_A) \eta_c$$

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

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

$$\eta_c = \frac{t_f - t_A}{t_f - t_i}$$

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/ft³. 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/ft³, 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.

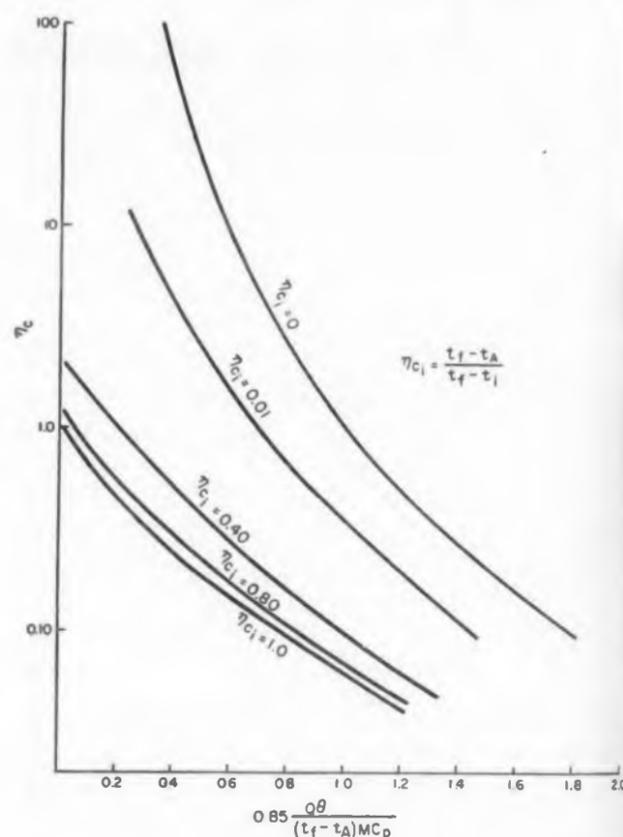
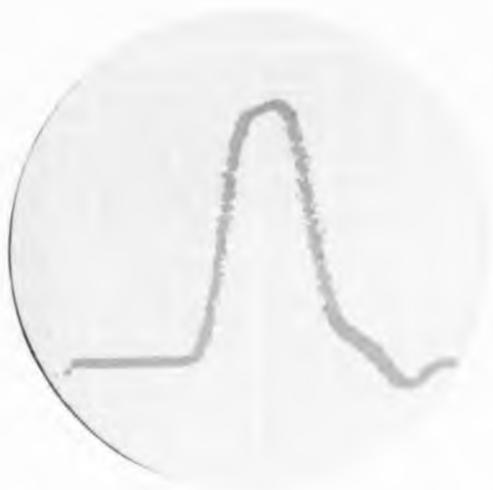


Fig. 6. Transient temperature correction factor, η_c , for laminar natural convection.

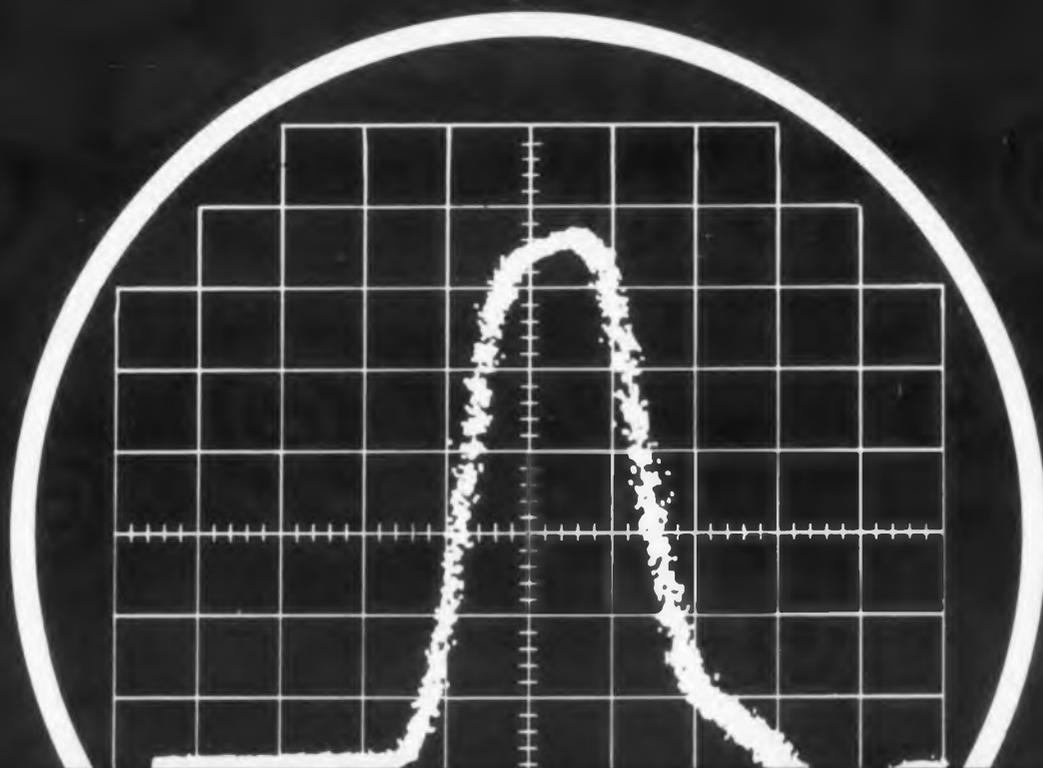
The maximum recommended temperature is 200 F, thus unreliable operation may result. If the area is increased by the use of fins, the steady state temperature will be lowered; however, the rate of temperature rise will be increased at the maximum temperature. If the inlet is closed when the air temperature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



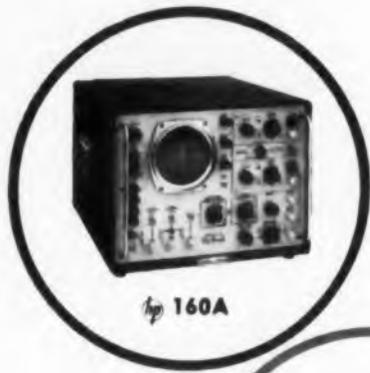
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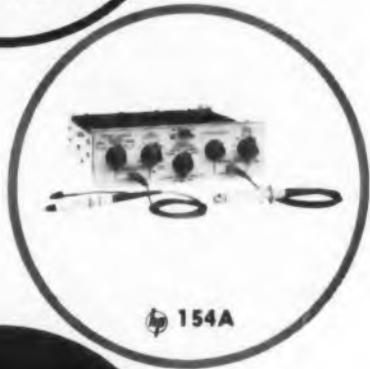
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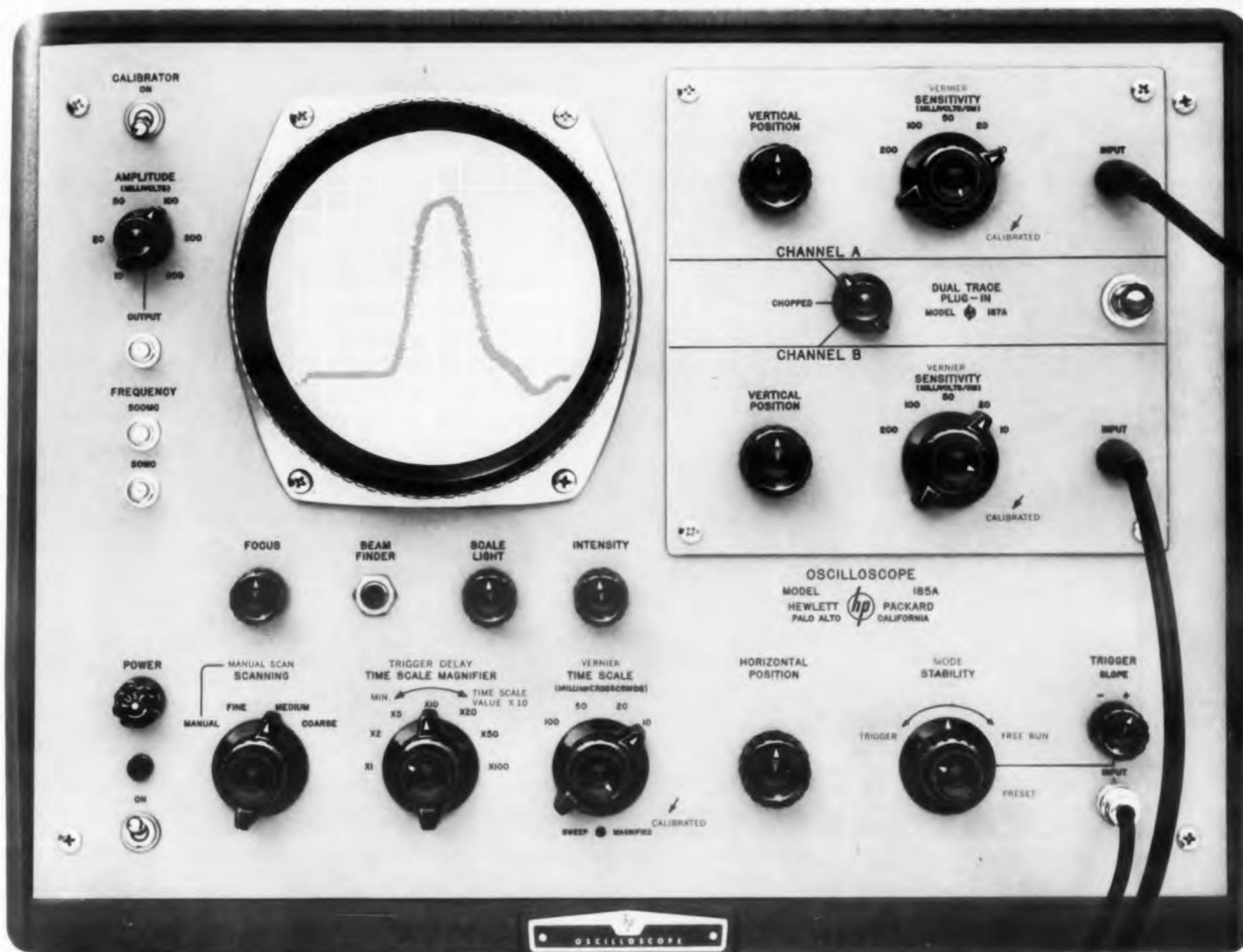
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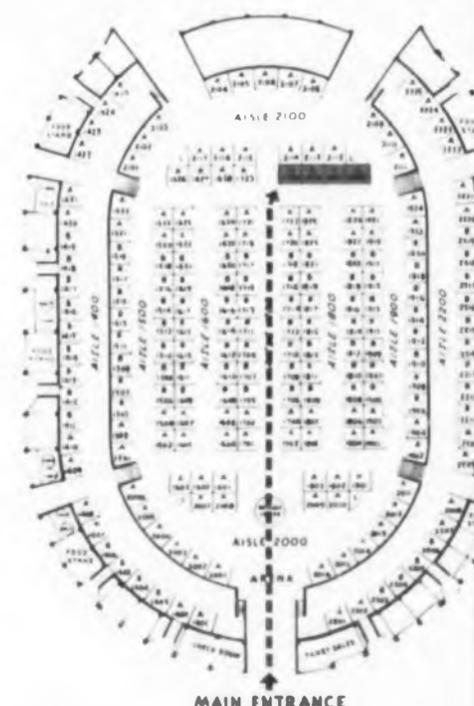
increasing amount so a different part of the signal is studied each time. After a pre-determined number of samples (50 to 1,000) the entire signal has been explored and the actual wave form recreated on the cathode ray tube face.

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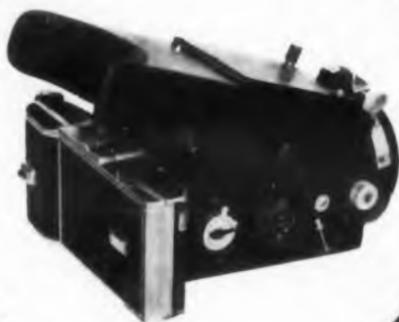
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Thus all parameters remain the same except the heat transfer area is increased to 5 ft² by the use of finned surfaces and the heat transfer is by natural convection for 5 min at maximum temperature.

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:

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

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

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

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

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

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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1. W. H. McAdams, "Heat Transmission"—Third Edition—Chapter Three, McGraw-Hill.
2. W. H. McAdams, *ibid*, Chapter Seven.
3. Report Number HF-845-D-8—Cornell Aeronautical Laboratory November 1, 1956—page 33.

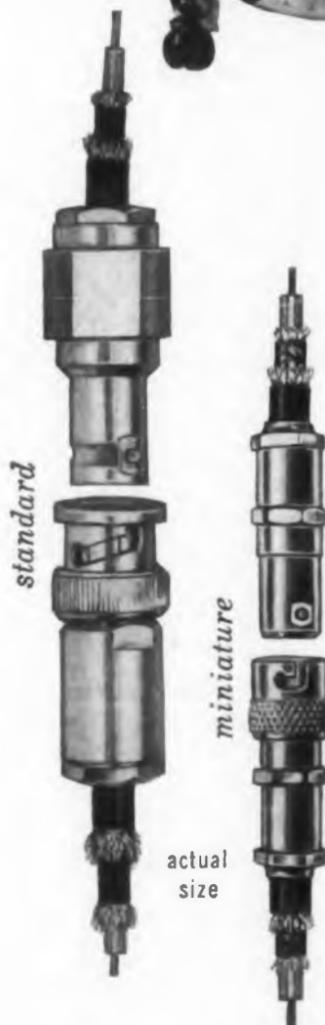
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Detecting Thermal Run-away of Power Transistors

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

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

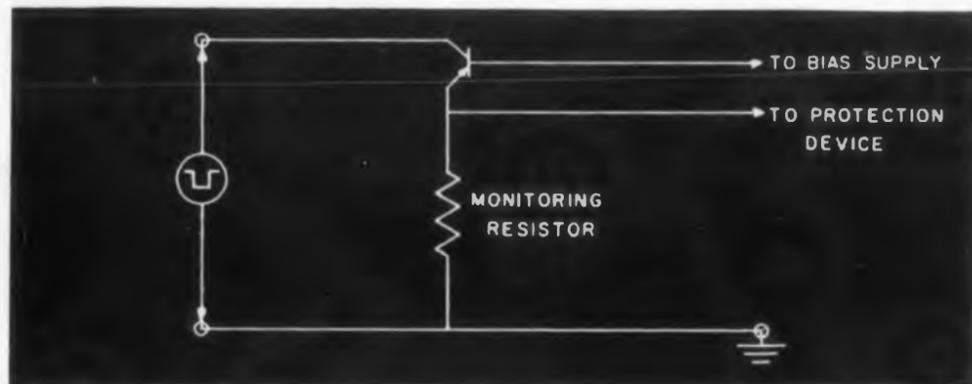
The block diagram of the protection device is shown in Fig. 2. The output of the pulse generator (or power amplifier if one is required) is applied to the test transistor. The output of the collector current monitor is applied to the first pulse amplifier and then to the diode differentiator. The output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

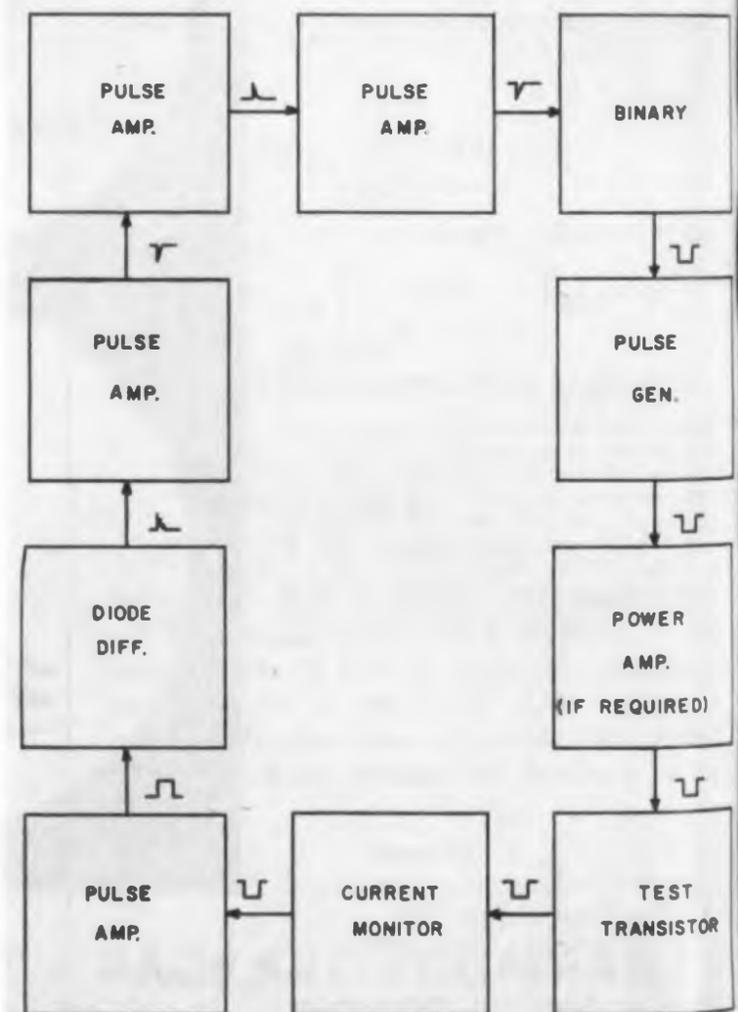
A protection device detects the changes which occur as failure is approached in the magnitude of the collector current, and removes the power from the test transistor. Because the device prevents destruction of the unit, a large statistical sample can be obtained at a small cost.

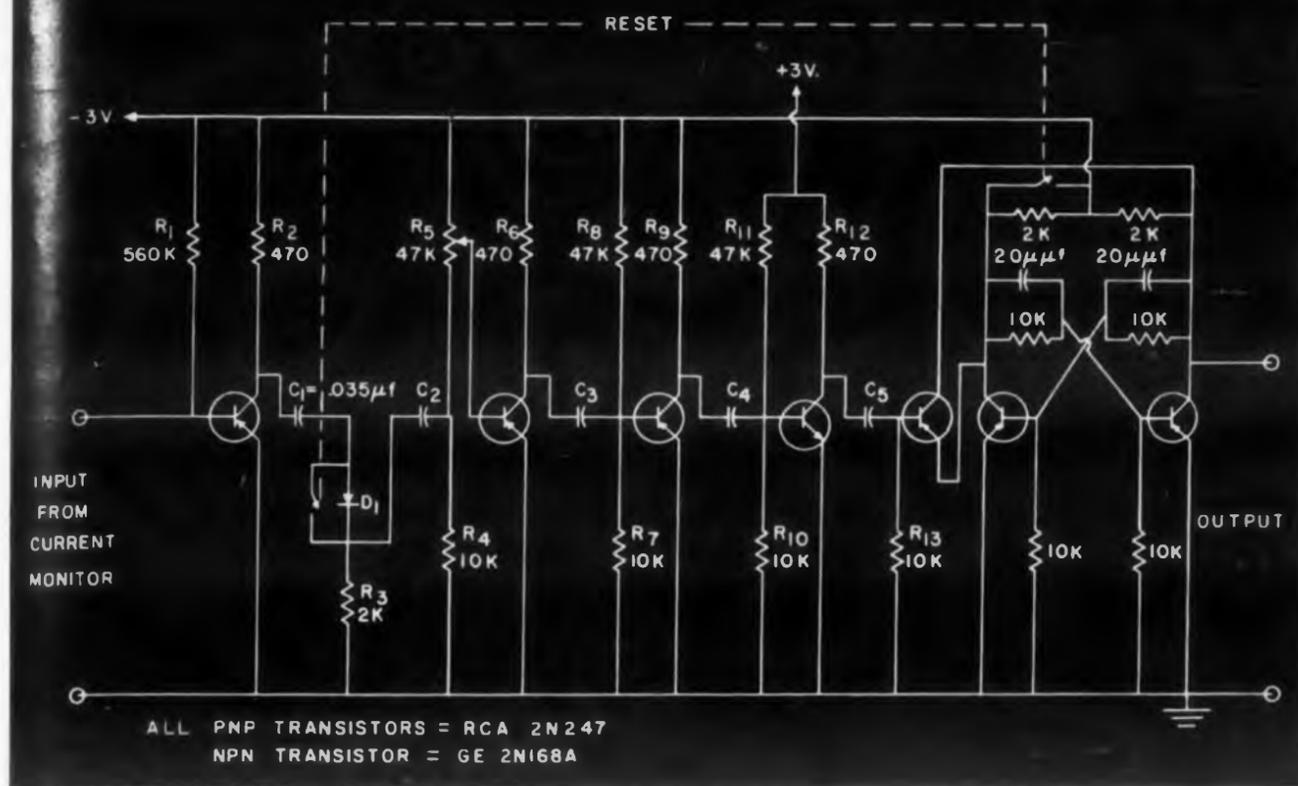
of T_1 , the first pulse amplifier transistor. The output of T_1 (a positive pulse) is applied to the plate of D_1 through C_1 . The combination of D_1 , C_1 , and R_3 constitute the diode differentiator. Since D_1 offers a low impedance to a positive pulse, the differentiator time constant is approximately 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. ■ ■

1. Christopher Jako, Pulse Ratings and Thermal Characteristics of Power Transistors, Tech. Rep't EE-4, Engineering Experiment Station, University of New Mexico, 1957

2. Richard Lee Mann, The Ratings of a Power Type Transistor, Tech. Rep't EE-2, UNM Engineering Experiment Station, Sept., 1956

3. James Reese and W. W. Grannemann, An Electric Analog of Heat Flow in Power Transistor, Tech. Rep't EE-11, UNM EES, June, 1958

4. James Reese and W. W. Grannemann, Transient Junction Temperatures in Power Transistors, Tech. Rep't EE-17, UNM EES, Aug. 1958

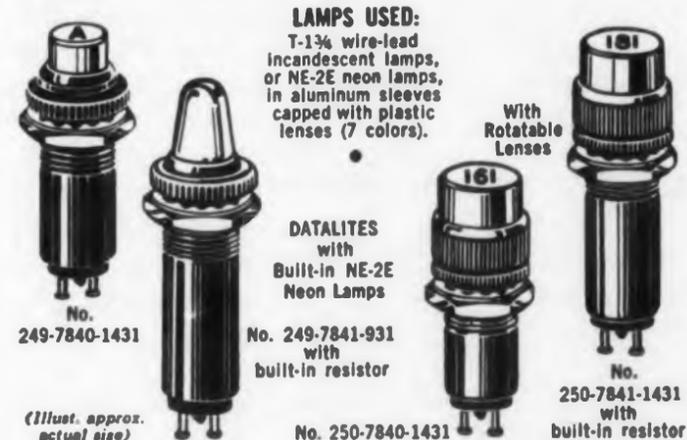


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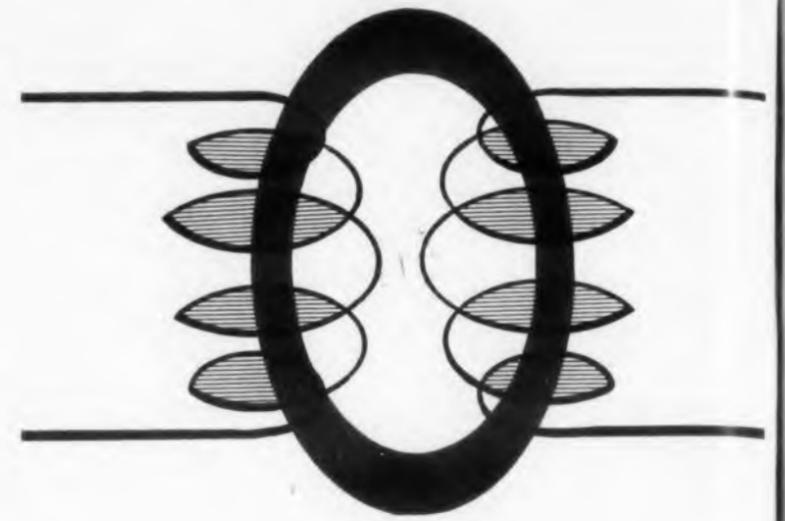
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CIRCLE 35 ON READER-SERVICE CARD

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:

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

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 μ sec 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 μ sec 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 μ sec 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 mag-

netization 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

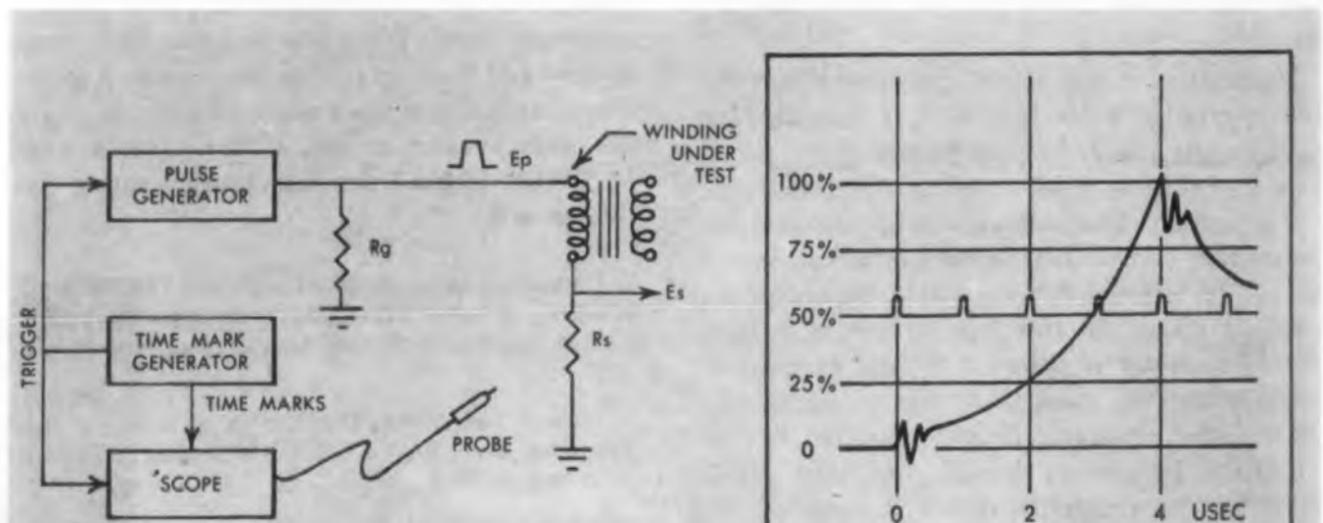


Fig. 1. Circuit for measuring inductance by the magnetization current method.

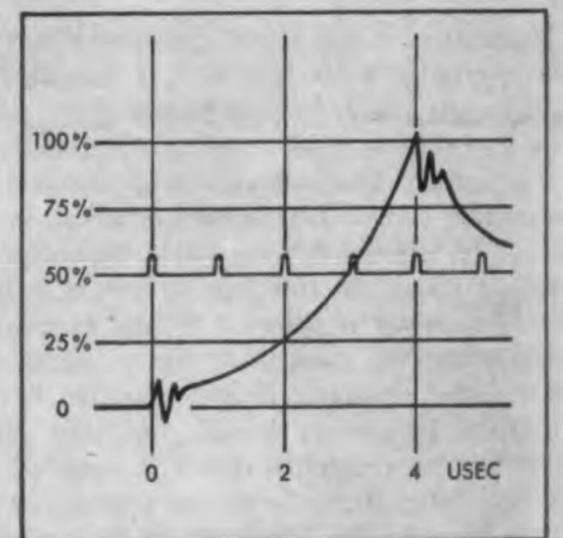


Fig. 2. Voltage E_s as seen on oscilloscope during magnetization current test.

Table 1. Inductance variation vs. excitation variation.

TIME in μ sec	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 $\ln(E/e)$ for common droop measurements.

% Droop	e	E/e	$\ln(E/e)$
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:

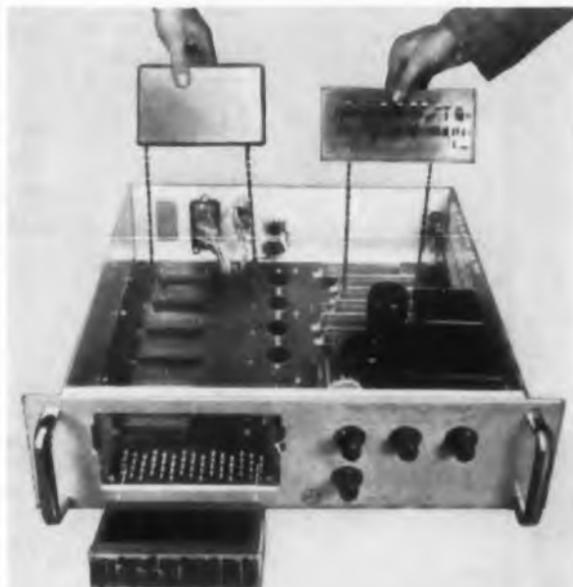
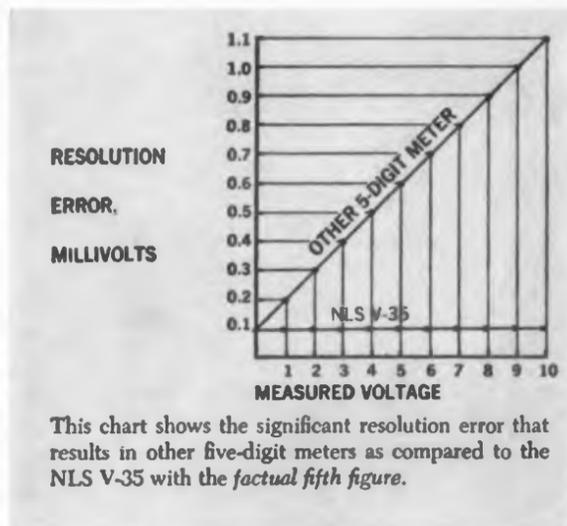
$$L = \frac{RT}{\ln(E/e)} \quad (2)$$

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

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Heater current	14.5 amps	Plate dissipation, max.	400 watts
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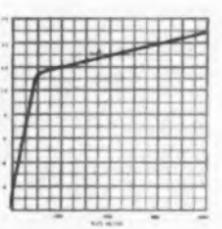


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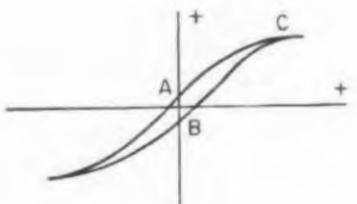
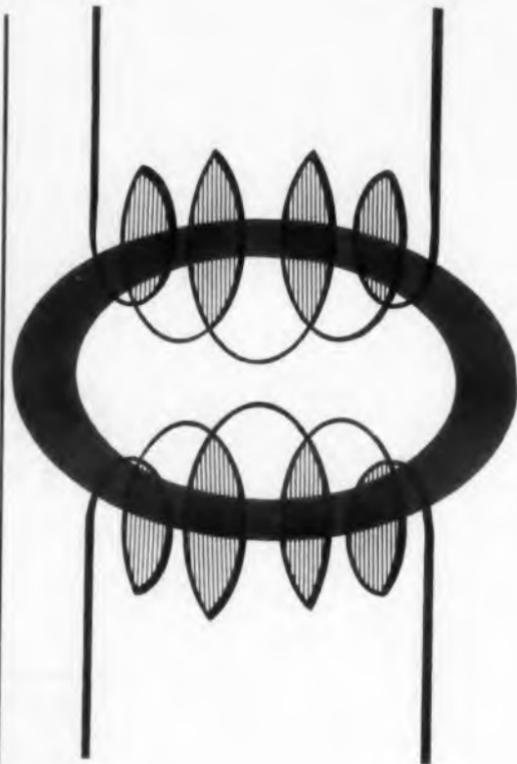


Fig. 3. A hysteresis loop.

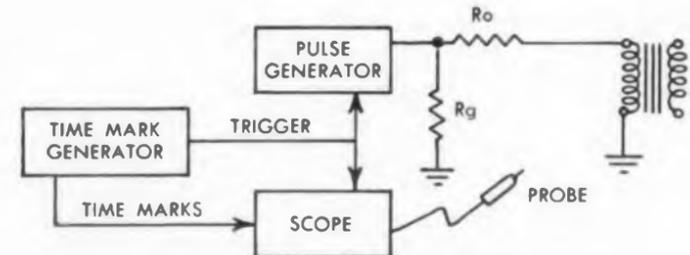


Fig. 4. Half-wave amplifier with closed current path around control winding.

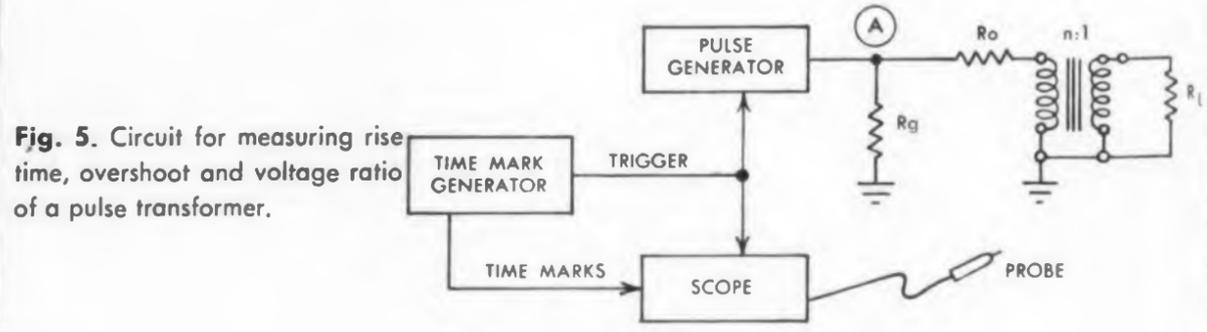


Fig. 5. Circuit for measuring rise time, overshoot and voltage ratio of a pulse transformer.

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 $\ln(E/e)$ can be tabulated for all values of droop. Some convenient values of the expression $\ln(E/e)$ for common droop measurements are shown in Table 2.

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

$$R = R_o + R_w + \frac{R_o r_o}{R_o + r_o} \quad (3)$$

where R_o is the inserted line resistance, R_w is the winding resistance, R_g is the generator terminating impedance, and r_o 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 $n^2 R_L$ 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

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.

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

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:

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

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. ■ ■

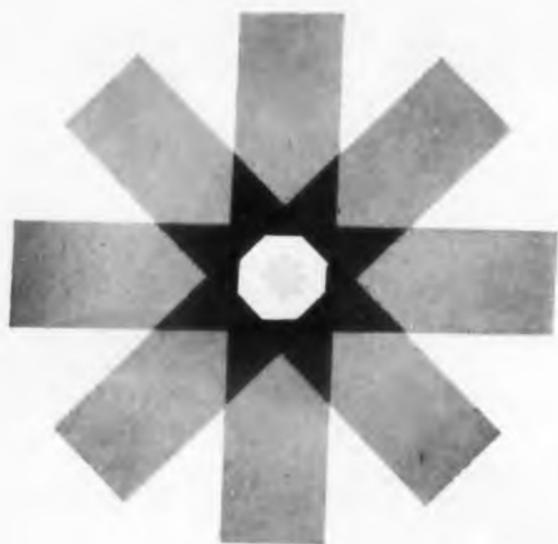


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CAMBRIDGE DIVISION, CAMBRIDGE, MARYLAND



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 pro-

posed 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.

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

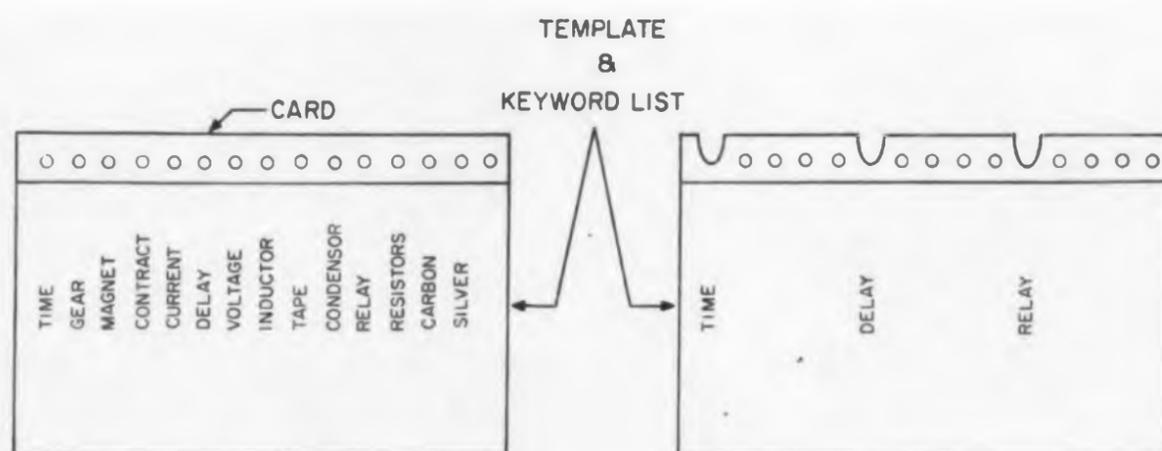


Fig. 1. Key words on the template show which holes in the cards must be notched.

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)

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N-105	Nixie readout. (Can be cabled to remote Nixie.)
N-106	Nixie readout with preset control switch. (Can be cabled to remote Nixie.)
N-107	Incandescent readout with inputs for external preset control.
N-108	Incandescent readout (remote) with inputs for external preset control.

TYPICAL SPECIFICATIONS

The N-102 Transistorized Decade, which includes visual readout of numerals 0 through 9 displayed vertically and illuminated by incandescent lamps, is identical electrically with Model N-101. Abbreviated specifications are as follows:

INPUT

Minimum Trigger Input: (0-100 kcs): 7 volts pos. pulse or step at 0.5 μ sec. rise time. (100 kcs to 250 kcs): 7 volts pos. pulse or step at 0.2 μ sec. rise time.

Max. Operating Frequency: 250 kcs.

Input Impedance: 470 μ fd. capacitance, max.

DC Reset input is provided (normally supplied by EECO T-129 DC Reset Generator).

OUTPUT (No Load)

Amplitude: 8 volts, peak to peak.
Output Levels: (N/10) and (N/10):
-11 volts DC and -3 volts DC, nom. Staircase: -11 volts DC to -3 volts DC in 9 steps.

Rise Time: (N/10): 0.5 μ sec.; (N/10): 0.5 μ sec.

Load: Typical, one N-Series Decade or one T-Series flip-flop. (Load information available on request.)

OPERATING TEMPERATURE

RANGE: -45°C to +65°C.

SIZE: 1-5/32" wide x 2-3/32" deep x 3-7/8" seated height (including handle). Dimensions are exclusive of external addenda found on external preset and Nixie models.)



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

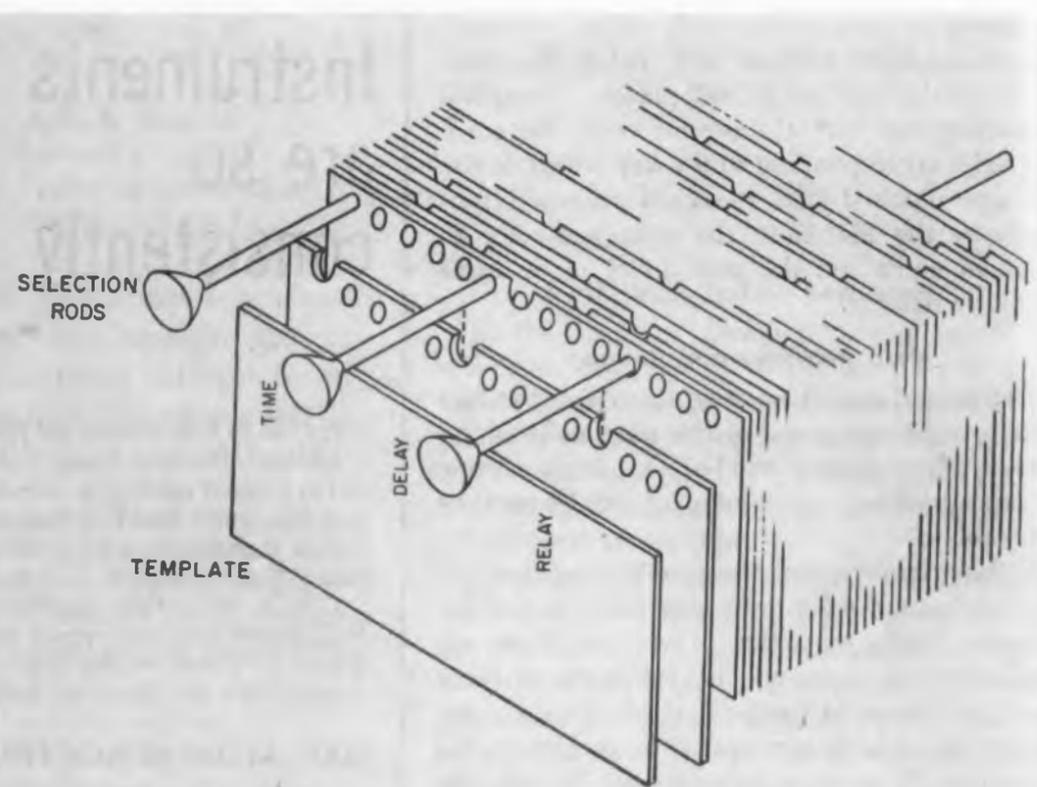


Fig. 3. Cards notched where rods are inserted drop from the stack. Article number appears on face of the card.

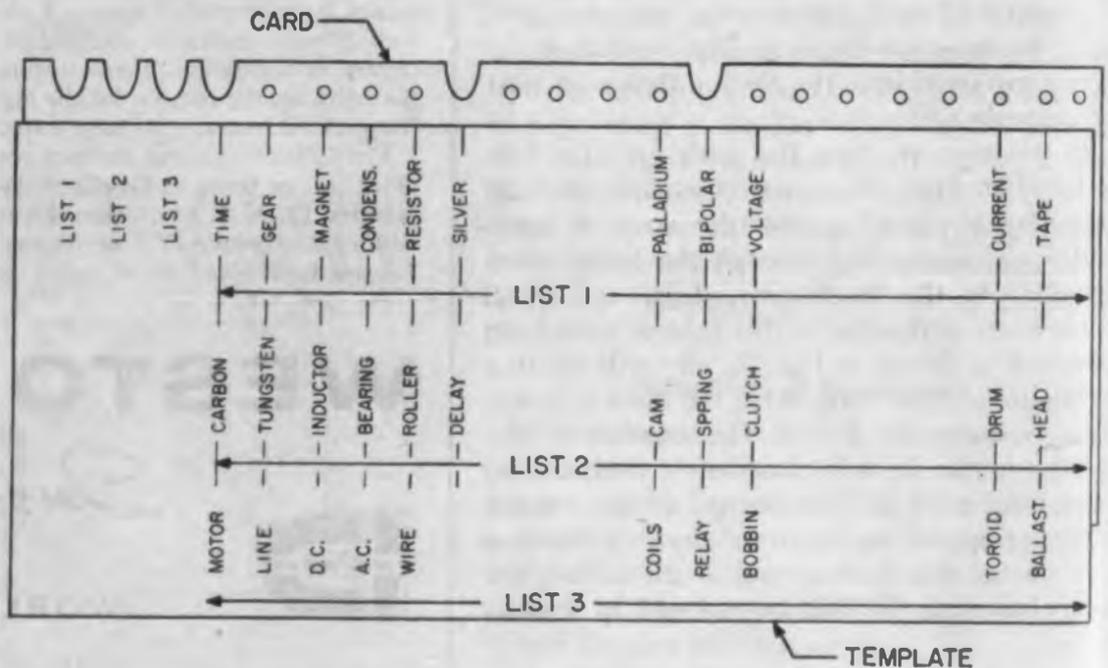
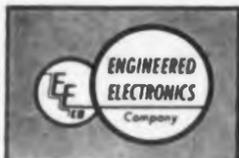


Fig. 4. Coding the template increases the number of items that can be cataloged.

Additional information on N-Series Transistorized Decades and other EECO products available on request.



ENGINEERED ELECTRONICS COMPANY
(a subsidiary of Electronic Engineering Company of California)

506 East First Street • Santa Ana, California

CIRCLE 40 ON READER-SERVICE CARD

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. ■ ■



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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



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

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.

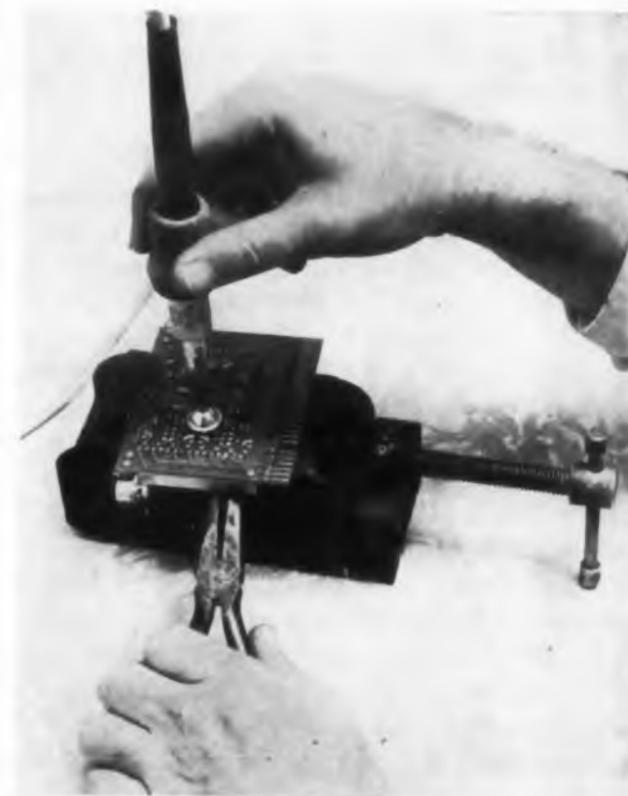
2. Alternately a soldering pot is used for part removal. The pot is usually constructed as a round or square container (about 1-1/2 or 2 inches in diameter) mounted on a fixed vertical iron. The board is placed over the solder pot and the faulty component removed. A new part is immediately inserted while 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.

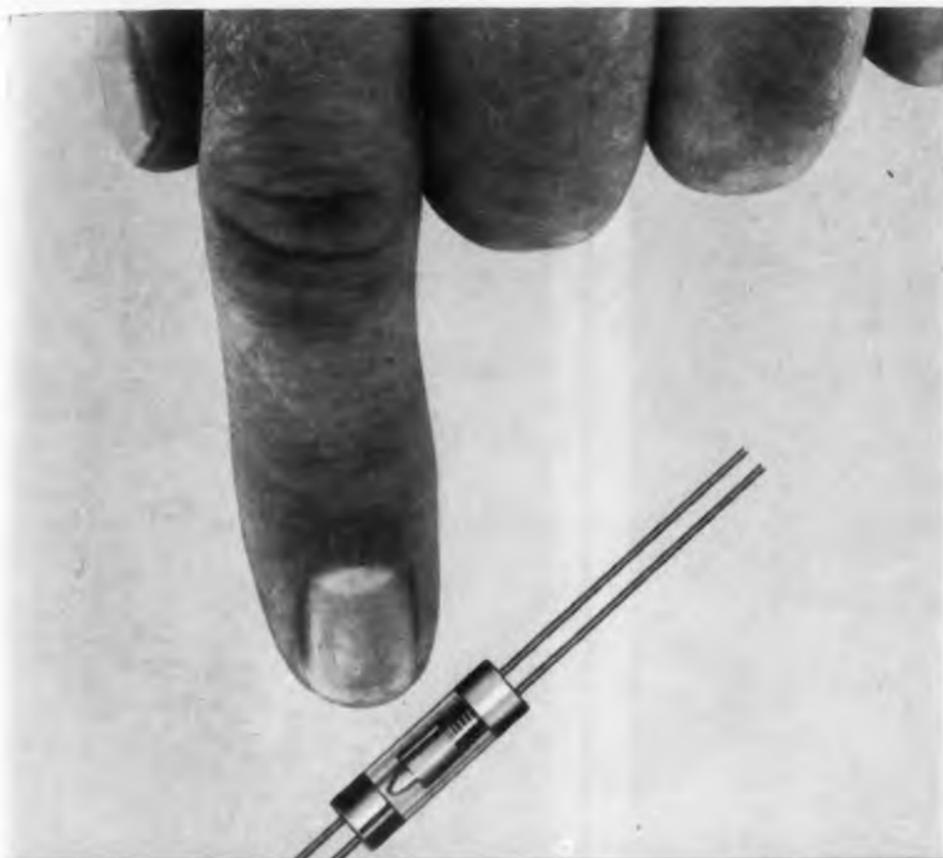
Do It Yourself . . . Or Buy

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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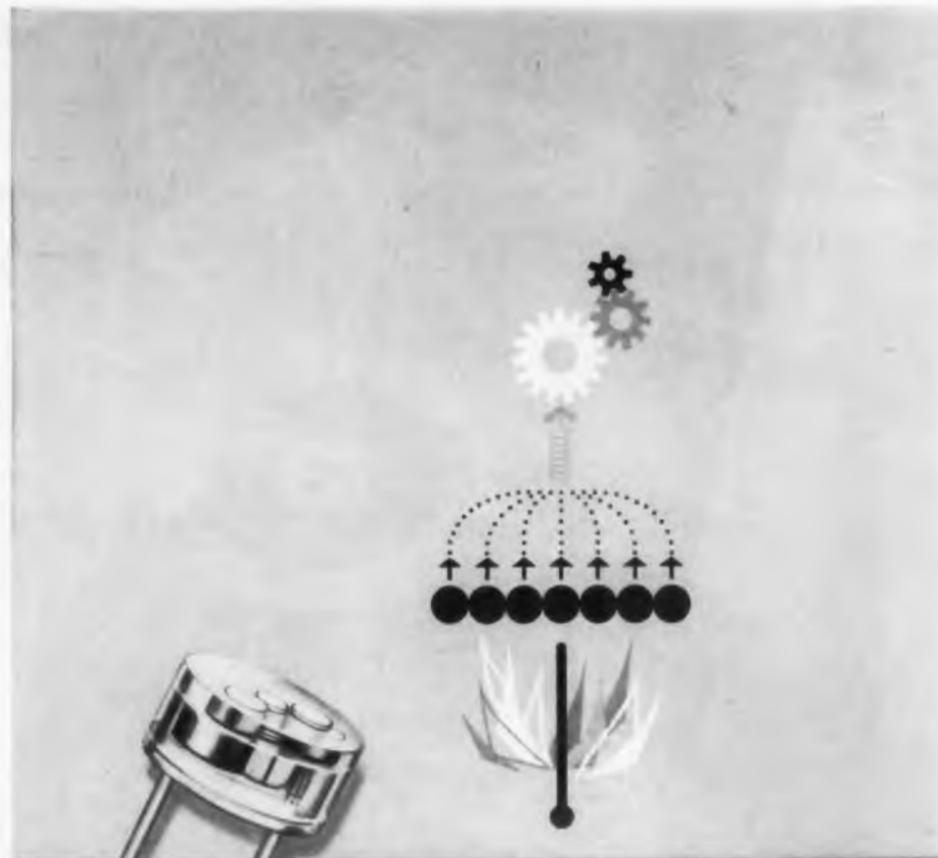
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CIRCLE 43 ON READER-SERVICE CARD

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 PCB 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 conveyor 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.

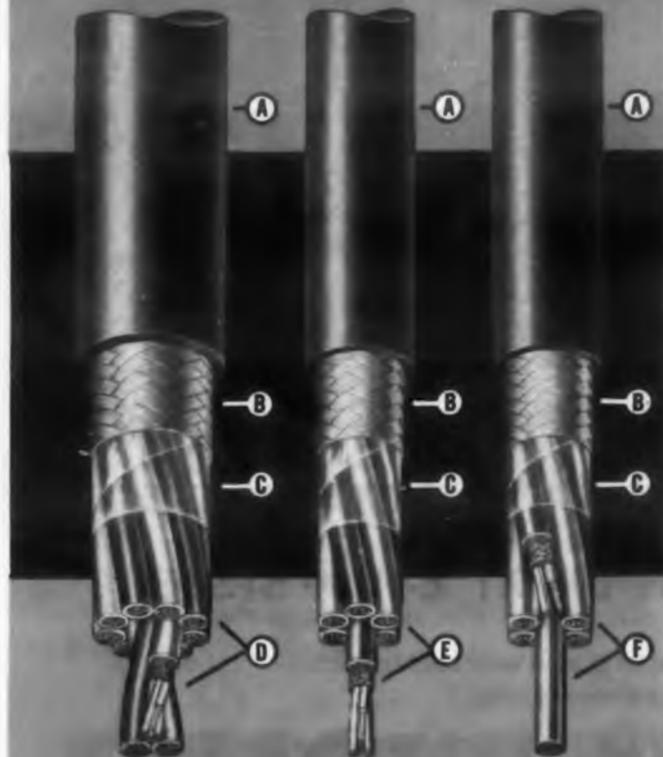
The printed circuit card then floats across the solder fountain, is caught and passed to inspectors, who check for bridged connections and clip icicles. GE is currently using Kester 1571 flux and 63-37 eutectic solder, carefully controlled to 550 F.

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.



Series 1 Cables Series 2 Cables Series 3 Cables



(A) Vinyl jacket (B) Tinned copper shield (C) Mylar tape wrap (D) 12 color coded groups. Each group: 2, 3, or 4 color coded conductors, shielded, jacketed (E) color coded groups. Each group: 2, 3, or 4 color coded conductors, shielded, jacketed (F) 6 color coded pairs cabled around vinyl filler. Each pair coded thermocouple wire, shielded, jacketed.

THE WILLIAM BRAND & CO., INCORPORATED

WILLIMANTIC 2  CONNECTICUT

electrical and electronic wires and cables • harnesses and cable assemblies • plastic and coated insulating tubings • identification markers

BRAND TEAMS WITH MARTIN TO MEET TOUGH CABLE SPECS FOR TITAN TEST FIRING

Absolute reliability! A must for the control and telemetering cables used for transmitting high fidelity signals during missile development static test firings. The data collected must be absolutely accurate if it is to establish the validity of the missile design or become the basis for necessary changes. The Martin Company found the solution to these tough signal transmission problems with three special multi-conductor cables produced by Brand. Here's how Brand teamed with Martin to meet these new and difficult cable specifications:

Series 1 Instrumentation Cables: — Problem: Cables to have approximately the same uniform diameter with varying numbers of conductors, to fit into standard connectors. To meet critical electrical requirements, especially low loss characteristics. **Solution:** Use color coded Turbolene (polyethylene type) insulation to meet electrical and physical requirements. Give twisted pairs a uniform circular cross section by using specially developed extruded Turbolene fillers.

Series 2 Instrumentation Cables: — Problem: Cables to operate up to 100°C and to have approximately the same finished diameter with varying numbers of conductors. **Solution:** Use insulated wires meeting MIL-W-16878, manufactured with Turbo 540 vinyl compound and nylon jacketed. Carefully control lay lengths during cabling, and outer jacket wall thicknesses.

Series 3 Thermocouple Cables: — Problem: Non-hygroscopic, funginert cables, each six thermocouple pairs. **Solution:** Develop extrusion and cabling techniques to economically process hard and springy chromel, alumel, iron, constantan and copper conductors. Use Turbo 540 vinyl compound as primary insulation and as filler.

There were additional problems common to all series. (1) A vinyl jacketing material for the shielded groups to operate at both high and low temperatures, and to have an IR value comparable to those found in vinyl primary insulation. Turbo 570, a new custom formulation, was developed to meet these requirements. (2) All groups of conductors laid in a predetermined pattern to facilitate termination. The cables were manufactured on large two-bay planetary cabling machines to control positioning. (3) Long, unbroken, uniform lengths — all control and instrumentation circuitry is carried in steel reinforced concrete tunnels between test stands and blockhouse as shown in the above drawing.

Whether in missiles, aircraft, business machines or electronics — Turbo cables are custom engineered for specific operating conditions; manufactured by quality-conscious technicians; tested foot by foot for specification compliance. We invite you to call on our extensive engineering experience to solve your cable problems. No obligation, of course. Send your specifications or requirements.

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If you encapsulate diodes, **every other method is now obsolete!** Write today for complete information and samples. Inquire, too, about the applications of E-Pak system to other semiconductor devices.

* Patents applied for

EPOXY PRODUCTS, INC.

A DIVISION OF JOSEPH WALDMAN & SONS
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ESsex 5-6000

CIRCLE 45 ON READER-SERVICE CARD

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.

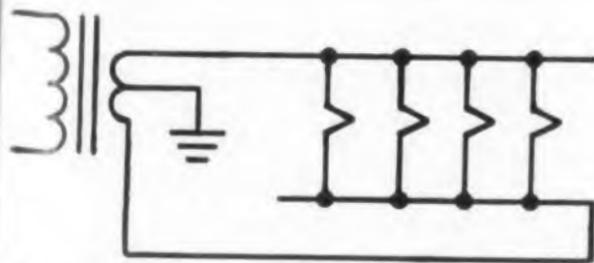
Harold J. Baron, Planning Engineer, Republic Aviation Corp., Missile Systems Div., Mineola, N. Y.

Equalize Parallel Filament Voltages

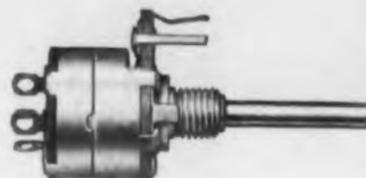
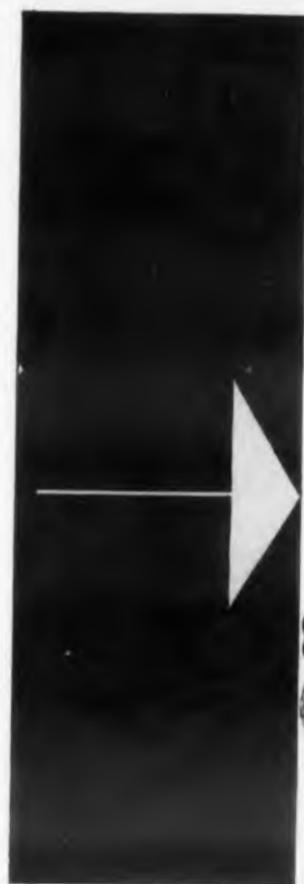
Voltage drops in filament wiring can lead to unequal filament voltages even with paralleled heaters.

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.



5/8" DIA. CONTROLS

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Stackpole F Controls are conservatively rated at 0.3-watts. They're available with threaded bushings or fold-tab mounts as well as with standard lugs or printed wiring terminals.

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For those who have no miniaturization problems, however, Stackpole also produces a complete line of standard-size single and dual controls. Send today for full details. *Electronic Components Division, STACKPOLE CARBON COMPANY, St. Marys, Pa.*

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ALL ROTATING ELECTRICAL EQUIPMENT • HUNDREDS OF RELATED CARBON GRAPHITE AND METAL POWER PRODUCTS



CIRCLE 46 ON READER-SERVICE CARD

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.

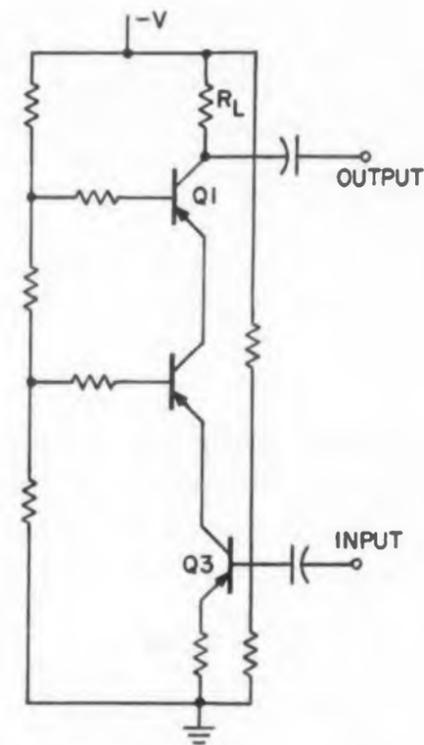


Fig. 1. Basic circuit for delivering high output signal voltages from transistors.

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

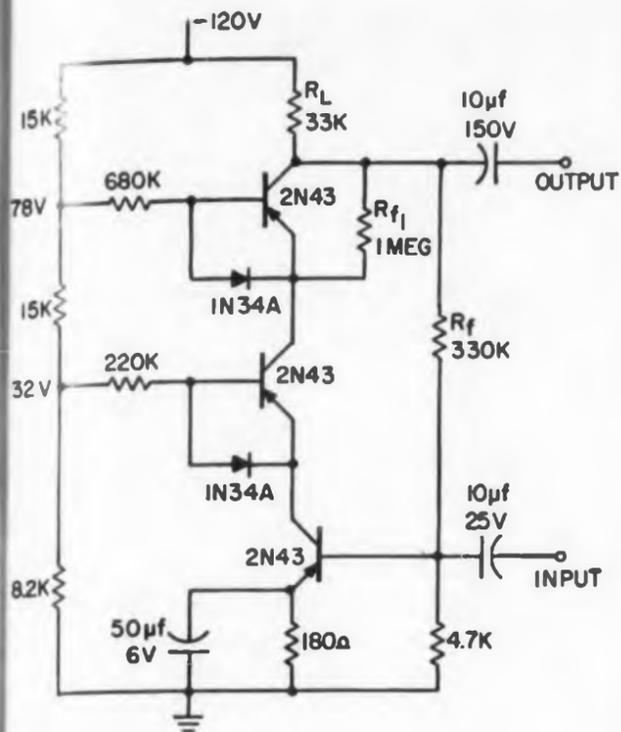


Fig. 2. This circuit provides a voltage gain of 10 and an output swing of 30 v rms. Its response is flat from 20 to 5000 cps.

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.

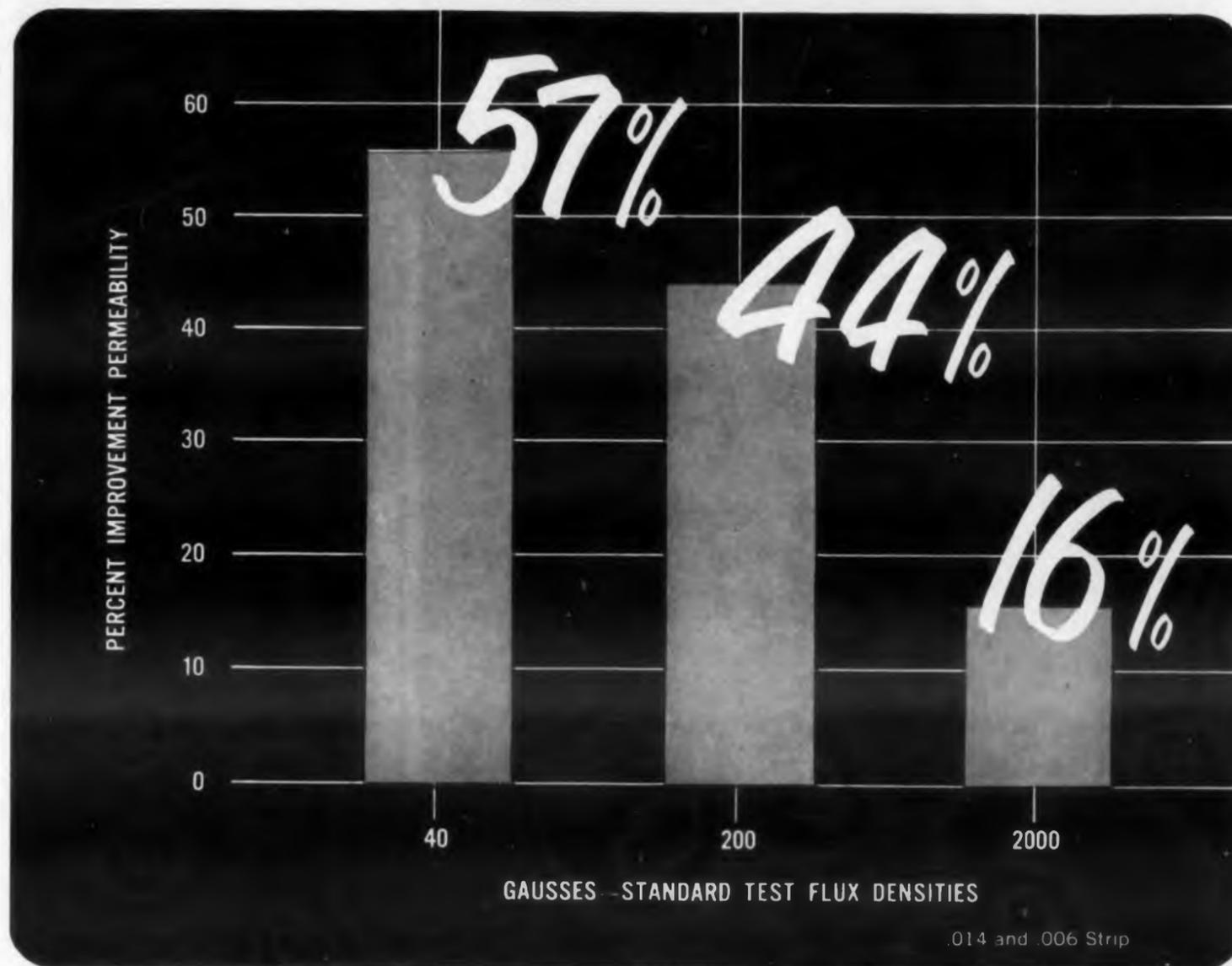
The third stage or input stage (common emitter) is designed for maximum gain with the input impedance of the second stage as its collector load. Its bias voltage is derived from the emitter resistor.

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.



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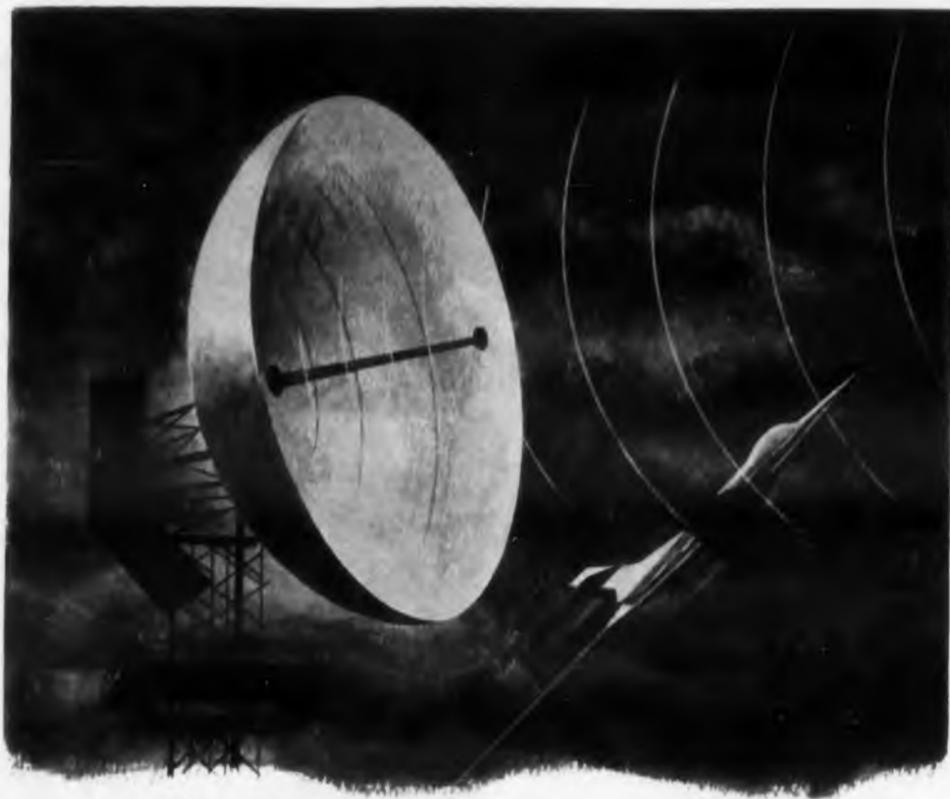
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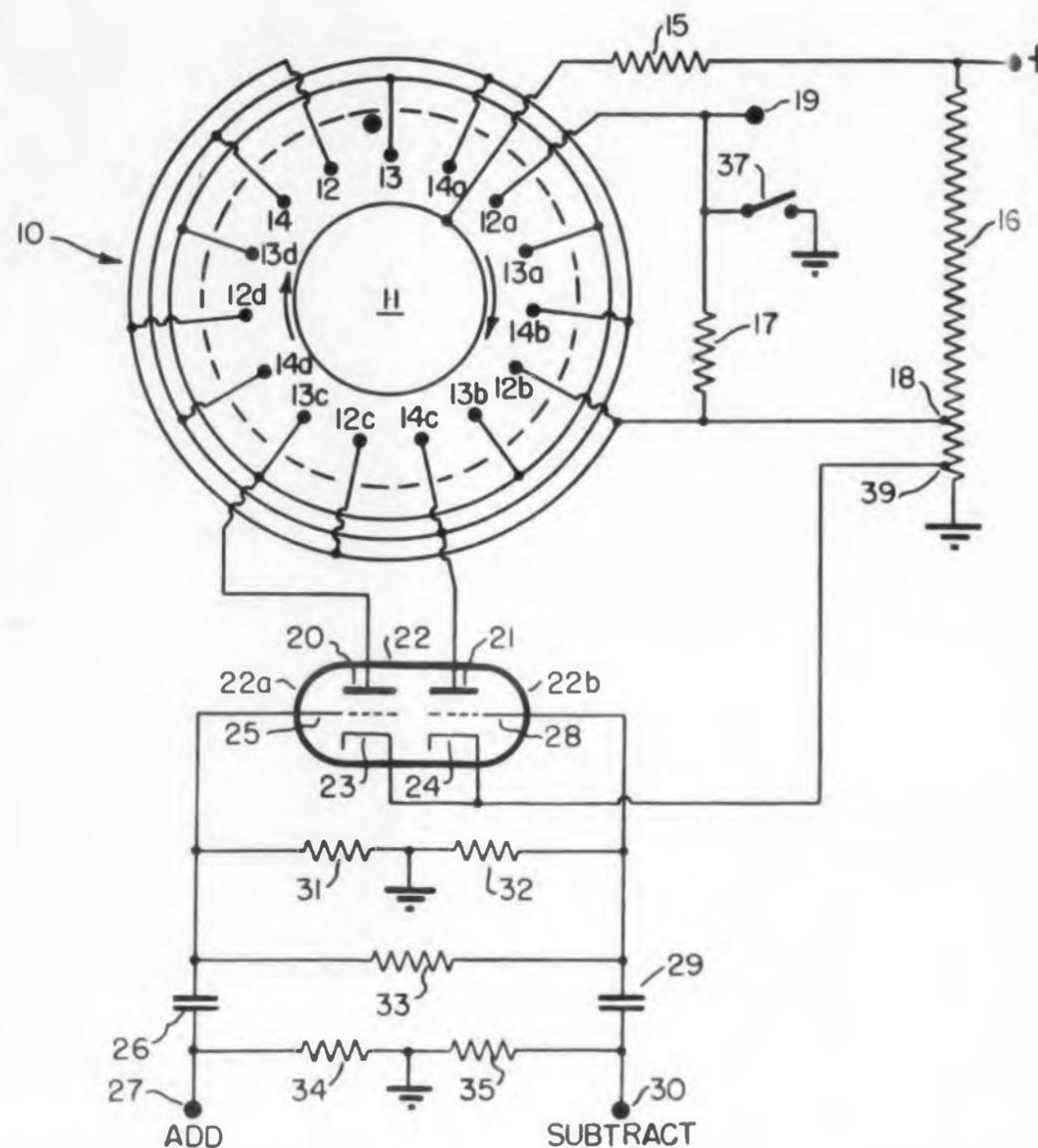
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PATENTS



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 charge 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.

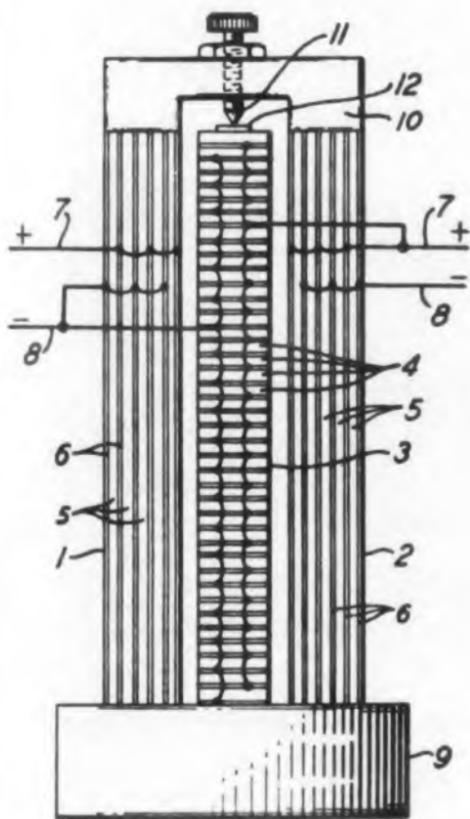
Piezoelectric Switching Device

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.

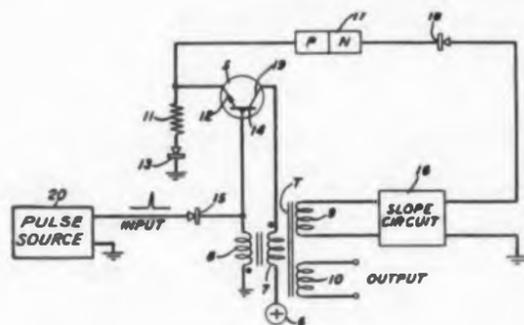
For full displacement in 10 μ sec, the structure should resonate at 25 kc. In this instance, the length is approximately 4 cm and the aggregate relative travel of the stacks, the sum of the displacements, is 0.36×10^{-3} in.



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.

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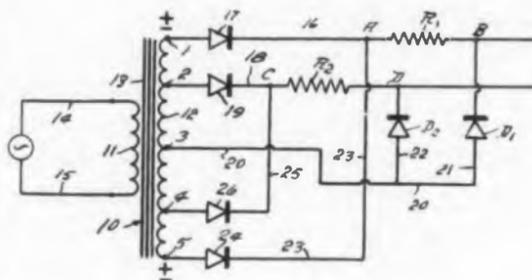
CIRCLE 51 ON READER-SERVICE CARD

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 wind-

ing. 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.

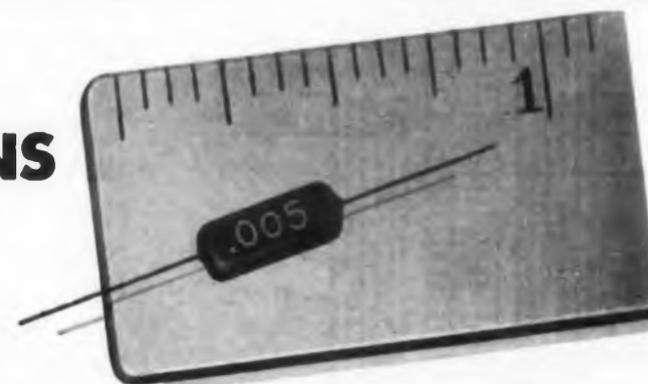
Pulse Forming Networks

Patent No. 2,867,752. Hugh F. Stoddard, 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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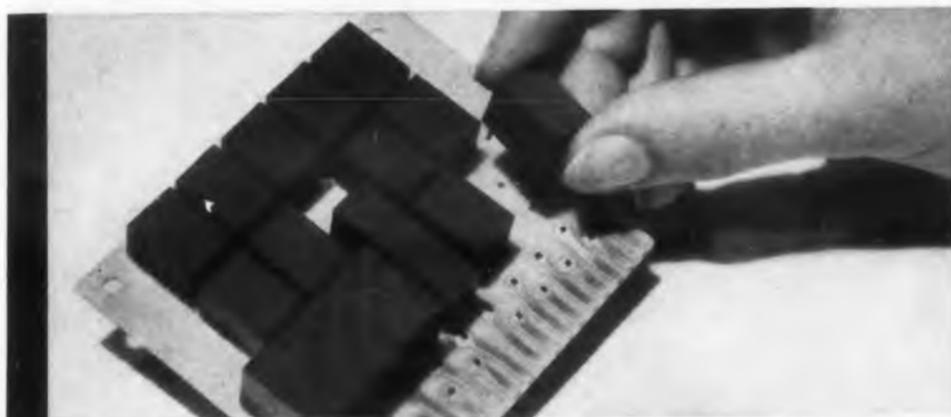
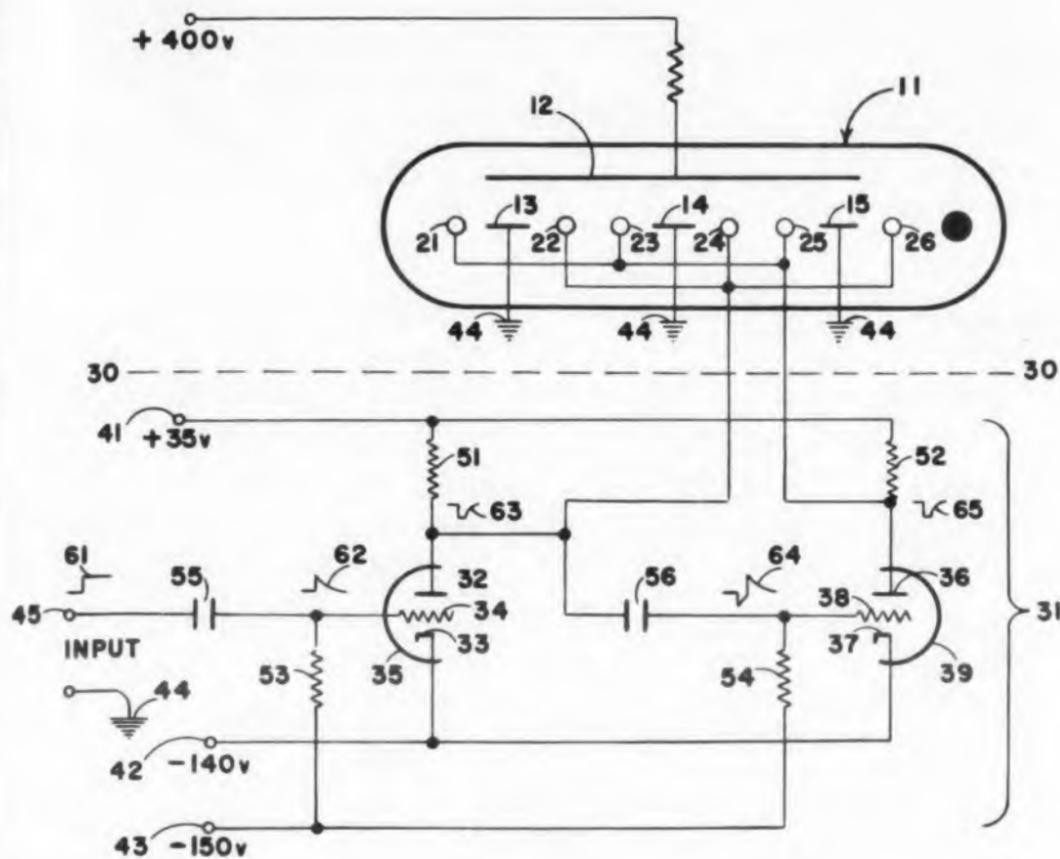
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New UNION readout instruments withstand shock, vibration and extreme temperature changes

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. $\frac{7}{32}$ -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.

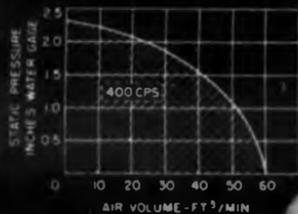
Operate Time. The operate time varies from 0.1 second to 1.0 second depending on character position.

Weight and Size. Maximum weight including case is seven ounces; without case, four and one-half ounces. Size encased is $5\frac{1}{4}$ inches long, $1\frac{1}{4}$ inches high and $\frac{3}{4}$ 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.

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CIRCLE 55 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.

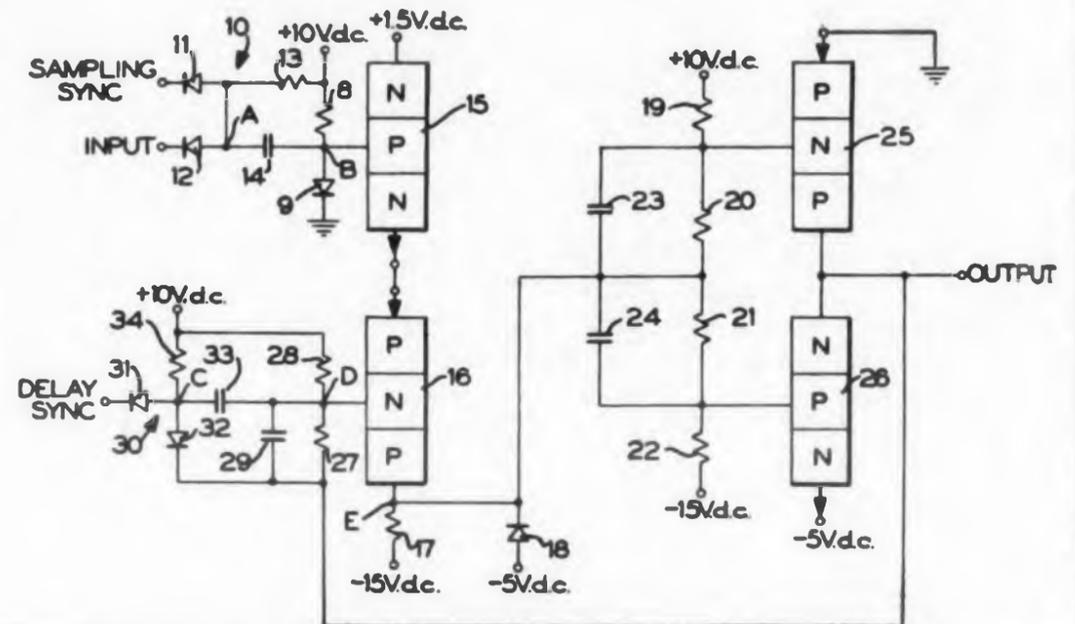


photo courtesy of Fairchild Controls Corporation.

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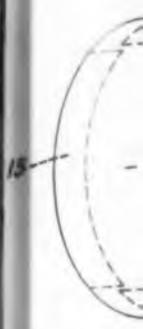
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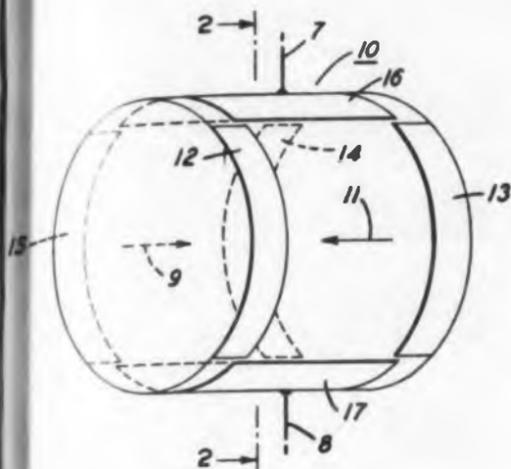
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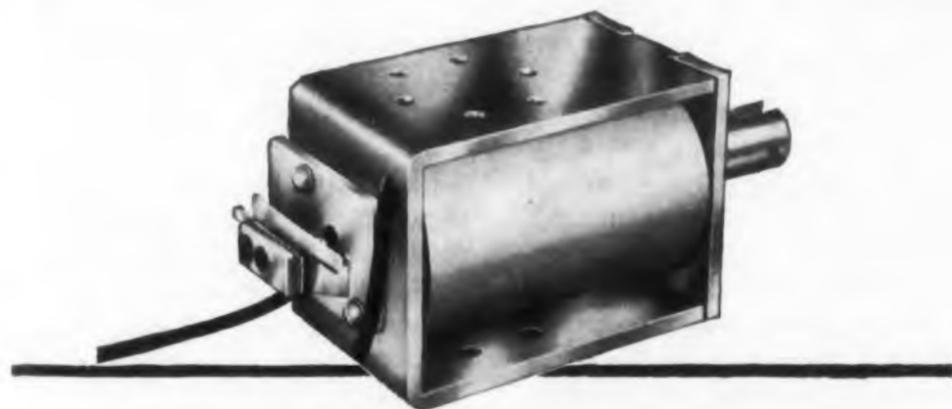
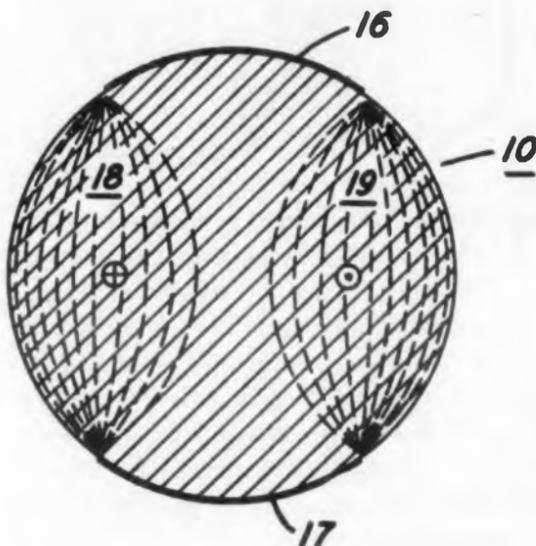
Ferroelectric Torsional Transducer

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.



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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. ■ ■



John Mitchell, Asst. Chief Engineer, Mobile and Portable Communications Products

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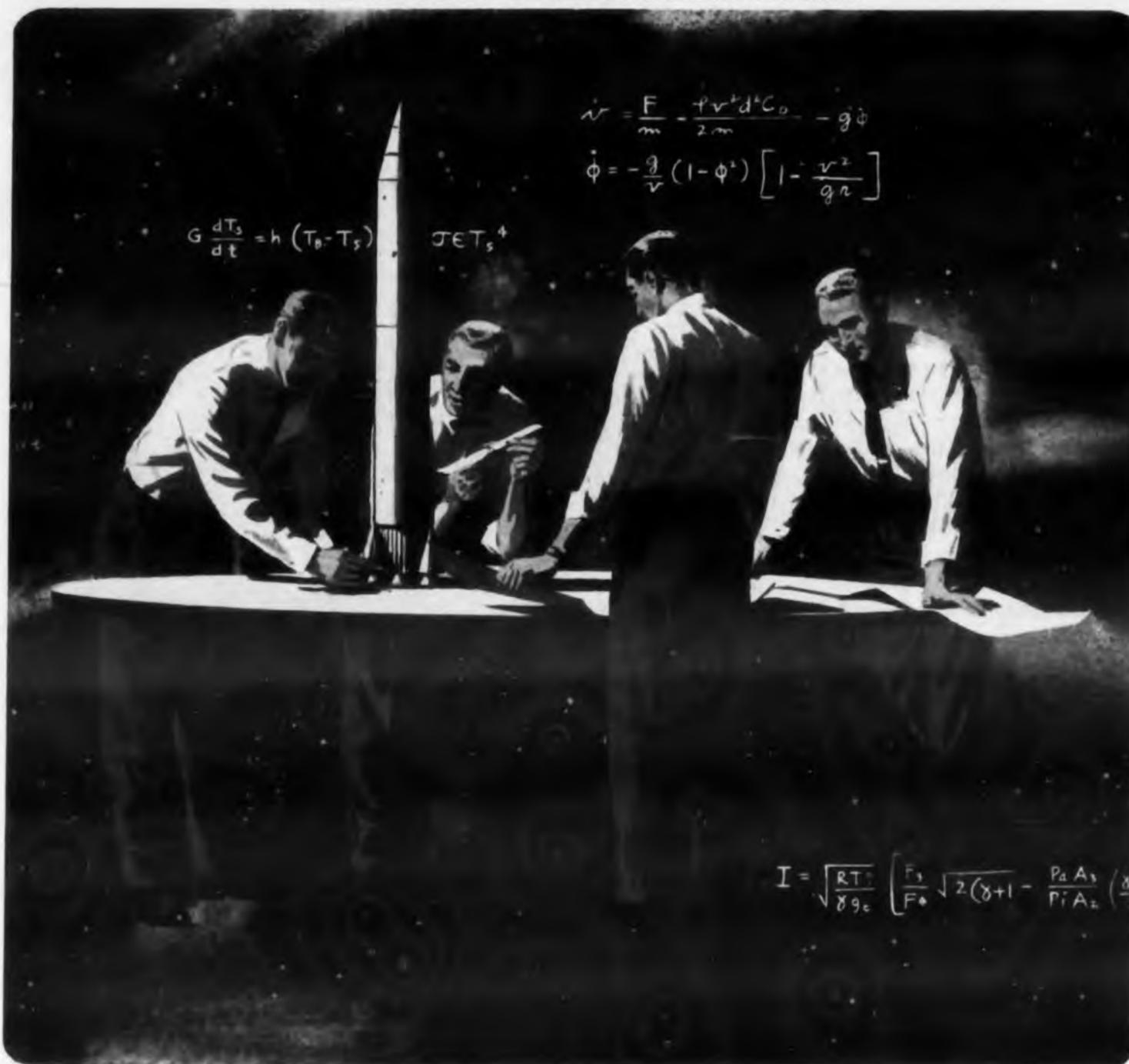


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team in accomplishing the complete objective.

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CAREER OPPORTUNITIES BROCHURES



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Mr. Howard P. Munday, Placement Div., CBS-Hytron* (Since publication, name of company has been changed to CBS-Electronics) Dept. ED
100 Endicott St., Danvers, Mass.

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16

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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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illustration. Includes photographs of ch, antennas, analyzers

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

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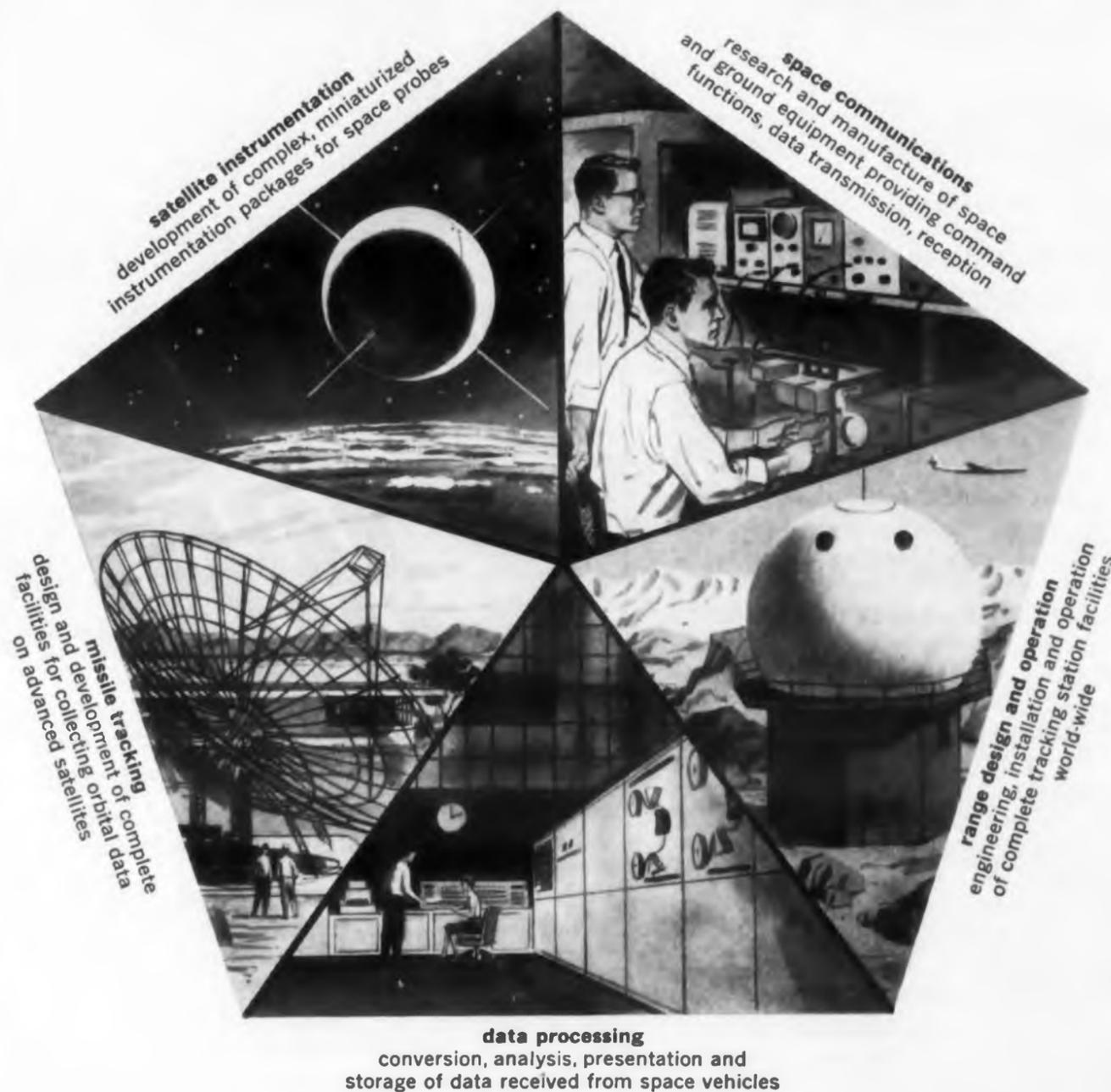
"New Dimensions", a generously illustrated brochure, includes a historical sketch of the company and describes its pioneering efforts in electronics. Separate projects underway in each of the four design and development divisions are heavily emphasized. Engineering positions available are discussed in 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.

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CIRCLE 904 ON CAREER INQUIRY FORM

ELECTRONIC DESIGN • August 5, 1959

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

ELECTRONIC DESIGN • August 5, 1959

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.

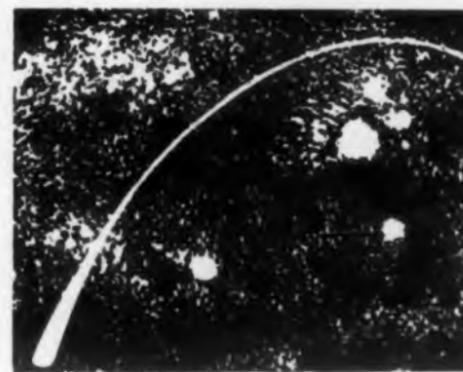
But getting the engineer to widen his interest beyond the purely mechanical appears fraught with frustration. He is apt to be more interested in "things" than in people. At cocktail parties he tends to talk shop rather than the plays of T. S. Eliot. Studies by the research department of Deutsch & Shea, 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 909 ON CAREER INQUIRY FORM

ELECTRONIC DESIGN • August 5, 1959

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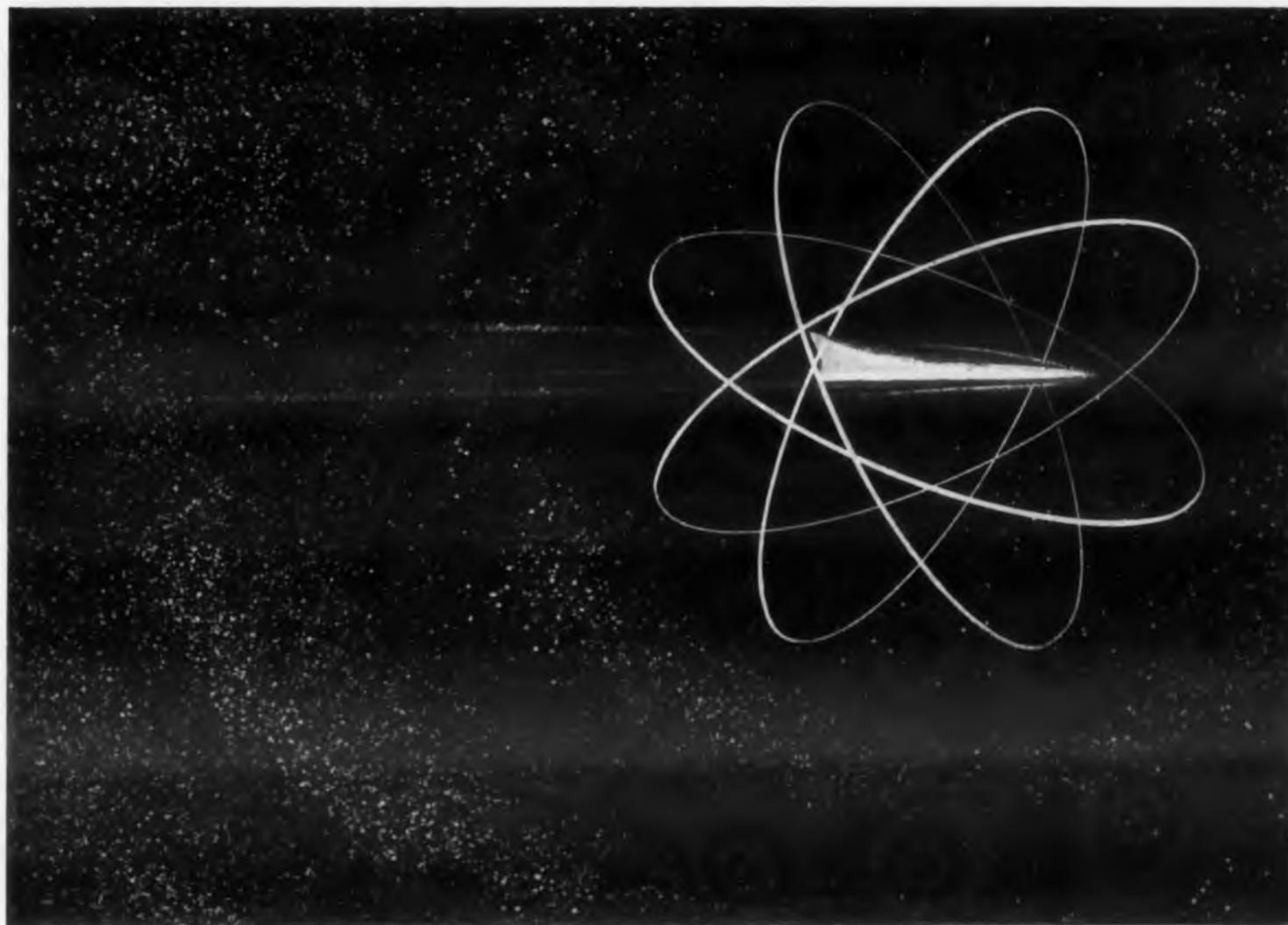
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ELECTRONIC ENGINEERING DATA

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.

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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

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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.



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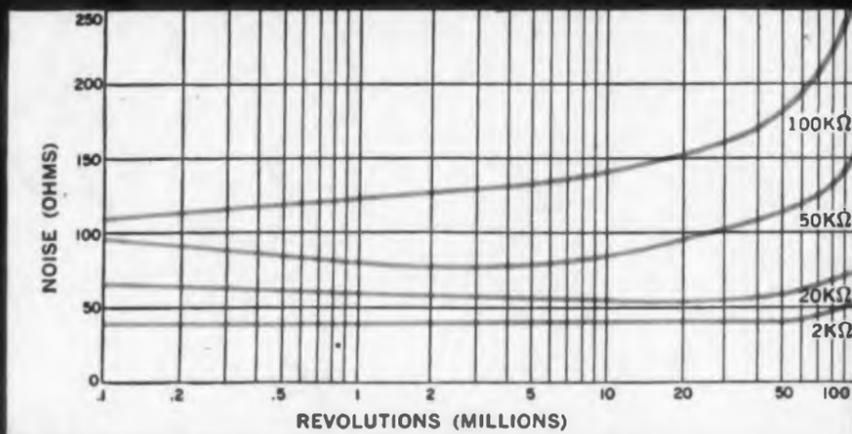
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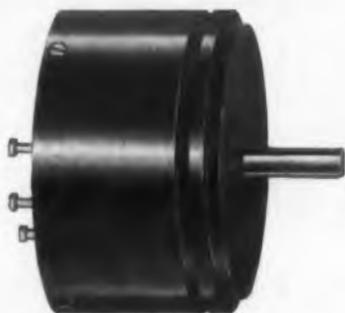
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BOOKS

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-



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data systems and statistical analysis of linear control systems are dealt with at length. Final chapters are devoted to non-linear 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.

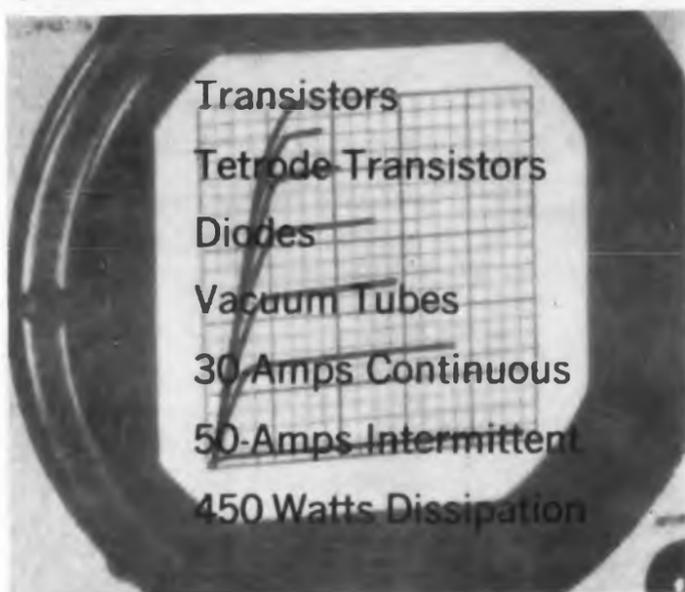
The book first introduces the reader to the aesthetic limits of the problem. It defines what can be accomplished musically with a computer at the present time, and what is—at the moment at least—outside the scope of available experimental tools.

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.

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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".

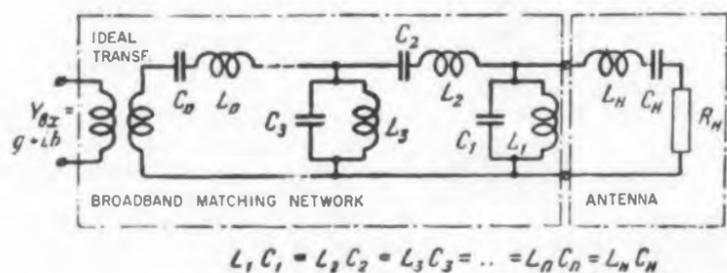


Fig. 1. Equivalent circuit showing broadband matching of an antenna, represented by a series resonant circuit.

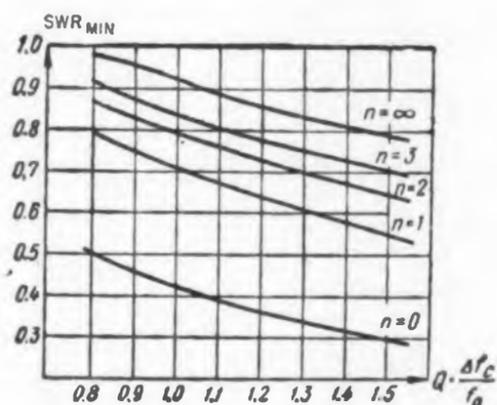
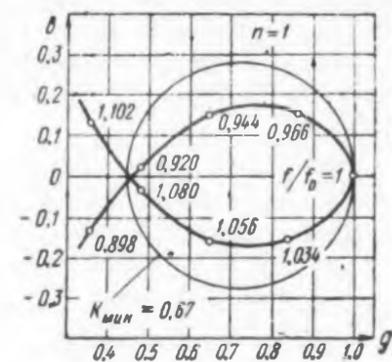


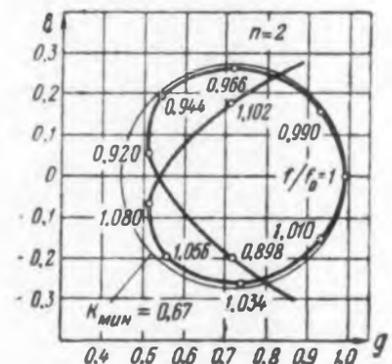
Fig. 2. Curves used to estimate the broadband properties of resonant antennas.

Engineering Calculation of Broadband Matching Characteristics of Tuned Antennas, by D. M. Sazonov, Moscow Power Institute (pp 53-62, 3 figs.).

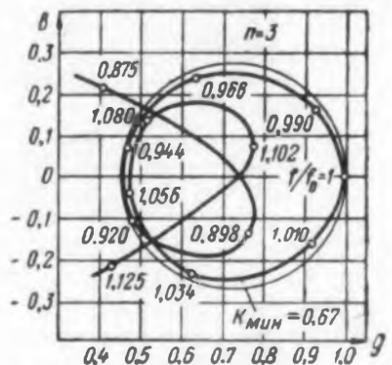
The equivalent circuit of the antenna and the matching network is shown in Fig. 1, the antenna being represented as a series-resonant circuit in accordance with the analysis first given by R. M. Fano (*Journal of the Franklin Institute*, Vol. 249, 1950). The broadband properties of the antenna, i.e., 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



$$a) \frac{\Delta f_c}{f_0} = 0.165; \frac{L_1}{L_N} = 0.050$$



$$b) \frac{\Delta f_c}{f_0} = 0.205; \frac{L_1}{L_N} = 0.036; \frac{L_2}{L_N} = 0.78$$



$$c) \frac{\Delta f_c}{f_0} = 0.225; \frac{L_1}{L_N} = 0.034; \frac{L_2}{L_N} = 1.26; \frac{L_3}{L_N} = 0.977$$

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.

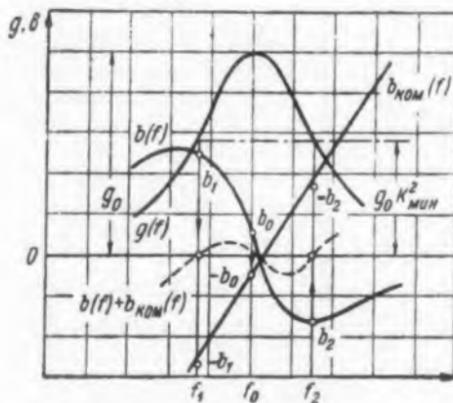


Fig. 4. Graphic calculation of the parameters of the matching network with $n = 1$.

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

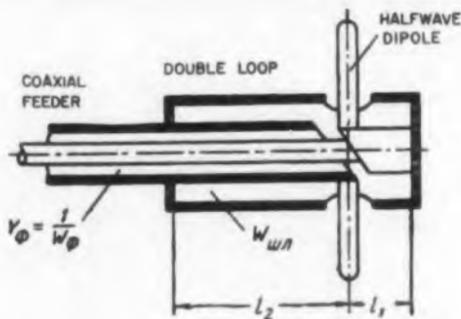


Fig. 5. Use of double parallel loop for matching.



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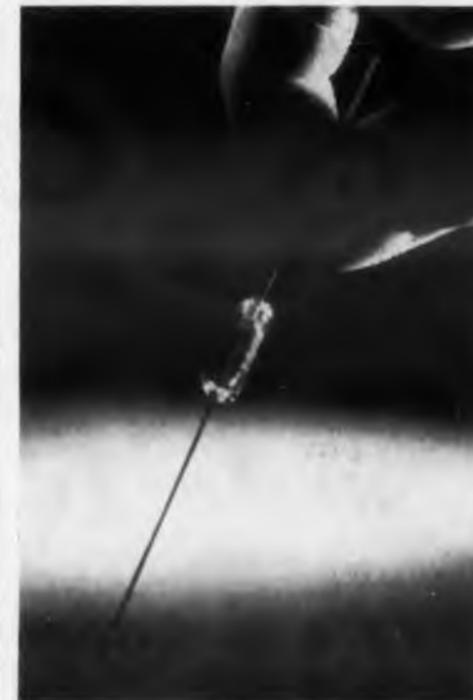
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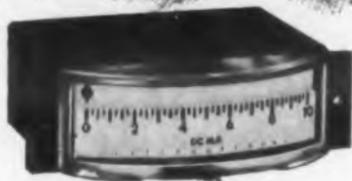
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RUSSIAN TRANSLATIONS

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

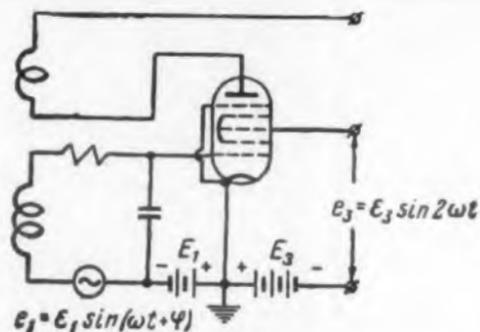


Fig. 6. Simplified diagram of oscillating system with periodically varying regeneration.

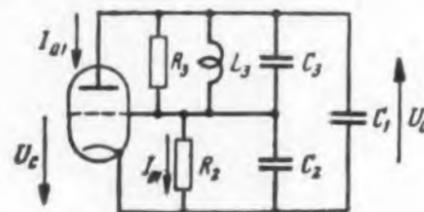


Fig. 7. Equivalent circuit of microwave oscillator at self-oscillation frequency.

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 Optimum 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



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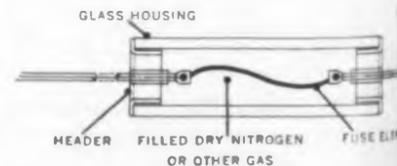
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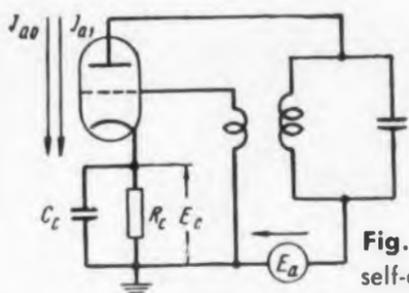


Fig. 8. Self-biased self-oscillator.

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"

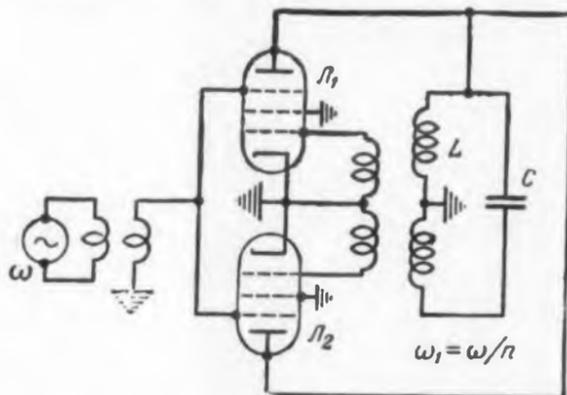


Fig. 9. Push-pull frequency divider with an odd frequency ratio ($n = 3, 5, \dots$).

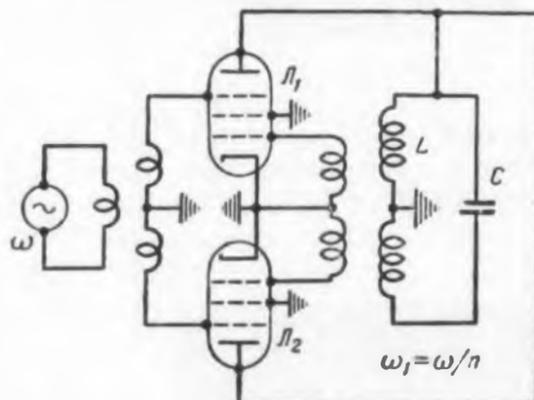


Fig. 10. Push-pull frequency divider with an even frequency ratio ($n = 2, 4, \dots$).

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Capacity: 1/2 gallon

An amazingly efficient, yet inexpensive, ultrasonic cleaner. Duty cycle timer permits operator to turn the unit on, set it, and leave; the SonBlaster will turn off automatically at the end of the cycle. Four choices of timers—from 0-15 min. to 0-120 min. Also available with out timer at slightly lower cost (G-201).

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Generator G-601 60 watts
Transducerized Tank NT-602
Capacity: 1 gallon

A more powerful production-type unit, with a special circuit and selector switch permitting operator to alternate between two tanks, when items being cleaned require different solutions or a two-step process.

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Transducerized Tank NT-1505 Capacity: 5 gallons
Generator G-1501 200 watts

The lowest price in the industry for a tank of this capacity and activity. Generator also will operate 2, 3 or 4 submersible transducers at one time, with just a turn of the load selector switch on the front panel.

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Capacity: 10 gallons

Generator G-5001
500 watts

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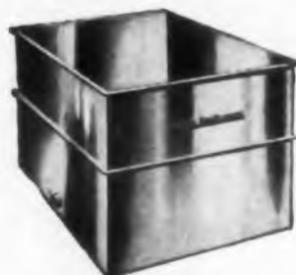
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Helix arc welded stainless case, hermetically sealed for safe, leak-proof immersion. Radiating face: 27 sq. in. Effective plane of radiation: 40-50 sq. in. (approximately 10" x 5"). Effective cavitation of volumes up to 1200 cu. in. at 24 in. tank height (5 gal.) and 2400 cu. in. at 48 in. tank height (10 gal.). Bulkhead electrical fitting on back allows all wiring connections to be made on outside of tank. For use in any arrangement or location in any shape tank you desire to use. Also available—model NT-604, identical with NT-605, except for pipe thread instead of bulkhead fitting, permitting electrical connections inside of tank.

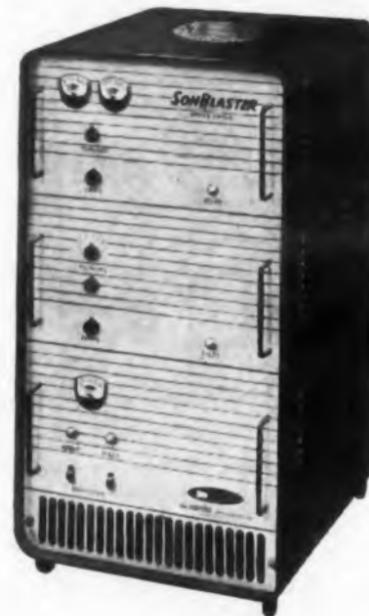
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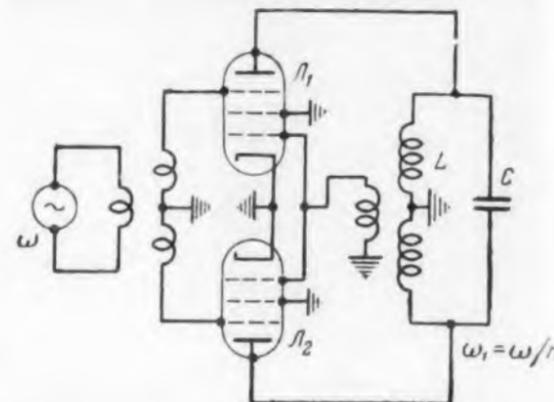


Fig. 11. Push-pull frequency divider with arbitrary frequency ratio.

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

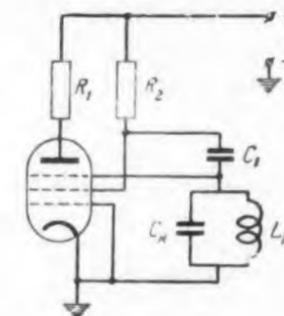


Fig. 12. Incorrect diagram of transitron oscillator (suppressor grid of the tube is at zero dc potential relative to the cathode).

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

linear, 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 $k_1\beta = 1$, 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)

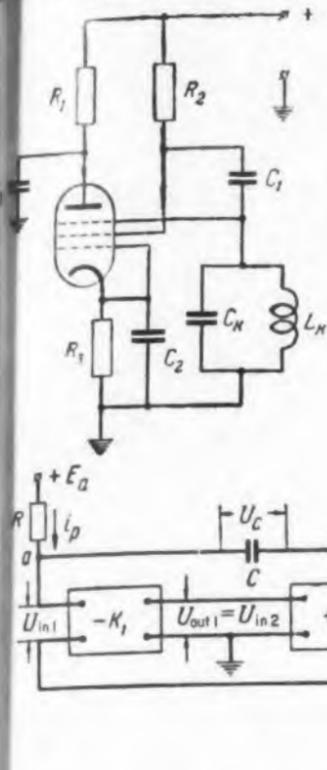


Fig. 13. Diagram of transitron oscillator.

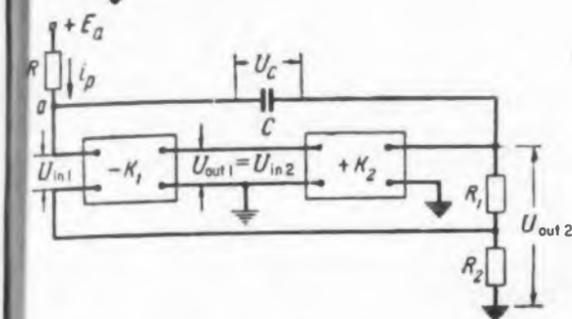


Fig. 14. Block diagram of linear sweep oscillator.

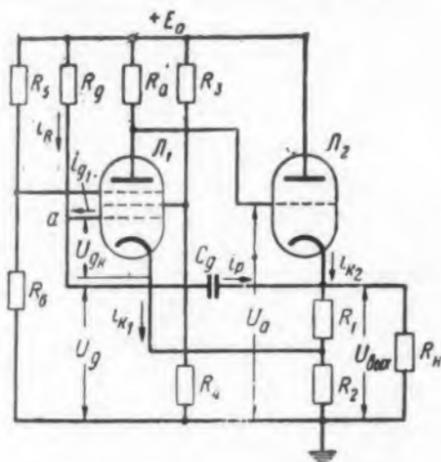


Fig. 15. Phantrastron type linear sweep oscillator.

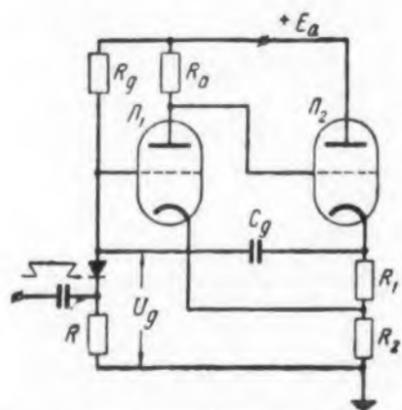
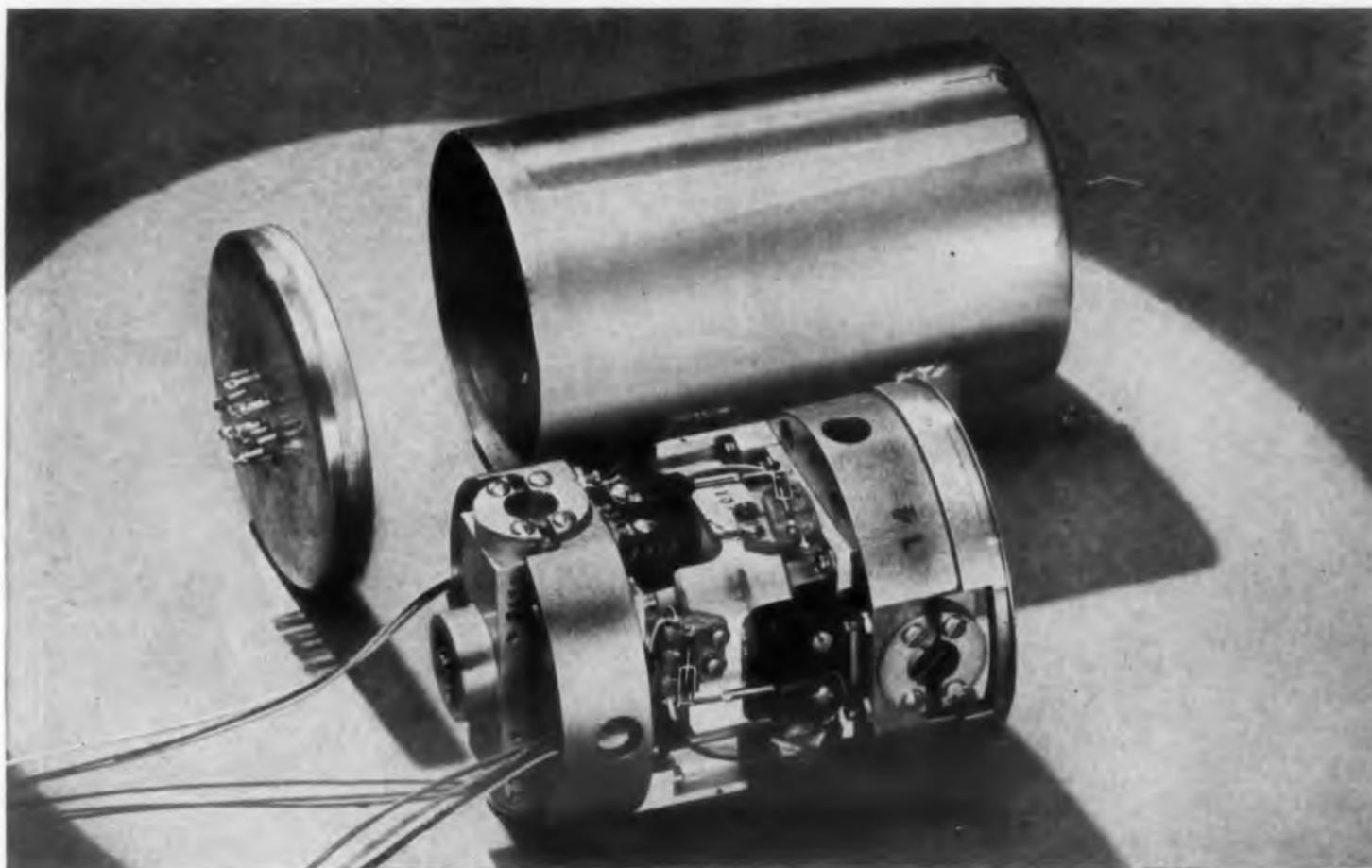


Fig. 16. Linear sweep oscillator employing triodes.



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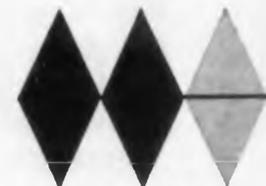
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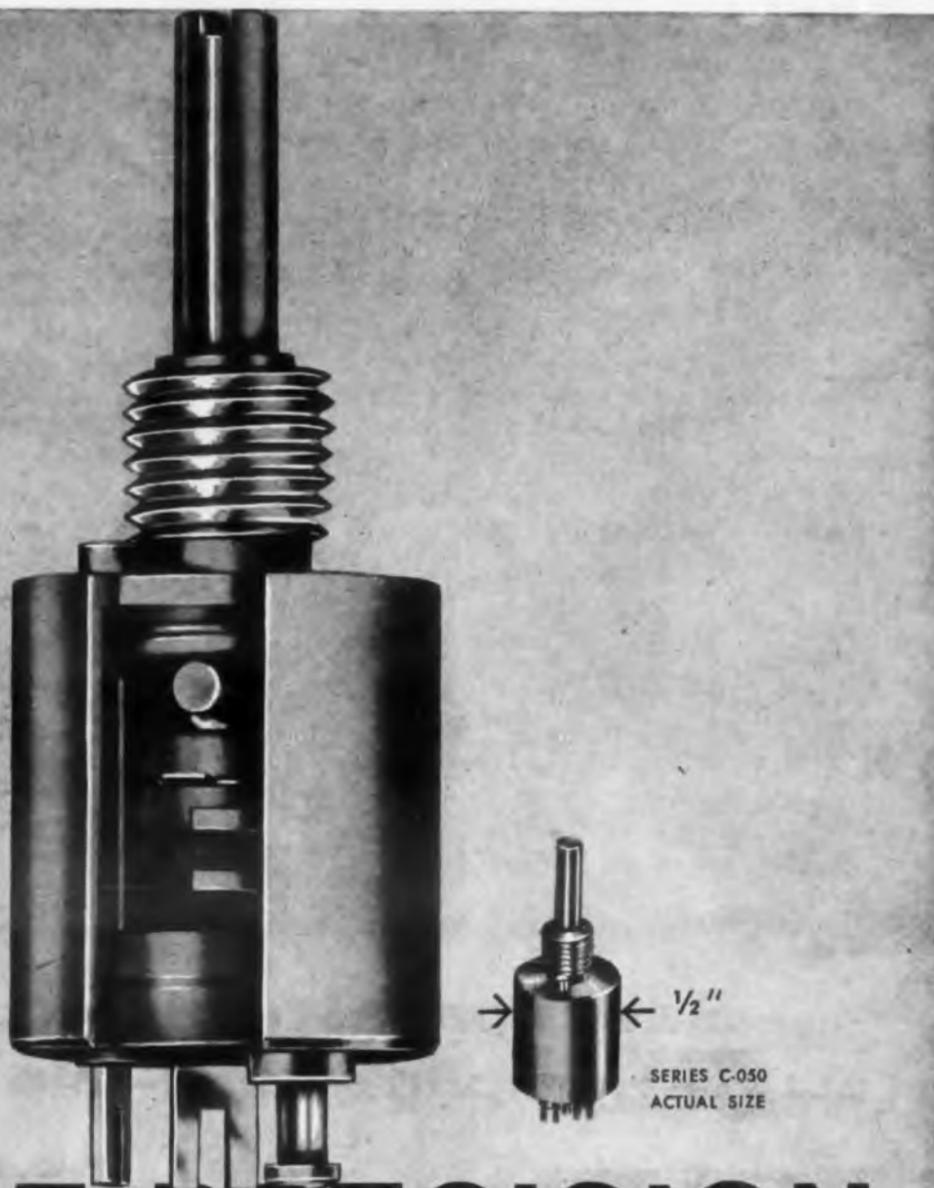
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RUSSIAN TRANSLATIONS

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 pentastatron 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 Non-linear 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.

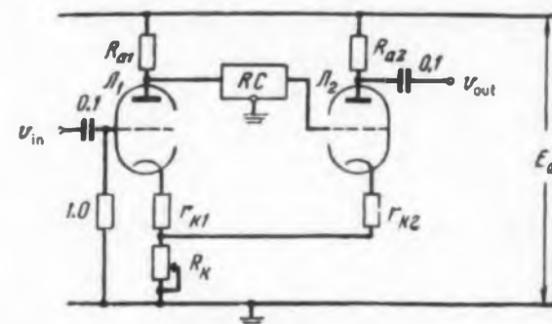


Fig. 17. Amplifier circuit.

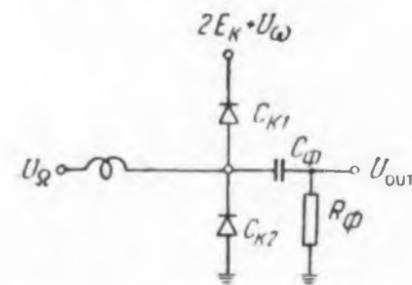


Fig. 18. Amplitude modulator of the capacitive divider type.

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

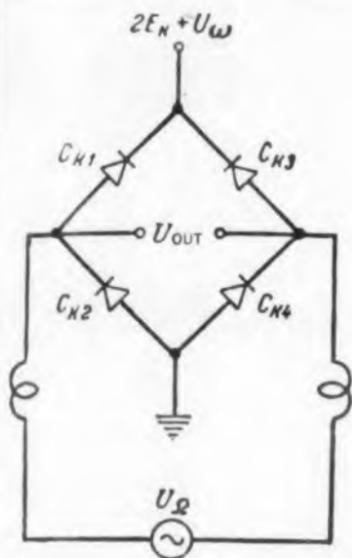


Fig. 19. Bridge-type amplitude modulator

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.

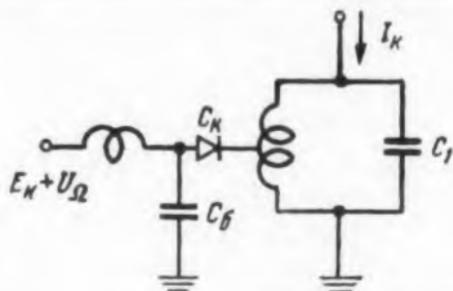


Fig. 20. Amplitude modulator using a parallel tank circuit.

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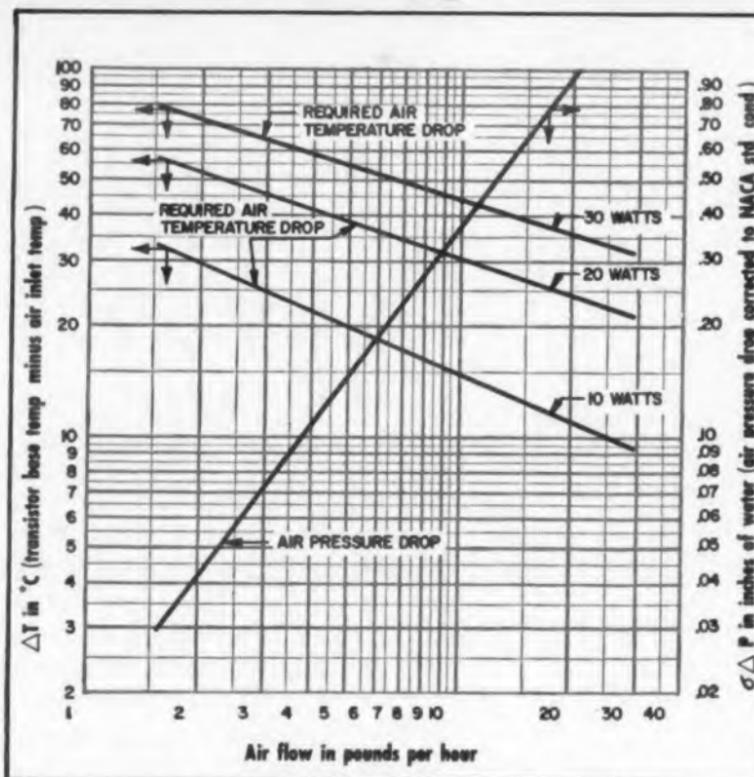
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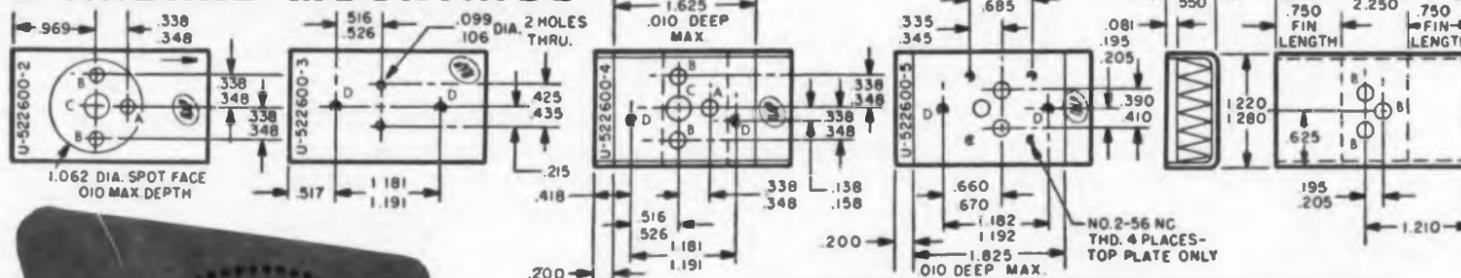
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GERMAN ABSTRACTS

Temperature
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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

$$\omega_r^2 = G^2 [H_e + M (N_x - N_z)/\mu_0] \quad (1)$$

$$[H_e + M (N_y - N_z)/\mu_0]$$

For a resonant directional line operating at a mean radian resonant frequency ω_m , with saturation magnetization M_0 at the mean operating temperature, temperature independence requires fulfillment of the conditions

$$u_m^2 = (\omega_m \mu_0 / GM_0)^2 = P^2 QR / (Q - R)^2 \quad (2)$$

and

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

where

$$P = N_x - N_y \quad (4a)$$

$$Q = N_y - N_x \quad (4b)$$

$$R = N_x - N_z \quad (4c)$$

For nonreciprocal phase shifters and Faraday

Independent Strips

E. Brenner

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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

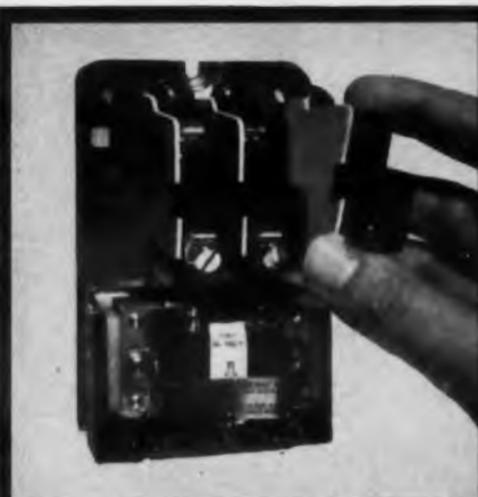
$$u_{ro} = \omega_{ro} \mu_0 / GM_0$$

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.



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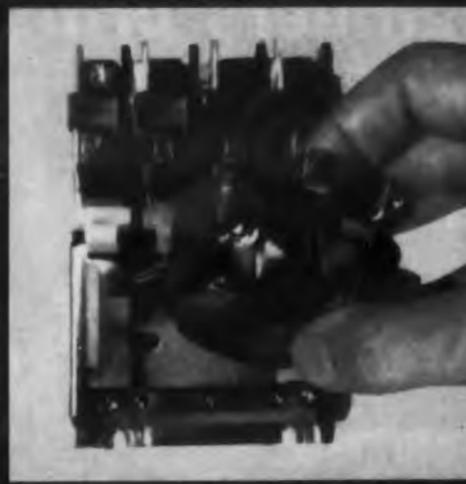
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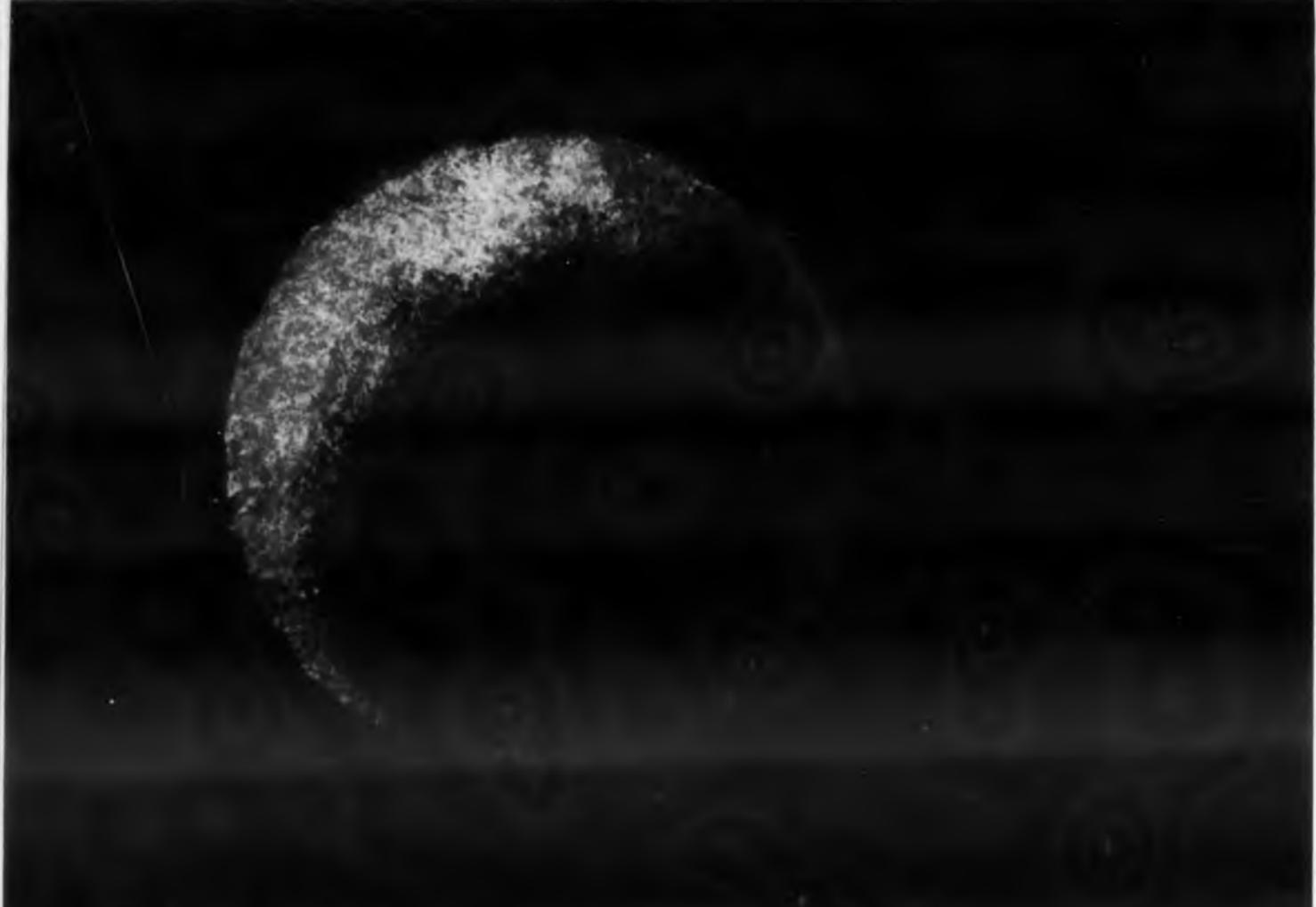
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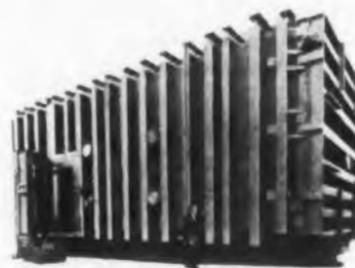


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REPORT BRIEFS

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 139-218 from Library of Congress, Washington 25, D. C.*

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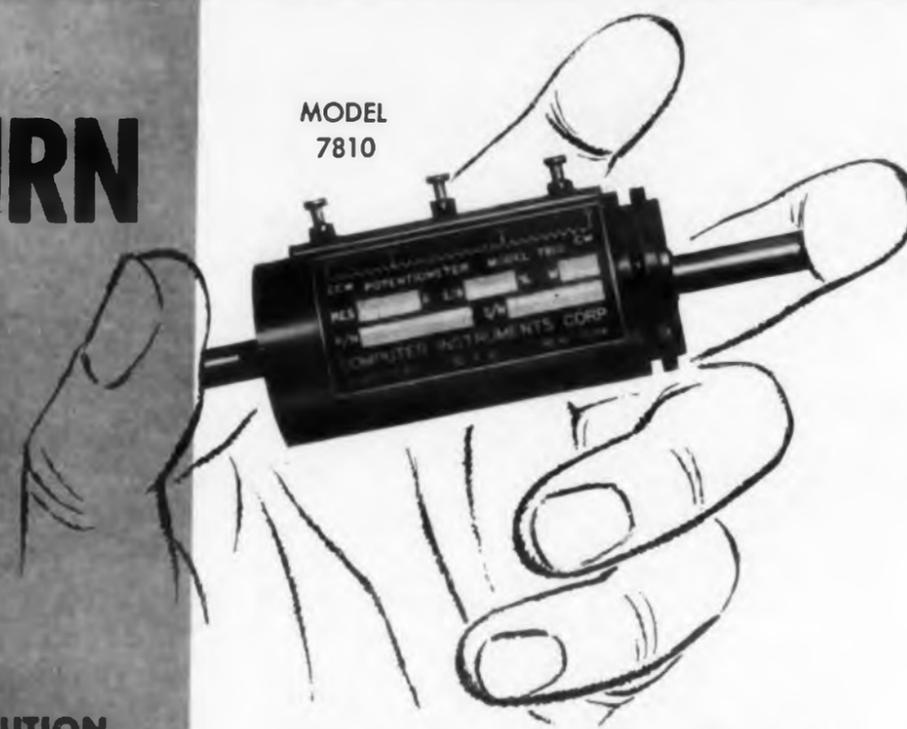
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REPORT BRIEFS

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

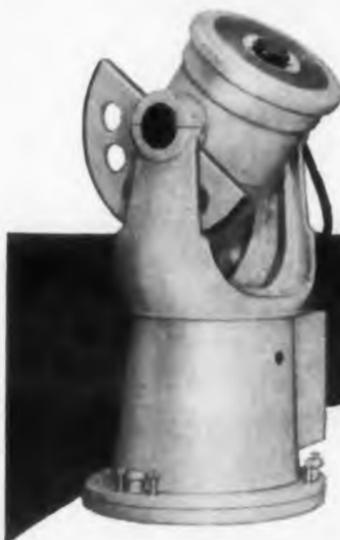
The objectives of this investigation are to determine the effects of moisture and heat on the electrical and physical properties of representative plastics and ceramics of various types and to derive expressions of mathematical relations describing various effects on dielectric properties as functions 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.



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OUTPUT:	50 ohms* *at output jack on instrument and at output connector of Type 517-B Output Cable

RF VSWR:	
INPUT:	< 1.3 500 kc to 500 mc < 1.6 500 mc to 1000 mc
OUTPUT:	< 1.05 500 kc to 100 mc* < 1.07 100 mc to 500 mc* < 1.1 500 mc to 1000 mc* *at output connector of Type 517-B Output Cable

AM Range: 10 to 100%	
AM Accuracy: $\pm 10\%$ 30 cps to 15 kc* $\pm 15\%$ 20 cps to 20 kc* *modulating frequency	
AM Frequency Range: 20 cps to 20 kc	
RF Input Requirements: 0.05 volts	

Unique design features make Type 245 Signal-Generator Calibrators ideally suited for laboratory, production and field applications in the calibration of signal generators and the testing of receivers. No corrections of any kind are required over the entire frequency range; the instrument is direct reading in both input and output voltage level as well as percent AM from 500 kc to 1000 mc. Completely transistorized, the circuit is designed for maximum stability and reliability. Only two simple balance adjustments are required, permitting rapid measurement. Prices: TYPE 245-C \$390.—TYPE 245-D \$385. F.O.B. Boonton, N. J.

THE NEW BRC CATALOG—ask for your copy today! Contains complete data and specifications on Boonton Precision Test Equipment including new instruments with exclusive design features.

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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 non-members.



GROUND SUPPORT EQUIPMENT

A Proven Kearfott Capability – Kearfott's prominence in the design and production of ground support equipment is a result of 15 years' experience in producing precision servo systems, computers, gyro reference systems and inertial guidance equipment. Kearfott test equipment is designed on modular principles which increase flexibility and economy and eliminate the obsolescence factor since modules can be readily modified or replaced. Modules are designed to be compatible with one another, thus providing test capabilities for a wide variety of applications.



Inertial Guidance System Test Console

FIELD-TYPE TEST EQUIPMENT: Modularized, self-contained unit that provides all power and signal voltages to operate, test or troubleshoot a gyro. All inputs to and outputs from the gyro are accessible at convenient jacks where connections to measuring equipment can be made, thereby enabling operator to evaluate gyro performance completely. Modules are slide-mounted for ready access if repair, modification or product improvement replacement are required. This portable equipment performs these basic tests:

Insulation resistance • Warm-up time • Torquer scale factor measurement
Gyro transfer function • Free drift • Gimbal offset drift • Continuity
Signal Generator Null • Phasing • Gyro drift • Fixed torque restraint



Scanalog 200-Scan
Alarm Logging System

IN-PLANT TEST EQUIPMENT: Rack-mounted modules comprise the necessary metering circuits, signal generators and power supplies, switching circuits and junction boxes to perform the following tests on inertial reference systems:

Voltage and phase • Current • Heating cycle checks • Verticality of platform in ground erection mode • First order erection time in ground erection mode • Measurements of platform roll and pitch output angles in ground erection mode • Measurements of free drift of platform in azimuth in ground erection mode • Measurement of azimuth gyro torquer scale factor in ground erection mode



Floated Gyro Test Console

GENERAL PURPOSE DATA PROCESSING: This data handling system provides a reliable, precise means of monitoring, logging and performing an alarm function of up to 200 separate temperature, pressure, liquid level or flow transmitters. Manual controls are provided for scanning rates, automatic or manual logging, data input relating to operator, time, day, run number and type of run. 200 numbered lights, corresponding to specific points being maintained, provide a visual "off normal" display for operator's warning. This system has growth built in and can be expanded in capacity to 1024 points and in scanning rate to 2000 points per second.

Write for complete information on Kearfott's ground support equipment.

Engineers: Kearfott offers challenging opportunities in advanced component and system development.



VTVM-PSVM



High-Speed
Precise Angle
Indicator Module



Automatic
Ohmmeter
Module

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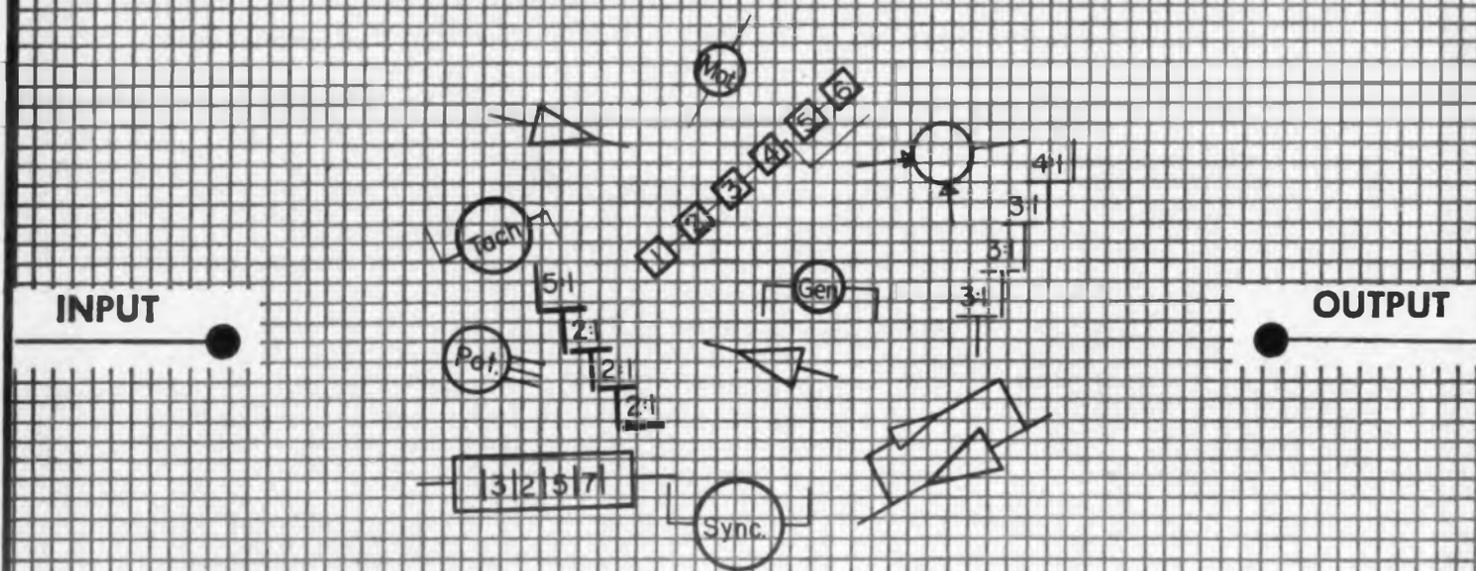
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Precision Electromechanical Controls and Instrumentation, Servomechanisms,
Precision Miniature Gearheads, Navigational Counters, Indicating Devices
CIRCLE 87 ON READER-SERVICE CARD



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; synchrosopes; 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.

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Whatever your high temperature needs—to 1550°F—there is a Mycalex insulation to meet them . . . each offering a *unique combination* of special advantages for electronic design: the *plus* factors of the inorganics and the design latitudes of the organics!

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SUPRAMICA 500—Machinable insulation, for operating temperatures to 850°F.

SUPRAMICA 620—Machinable insulation, for operating temperatures to 1550°F.

MYCALEX 385—Machinable insulation, for operating temperatures to 700°F.

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Unmatched speed, unequalled sensitivity

EG&G's 2236A TW Oscilloscope is the newest of a family of millimicrosecond instruments. This precision instrument has met the exacting requirements of nuclear weapon tests conducted for the AEC.

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Current applications of the EG&G 2236A include its unprecedented performance in measurement of:

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- Reverse recovery time of high-speed semiconductor diodes
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CIRCLE 105 ON READER-SERVICE CARD

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 multi-turn 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 non-linear potentiometers, and precision mechanisms. Write to: Spectrol Electronics Corp., Dept. ED, 1704 South Del Mar Ave., San Gabriel, Calif.

Environmental Testing 07

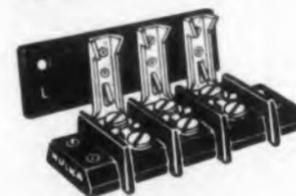
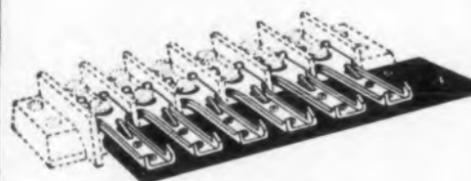
This 31-page illustrated booklet describes the firm's environmental test facilities and services. The reproducible environments discussed include conditions of vibration with varying temperatures and altitudes, humidity, tension and compression, shock, acoustics, acceleration, and pressure. Also described 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.

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Cut wiring time and cost!



Here's a practical device to simplify your wiring work and assure correct connections. Multi-conductor cable is attached at either end of strip with a clamp. Each wire is soldered to terminal lug. Then, sliding and tightening the spade-type lugs under the binder screws of terminal block, all connections are completed. Supplied with flat lugs or with 90° upright lugs.

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CIRCLE 109 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959

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.

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dependable
CERTIFIED
SPECIFICATIONS
for accurate
data

- Directly calibrated single line plots
- Response to fundamental frequency only
- Discrimination against hum and noise
- Dynamic range almost without limit
- Precise Frequency Markers (from signal generator)

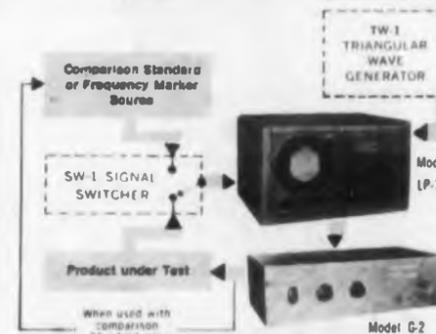
Now covering the range from
0.5 cps to 15 mc,

PANORAMIC Frequency Response Analyzers are distinguished for their effectiveness in plotting amplitude response vs. frequency in the study of acoustic devices, transmission lines, audio and video amplifiers, filters, and shaker tables.

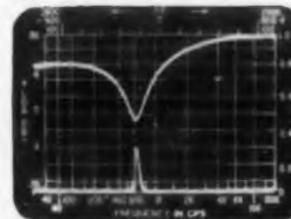
The analyzing system consists of a response indicator and spectrum analyzer which in combination serve respectively as a sweep frequency source and synchronous selective detector. Five systems are available. Each covers a specific frequency range. (see chart below) The TW-1 Triangular Wave Generator supplies a variable rate bi-directional sweep that ends the problems of time delays and ringing of sharply attenuating networks. With the SW-1 Signal Alternator, direct comparison of the characteristic under test against a "standard" signal, or the injection of frequency marker pips from a signal generator, is simplified.



Model G-3



Here is a typical frequency response tracing system hook-up—with the unique type of information displayed in different studies—



Plot of Rejection Network. Precise frequency marker from signal generator, alternately injected by SW-1 Signal Alternator, simplifies frequency determination.

Plot of Filter Performance, 52.5 kc $\pm 15\%$ with SB-7b Analyzer and G-3a Unit. Pass-band is deflected 40db above full scale, permitting precise plot in -80 db area. This recording shows the dynamic range of the PANORAMIC system.



The five G-Units and paired Frequency Analyzers have the following performance characteristics—

Response Indicator Model	G-5	G-2	G-3a	G-15	G-6
Companion Panoramc spectrum analyzer	LF-2a LF-2aM	AP-1 LP-1a	SB-7bz	SB-15	SPA-3 SPA-3/25
For use in the frequency range	0.5 cps to 2250 cps	20 cps to 22,500 cps	1 kc to 300 kc	100 cps to 525 kc	200 cps to 15 mc
Output Voltage (into matched load)	0 (nom.) to 5 v	500 μ v to 5 v	250 μ v to 2.5 v	250 μ v to 2.5 v	200 μ v to 0.2 v
System Flatness	± 0.5 db to 2250 cps	± 1 db	± 0.5 db	± 1 db to 200 cps to 525 kc	± 1.5 db
Output Impedance	3000 ohms	100, 500, or 3000 ohms	600 ohms	600 ohms	72 ohms



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CIRCLE 117 ON READER-SERVICE CARD

Got a problem that calls for thread-cutting screws?

PARKER-KALON offers three new, improved thread-cutting screws for every application in every material



1 New, Improved P-K Type F*
 . . . hardened thread-cutting screws developed for use in friable, granular or brittle material. The pilot, with its five tapping flutes, cuts a machine screw thread as the screw is turned in. The Type F is ideal for making fastenings to ferrous and non-ferrous castings, bronze or brass forgings, heavy gage sheet metals, structural steels, plastics and resin-impregnated plywood.

The five cutting flutes on the new, improved P-K Type "F" and "BF" reduce pressure development by 80 percent! The completely formed threads on these screws have sharper cutting edges, and 5 deep flutes that are of continuous depth. These features make for better clearance of the accumulated material and assure minimum stresses in driving, and avoid the possibility of stripping or galling.



2 "Pentap" . . . the new, Improved P-K Type B-F*
 (formerly F-Z) combining the five thread-cutting flutes of the Type F screw with the coarse-pitch, widely-spaced threads of the P-K Type B. The thread-cutting "Pentap" Type B-F distributes cutting pressure evenly, lets chips drop to the bottom of the hole, and prevents cracking of material. It is designed for making fastenings to comparatively thin sections and bosses in friable and brittle plastics.



3 P-K® Type L†
 . . . is a completely new and improved thread-cutting screw developed by Parker-Kalon especially for use in Nylon. The Type L functions as a combination thread-cutting and thread-forming screw in that it cuts a small amount of the Nylon to allow the full diameter threads to form. Type L offers a particular advantage in Nylon assemblies which must be disassembled for service, because the P-K Type L can be removed and replaced without stripping or galling.



FOR SEMS . . . and Neoprene or Nylon washer STAPS† in thread-cutting and thread-forming tapping screws, or machine screws in any kind of pre-assembled fastener-washer combination, P-K can supply them, too!

KEEP AMERICAN INDUSTRY AT WORK . . . BUY P-K . . . MADE IN U.S.A.

*Patent Pending †U. S. Patent 2,350,346

FOR SAMPLES OF P-K THREAD-CUTTING SCREWS AND SEMS, CALL YOUR LOCAL P-K "BULK-STOCKING" DISTRIBUTOR

PARKER-KALON® fasteners

PARKER-KALON DIVISION, General American Transportation Corporation, Clifton, New Jersey • Offices and Warehouses in Chicago and Los Angeles

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 in 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.



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the industry's most versatile SWEEP GENERATOR

Helps Martin Orlando develop guidance systems for such missiles as the Army's Lacrosse and the Navy's Bullpup. This one instrument covers all needs from 1/2 MC to 1200 MCS, for IF's, radar, video, telemetering and communications!



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Industrial Products Division



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.25 volt RMS on VHF - .5 volt RMS on UHF!

*WIDE SWEEP WIDTHS!

VHF - 100 KC to 400 MCS.
UHF - 100 KC to 40% or more of C.F.

*FLAT OUTPUT!

Flat to $\pm .5$ db on
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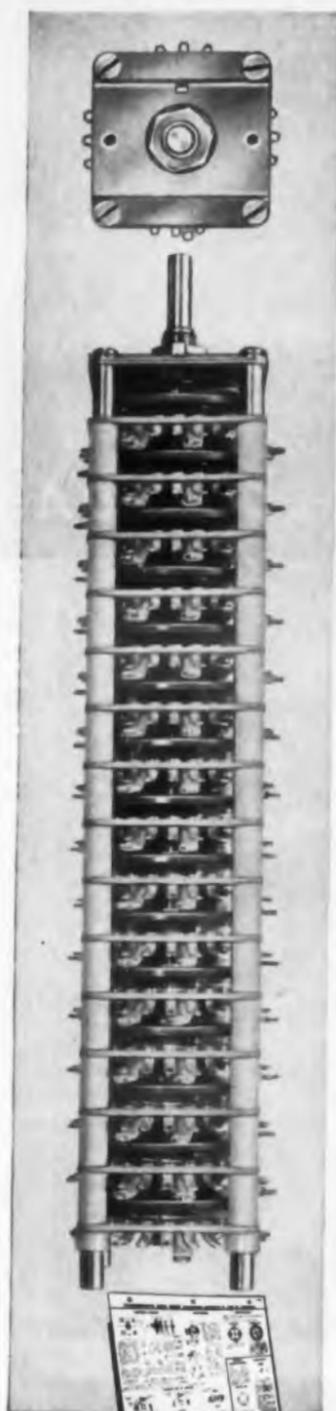
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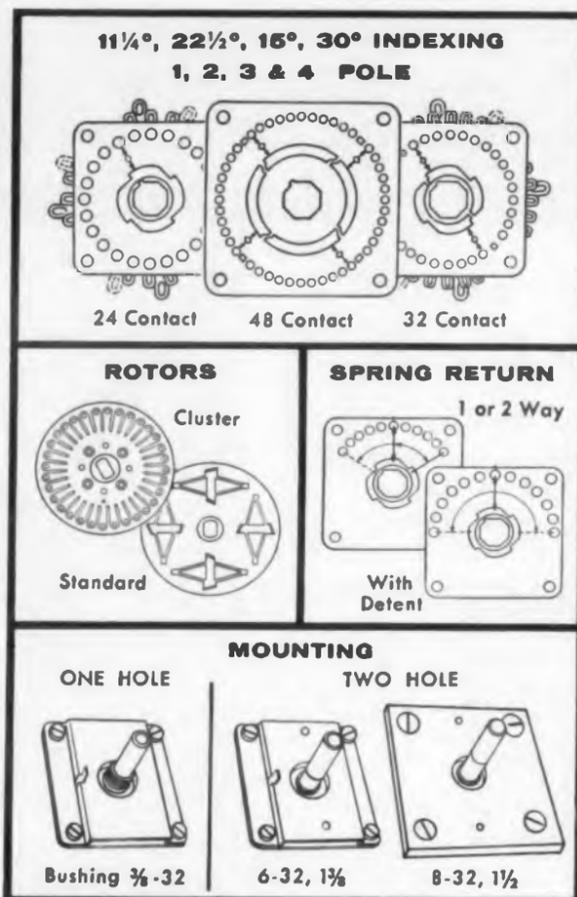
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ELECTRICAL SPECIFICATIONS: Operating Voltage—to 2000 volts; Breakdown Voltage—to 3000 volts; Breaking Current—5 amp @ 125 V. ac.; Carrying Current—15 amp.

Write for complete specifications on the new Shallcross "Miniature Series".

Shallcross

SHALLCROSS MANUFACTURING COMPANY, 4 Preston St., Selma, N. C.

CIRCLE 132 ON READER-SERVICE CARD

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., 450 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.

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CIRCLE 138 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959

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.



*Gertsch CRT-3 Subminiature Coaxial RatioTran**

- ONLY 2½" IN DIAMETER
- ACCURATE TO 0.001%
- QUALIFIED TO MIL SPECS

EXCELLENT PERFORMANCE. This Gertsch AC voltage divider, has inherent characteristics of high input impedance, low effective output impedance, and very low phase shift. Input voltage: 0.35 f (f in cps) or 140-volt max at 400 cps. Frequency range: 50 to 10,000 cps. Unit is ageless, requiring no calibration tests. Performance approaches that of the ideal divider.

MANY TYPES. Subminiature RatioTrans are available with 4-place, 5-, and 6-place resolution, and in a wide variety of decade arrangements. Available either servo mount or flange mount. Complete data sent on request. Bulletin CRT-3. Or contact your Gertsch representative.

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CIRCLE 145 ON READER-SERVICE CARD

SHOCK	50 G's - 7 ms
VIBRATION	
OPERATING:	MIL STD 167, Type I
NON-OPERATING:	MIL E-4970, Proc. III
SALT SPRAY:	MIL E-5272A
DRIP PROOF:	MIL STD 108
FUNGUS:	MIL E-5272
HUMIDITY:	MIL STD 202A
HIGH TEMP.	
OPERATING:	+ 52° C
NON-OPERATING:	+ 71° C
LOW TEMP.	
OPERATING:	- 18° C
NON-OPERATING:	- 54° C
DIELECTRIC	
STRENGTH:	900 V RMS, 60 cps



Now you can pick the right handle design from Chassis-Trak

If you want panel handles solely for pulling your equipment from its cabinet, Chassis-Trak plain blank handles are just the ticket. But don't forget that Chassis-Trak also offers eight other handle designs to meet any tilting, locking and special installation needs.

The complete Chassis-Trak line includes handles with push button panel locks, trigger tilt controls plus positive clamp-type models for installation where extreme shock and vibration are encountered. In short, there's a Chassis-Trak handle design that fits the bill exactly no matter where or how your equipment is mounted.

Chassis-Trak handles are die cast or sand cast of aluminum alloy. Chip resistant finish is aluminum slurry baked on over a clear lacquer-base sealer. Finish has successfully passed salt spray

(1,000 hours) and humidity (200 hours at 100%) tests. Offset design permits maximum use of panel space. All handles furnished complete with hardware and mounting instructions.

All models can be finished to your specification. Get details from Chassis-Trak engineers.

Chassis-Trak "Detent" slide, shown in one of seven different tilting positions.



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inc.**

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525 South Webster, Indianapolis 19, Indiana

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are a must!

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MICROPOTS • MICRODIALS • INSTRUMENT MOTORS • FREQUENCY STANDARDS
CIRCLE 147 ON READER-SERVICE CARD

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.



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CIRCLE 153 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959

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.

MAKE YOUR SELECTION FROM THE 'HIGH RELIABILITY' LINE

H-H "Gray Line" RHEOSTATS

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TYPE A



TYPE AMS



TYPE AM



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Three Terminal, 25 Watt Type A Rheostats —

Functions smoothly as a rheostat or potentiometer under adverse operating conditions. Strong, corrosion resistant terminals are welded to winding form. Vitreous enamel makes wound ring integral part of refractory base.

Type AMS Rheostats with Screw Terminals

This H-H quality component is essentially the same as Type AM except for terminals which are screw type. The 25 watt AMS incorporates all the mechanical and electrical advantages of Type AM rheostat.

Three Terminal, 25 Watt Type AM Rheostats —

Rugged, compact components with excellent heat dissipating characteristics. Feature porcelain, vitreous enamel construction with resistive element wound on a flat, pure mica form within the refractory base. Circuit elements fully insulated from other parts.

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Comply with MIL-R-22 Specifications. H-H high temperature enamel provides maximum safety under overloading. Bus-bar design for ample resistance and safety at maximum current. Constant pressure contact assures trouble-free operation.

Ruggedized H-H Resistors — Hardwick, Hindle Gray Line Resistors are available in fixed, adjustable, ferrule and axial lead types for all commercial and military applications. Super-rugged design assures complete dependability. All rheostats available with detent "off" position and solderless quick-connect terminals.

Available Nation-wide at authorized H-H distributors. Call or write for catalogs and complete information.



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KEEP TRANSISTORS COOL

Keep transistors at or below maximum operating temperatures with these new Birtcher Transistor Radiators. Provides the transistor with its own heat sink and a greatly increased radiating surface. Easy to install in new or existing equipment. Modifications to fit hundreds of popularly used transistors.



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C1430 Series

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 - Miniature size
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Also available in . . .

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NEW LITERATURE

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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.

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L-F Dynamic Coefficients
of Vacuum-Tubes
and Transistors

MEASURES:

Forward and reverse-voltage amplification factor, resistance and transconductance of tubes; dial settings read directly to 3 figures — independent measurement of each parameter. Determines short-circuit conductance parameters of transistors including h_i hybrid parameter and forward-reverse voltage ratios including h_r hybrid parameter. The h_r factors can be determined — other parameters calculated from short-circuit parameters.

Highly accurate bridge for evaluating tube coefficients and most transistor I-f parameters, for the designer and the production line.

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ELECTRONIC DESIGN • August 5, 1959

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

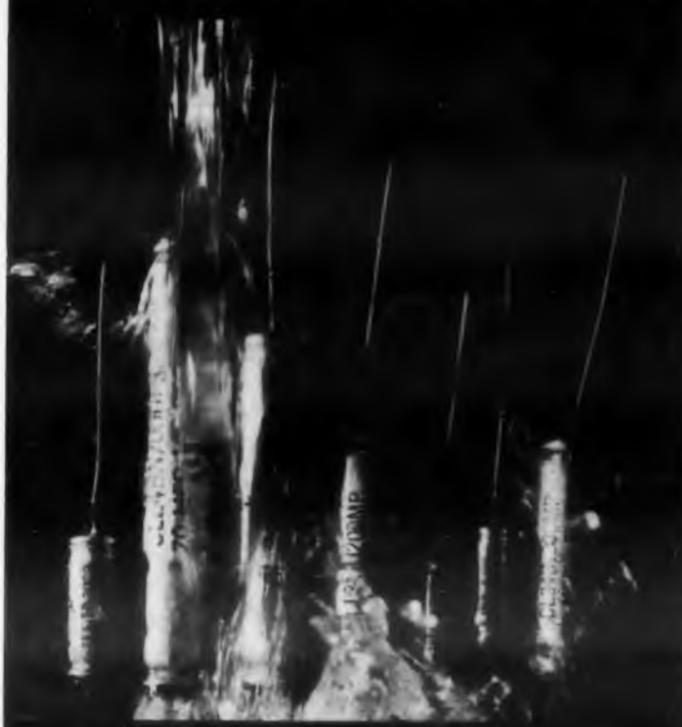
Instrument chopper catalog, eight pages, gives a complete glossary of chopper terms, and component electrical and physical specifications. Also included are technical descriptions of chopper test and evaluation equipment. James Vibrapowr Co., 4050 N. Rockwell St., Chicago 18, Ill.

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.

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TANSITOR TANTALUM CAPACITORS

Although every TANSITOR capacitor has passed the rugged MIL-C-3965 C salt water test, with flying colors, it's possible that after 50-100 years one might break down. Our replacement rate last year for all causes, however, was only 0.001%. So, if you want *reliability* in your tantalum capacitors for shipboard or airborne electronic equipment, we suggest you check with us.

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- -55 to +125 C operating range at 150 volts or less in wide range of capacities
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- Non-corrosive electrolyte
- Etched or plain, polar or non-polar
- Long shelf life at -65 C

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NEW MINIATURE LIGHTED Push Button Switch

With independent lamp circuit.

Normally open, momentary contact. NE2B neon lamp circuit independent of switch for maximum flexibility. Rated

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Life expectancy 500,000 operations.

3/8" dia. — 1 1/4" behind panel. 3/32 threaded

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PIONEERS IN MINIATURIZATION

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How KPR* helps you make etched circuits

*Kodak Photo Resist

If you manufacture etched circuits for electronic equipment, you'll like KPR. Fast and easy to use, stable, durable, it is an all-plastic, pre-sensitized, liquid surface coating. Here's how it works...

- (1) Clean metal thoroughly; a power brush saves time here.
- (2) Easiest way to get rid of oxides after scrubbing is with acid rinse.
- (3) Then, coating is easy with KPR. You can spray, dip, or use a whirler. KPR is so stable you can coat plates months in advance, without affecting exposure times.
- (4) Exposure times are short on any metal. Use arc lights, or ultraviolet. Your exposure time stays constant, even through atmospheric changes, protects you against makeovers.
- (5) Rapid, continuous processing can be done in vapor-spray degreaser for economy on large runs—in tanks or trays on shorter runs.
- (6) Use standard copper etching techniques with ferric chloride. KPR protects panel surface image during fabrication, then strips off clean when panel is "skated" on tin-lead solder, leaving excellent solder joints.

There's full information in a new booklet titled "Industrial Uses of Kodak Photo Resist"—yours free for the asking.

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FOR ALL PHASES
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TESTING...YET
LOW IN COST!**



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**±0.1% TOLERANCE
MINIATURIZED**

OVER 50% SMALLER AND LIGHTER THAN OTHER
STANDARDS OF COMPARABLE ACCURACY



By quick and easy insertion of ARCO standard capacitors into the adapter jig, a capacitance value of four significant figures with an accuracy of $\pm 0.1\%$ is obtained.

ARCO electronics inc.

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Complete set of 32 precision standards ranging from .0001 to .5 mfd. Includes handsome durable carrying case (11 $\frac{1}{2}$ " w x 9 $\frac{3}{8}$ " h x 3 $\frac{3}{8}$ " d) plus a 4-position adapter.



SPECIFICATIONS:
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5000 megohm-microfarads or 50,000 megohms, whichever is the lesser.

TEMPERATURE COEFFICIENT
.0001 to .1 mfd.
+40 ± 15 ppm/ $^{\circ}$ C.
0.2 to 0.5 mfd.
-130 ± 10 ppm/ $^{\circ}$ C.

MAXIMUM VOLTAGE
.0001 to 0.04 mfd.
500 volts peak.
.05 to 0.5 mfd.
300 volts peak.

DISSIPATION FACTOR
.0001 to .0004 mfd. - 0.15%
.0005 to .001 mfd. - 0.1%
.002 to 0.5 mfd. - 0.05%

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CAPACITORS MAY BE
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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.

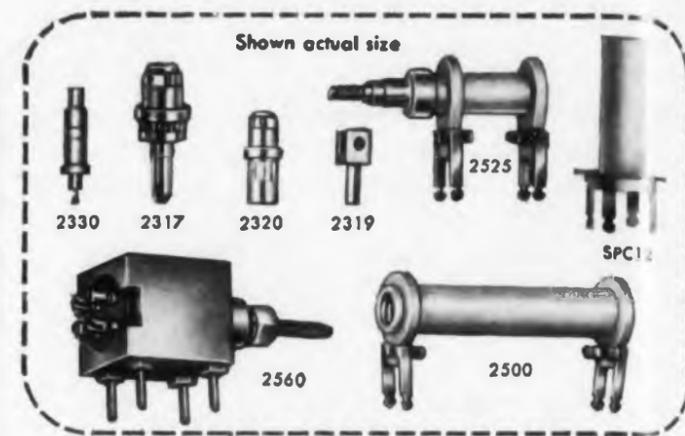
Ultrasonic Switches

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.



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But CAMBION® Printed Circuit Components are built to withstand the constant shock and vibration so common in today's electronic equipments. From printed circuit connectors to shielded coil forms, they're made from finest quality materials . . . processed and tested under thorough quality control methods . . . unconditionally quality guaranteed.

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CIRCLE 184 ON READER-SERVICE CARD

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Write for Bulletin UE

CIRCLE 185 ON READER-SERVICE CARD
ELECTRONIC DESIGN • August 5, 1959

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.

Hi-G Inc. brings you news about SHOCK... VIBRATION... and AC type RELAYS

There's an **AC RELAY** for every DC RELAY in the complete Hi-G line

Hi-G — manufacturers of the only complete line of balanced rotary relays — now offers an AC type relay equivalent to every DC relay. The AC relays — like DC types — are designed by Hi-G for reliable performance with the amazing **BALANCED ROTARY ARMATURE** which assures smooth, efficient, chatter-free performance even under conditions of extreme shock and vibration.

For more facts, write for complete new catalog No. 259



HI-G SHOCK AND VIBRATION RESISTANT RELAYS

SM SERIES	AC TYPES — SMR • SMRP • SMANR • SMAR • SMARP DC TYPES — SM • SMP • SMAN • SMA • SMAP	CONTACTS: SPDT or DPDT, Standard rating 2 amps resistive at 115 V AC or 28 V DC. VIBRATION: 5-2000 cps at 20 G, standard. SHOCK: 50 G, 11 ms operating, standard.
SL SERIES	AC TYPES — SLR • SLRP • SLANR DC TYPES — SL • SLP • SLAN	CONTACTS: 1 to 4 pole form C., Standard rating 3 amps resistive at 115 V AC or 28 V AC. VIBRATION: 5-2000 cps at 20 G, standard. SHOCK: 50 G, 11 ms operating, standard.
E SERIES	AC TYPES — ER • ESR • ESSR DC TYPES — E • ES • ESS	CONTACTS: SPDT or DPDT, Standard rating 2 amps resistive at 115 V AC or 28 V DC. VIBRATION: 5-2000 cps at 10 G, standard. SHOCK: 30 G for 11 ms operating, standard.
S & R SERIES	AC TYPE — R DC TYPE — S	CONTACTS: 1 to 4 pole, form C., Standard rating 4 amps resistive at 115 V AC or 28 V DC. VIBRATION: 5-2000 cps at 20 G, standard. SHOCK: 50 G, 11 ms operating, standard.
MS SERIES	AC TYPE — MSR DC TYPE — MS	CONTACTS: SPDT or DPDT, Standard rating 2 amps at 115 V AC or 32 V DC. VIBRATION: 5-2000 cps at 10 G, standard. SHOCK: 30 G for 11 ms operating, standard.
NOTE: Standard AC coils supplied with silicon rectifiers, mounted internally, in either one-half wave or full wave configurations.		SHOCK: Units available to pass MIL-S-901B, 1000 G shock.

Hi-G Hi-G INC. • BRADLEY FIELD • WINDSOR LOCKS • CONNECTICUT • TEL: NATIONAL 3-2481 • TWX: 562

CIRCLE 191 ON READER-SERVICE CARD

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 μ amp 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 μ v 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 cm² 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 μ f 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

WHY USE TWO?



WHEN ONE **JFD** LC TUNER WILL DO!



The versatile new JFD LC Tuner combines the characteristics of a precision variable capacitor and a metallized inductor. Its unique miniaturized construction helps effect compact electronic packaging to meet space challenging demands . . . affords higher reliability, faster assembly, and greater economy in prototype design or production.

A wide selection of 12 LC Tuners (in panel and printed circuit mounting types), each offering a large range of resonating frequencies, meet most circuitry requirements. If our standard line does not meet your needs, our engineering staff will be glad to design LC Tuners that suit your individual circuit specifications.

Model	Typical LC Tuners Now Available		
	Self Resonating Frequency Range	Length Above Panel	Diameter
LC303	450-700 MC	.635	5/16"
LC304	300-500 MC	.845	5/16"
LC306	200-450 MC	1.104	5/16"
LC309	125-200 MC	1.691	5/16"

Write for Bulletin 216 for further facts. Include your current design or performance problems for specific recommendations.

JFD

Pioneers in electronics since 1929

ELECTRONICS CORPORATION

1462 62nd Street, Brooklyn, New York

JFD Canada Ltd.
51 McCormack St.
Toronto, Ontario, Canada

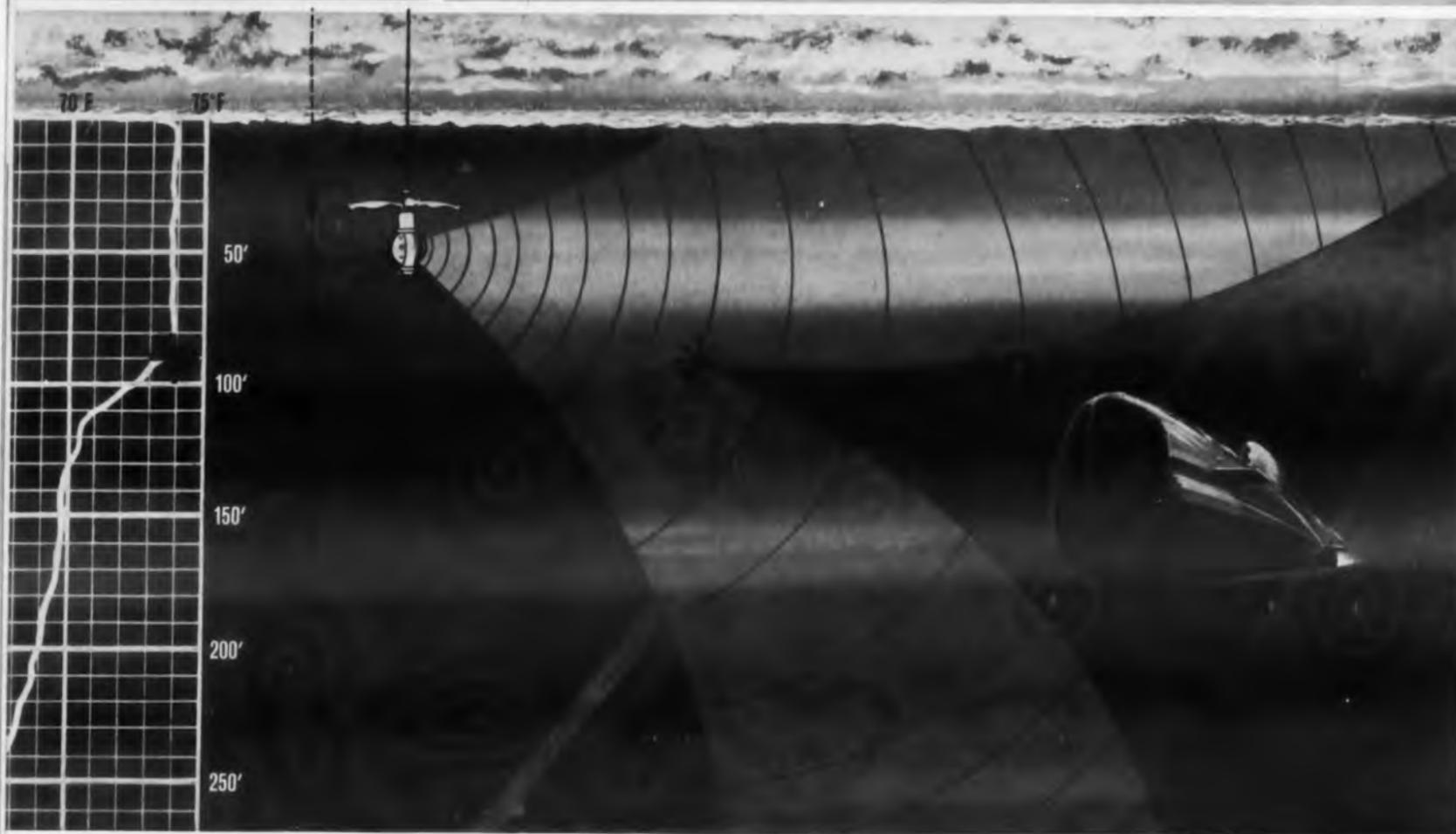
JFD International
15 Moore Street
New York, New York

PHONE DEWEY 1-1000

CIRCLE 197 ON READER-SERVICE CARD

idea:

Submarines can hide within range of helicopter-borne sonar by "riding the thermocline"—a water temperature change that casts shadows in sonar search patterns. Precise temperature-vs.-depth records allow the operator to spot thermoclines and change his search pattern to look into the shadows. Existing gear "worked", but it took too long and could not define the shadow zones very accurately. TI engineers created an automatic recorder, the **bathythermograph**, more accurate than a laboratory thermometer, that gives results instantly where they were needed—in the helicopter. Small as a portable typewriter, it easily fits with the sonar into the space available. **RESULT: Same sonar—fewer missed submarines.**



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YOUR SPECIAL TOUCH with unsolved problems buys you a solid future in any of Texas Instruments major military programs — Antisubmarine Warfare, Heavy Surface Radar, Missile Systems, or Electronic Surveillance. For example, you can try your hand at solving the Navy's clearly stated ASW requirement: Build something that will detect and classify a fast-moving submerged submarine at depths of 1500 feet, more than 50 miles from your aircraft.

Your experience in one of the following technologies may find immediate application in one of our four major programs:

radar • sonar • infrared • magnetic anomaly detection • passive detectors • servos • navigational systems • special-purpose computers • timers • programmers • microwave • telemetering • data link • optics • video mappers • visual displays • intercom

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write for your copy



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 $\pm 8\%$.

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., Capatron 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 μ a

Model PS-28 high voltage power supply produces 16 kv dc at 200 μ a 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 CARD

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 push-button 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

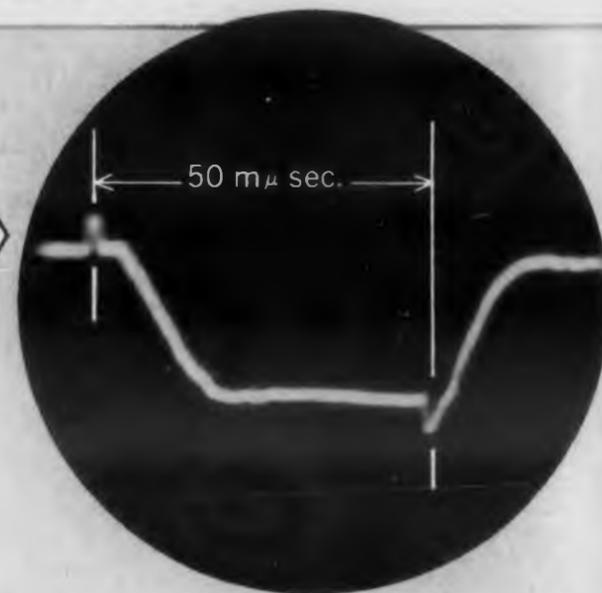
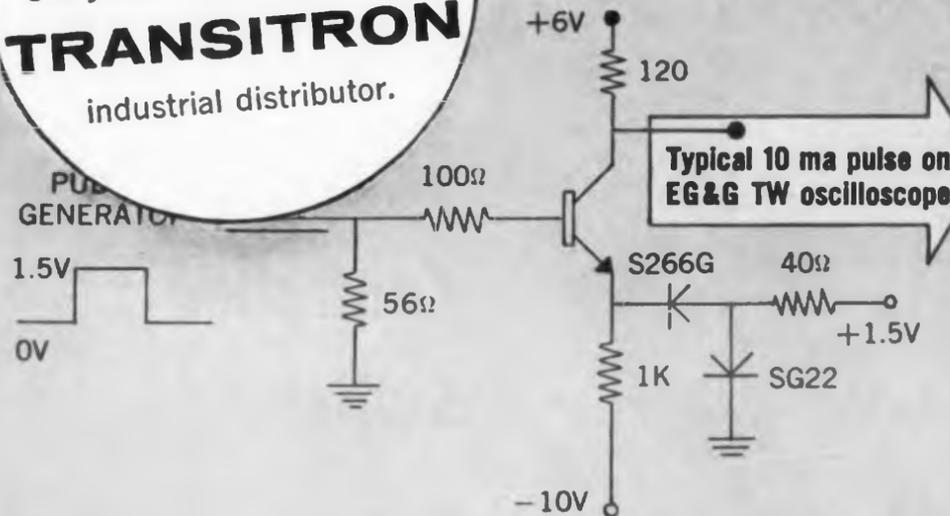
CIRCLE 204 ON READER-SERVICE CARD

CIRCLE 205 ON READER-SERVICE CARD

FIRST SILICON TRANSISTORS WITH 150 Mc Alpha Cutoff PLUS POWER

**PRICE
REDUCTION!**

See your nearest authorized
TRANSITRON
industrial distributor.



ABSOLUTE MAXIMUM RATINGS

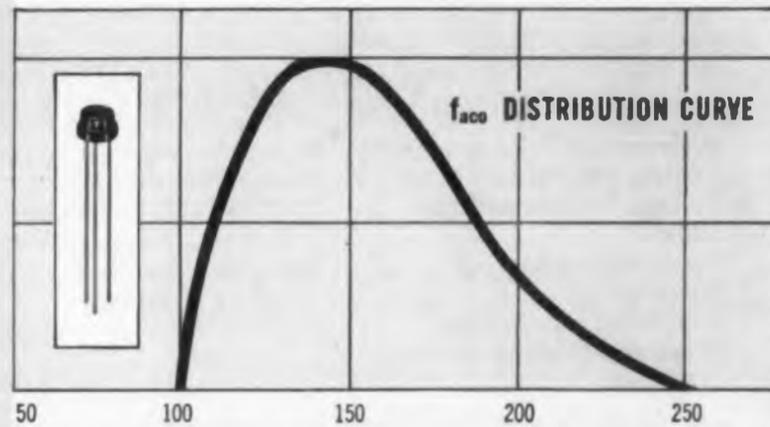
Collector to Emitter Voltage — V_{CE}	15 Volts
Collector to Base Voltage — V_{CB}	15 Volts
Emitter to Base Voltage — V_{EB}	3 Volts
Total Power Dissipation: at 125°C Case Temperature	.5 Watts
at 100°C Amb. Temperature	0.5 Watts

SPECIFICATIONS AND TYPICAL CHARACTERISTICS AT 25°C

	Min.	Typical	Max.	Test Conditions	
D.C. Current Gain	h_{FE}	20	40	—	$I_C = 10\text{ma}$, $V_{CE} = 6\text{V}$
D.C. Collector Saturation Voltage	V_{CE}	—	.5	0.6V	$I_C = 10\text{ma}$, $I_B = 2\text{ma}$
Collector Cutoff Current	I_{CO}	—	2	$5\mu\text{a}$	$V_{CB} = \text{Rating}$
Output Capacitance	C_{ob}	—	8	$12\mu\text{f}$	$V_{CB} = 6\text{V}$, $I_E = 0\text{mA}$
High Frequency Current Gain	h_{fe}	5	7.5	—	$F = 20\text{mc}$, $V_{CE} = 6\text{V}$, $I_E = 10\text{mA}$
Delay Time	t_d	—	6	$\text{m}\mu\text{sec.}$	
Rise Time	t_r	—	12	$\text{m}\mu\text{sec.}$	
Fall Time	t_f	—	10	$\text{m}\mu\text{sec.}$	

Here's a silicon logic transistor with the speed of the fastest germanium types . . . **PLUS POWER HANDLING ABILITY!** Transitron's 2N1139 represents a giant step forward in transistor technology, augmenting the industry's most complete line of silicon transistors. Typical total switching times average less than 30 milli-microseconds.

Transitron's fast switching types now cover the entire current range up to 5 amperes — offer a rugged silicon transistor for every switching application.



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Transitron

electronic corporation • wakefield, massachusetts

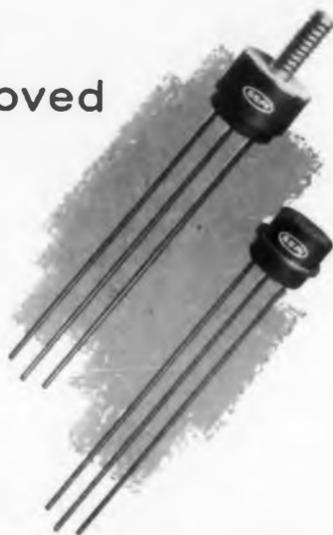


**... a new approach
in solving tough
switching problems**

which can result in
significant miniaturization

- higher reliability • improved circuit performance

SSPI



**Silicon PNP
Controlled
Switch**

- OPERATING CURRENT RANGE 10 - 1000 mA
- 0.1 mA TYPICAL GATE CURRENT TO "FIRE"
- VOLTAGE RATINGS TO 200 V
- "TURN ON" TIME TYPICALLY UNDER 0.2 μSEC
- LOW "ON" VOLTAGE, TYPICALLY UNDER 2 V
- OPERATION TO 150° C
- MINIATURE SIZE, IN TO-9 PACKAGE
- MECHANICALLY RUGGED

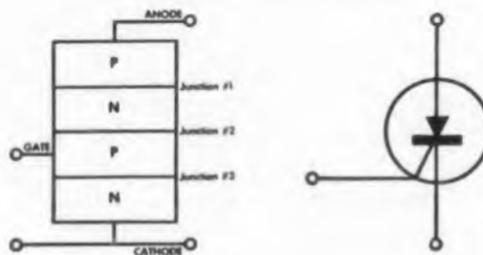
Within their power ratings, the PNP controlled switches can replace thyratrons, magnetic amplifiers, relays, vibrators, mechanical switches, diodes, transistors and unijunction transistors in a wide variety of applications, including:

High current pulse generation	High gain proportional control
Timing, time delay	Servo motor driving
Voltage limit detection	D. C. to D. C. conversion
Logic	D. C. to A. C. conversion
Static switching,	High voltage pulse &
Static relays	sweep generation
Controlled rectification	Modulation
Relay and solenoid driving	

Available now through your local SSPI representative
or by contacting the factory direct.

Current gains to 5000 and power gains to 500,000 can be achieved at output current levels as high as 1000 mA. Peak pulse currents up to 20 amperes are possible for low duty cycle pulses of 10 microseconds or less duration. The unique "latch-on" properties of the Silicon Controlled Switch permit low level pulse turn on control which frequently gives major circuit simplification.

This versatile new component is particularly useful for squib firing, time delay static relays, warning and protective systems, beacon and radar modulators, core switching, power supplies, and control instrumentation.



Write for Bulletin C420-01

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 μsec; rise time is 10 μsec 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 μ a 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 feed-through 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.

Kotron Manufacturing Co., Dept. ED, Woodstock, N.Y.
Booth 2810-2812

CIRCLE 212 ON READER-SERVICE CARD

CIRCLE 213 ON READER-SERVICE CARD

Recipe for ferrite dependability: SPERRY



Controlled material is key to the repeatability of ferrites and other solid state devices.

New Ferrite Isolators From Sperry

ELIMINATES EXTERIOR MAGNETS

ACTUAL SIZE
MODEL 44L33

TYPICAL SPECIFICATIONS

	Model 44L11	Model 44L33
Frequency Range	1250-1365 mc	1700-2400 mc
Isolation	min 12 db max 15 db	min 13 db max 20 db
Insertion Loss	min 0.5 db max 0.8 db	min 0.6 db max 1.0 db
Average Power	10 w	10 w
VSWR	min 1.05 max 1.15	min 1.04 max 1.20
Weight	max 1 lb.	max 1/2 lb.
Dimensions	diameter (max) 1 1/2 in. insertion length 11 1/2 in.	diameter (max) 1 in. insertion length 10 1/2 in.
Connectors	input Type N male output Type N female	input Type N male output Type N female

New ferrite isolators which eliminate the need for bulky external magnets are now available in S_c and L bands for relay and radar systems applications.

These new slim isolators take up no more room than reciprocal attenuators and are one-fourth the weight and volume of conventional isolators.

An entirely new principle uses a small internal magnet, compact enough to fit within the coaxial envelope. The whole field of this magnet is utilized, thereby controlling the ferrite material more effectively than is possible with large conventional magnets.

Stray magnetic fields are reduced to a negligible value for most applications. These isolators, with their well protected magnets, will exhibit an extremely long shelf life even when stored in the proximity of other magnetic material.

Samples available for evaluation in system breadboards or prototypes.

***465**

SPERRY

dressen-barnes

BOOTH 2221

DESIGNERS AND MANUFACTURERS OF DC POWER SUPPLIES

WESCON



PREVIEW!

NEW TRANSISTORIZED 5 AND 10 AMP DC POWER SUPPLIES

CALIBRATED ADJUSTABLE OVERLOAD PROTECTION
OUTPUT: 1/2 to 32 VDC, 0 to 10 AMPS.

RIPPLE: Less than 1 MV

REGULATION: Line, less than 18 MV; Load, less than 18 MV

MODEL 62-142 (ILLUSTRATED)

DIMENSIONS: 19 in. W, 8 1/2 in. H, 16 in. D.

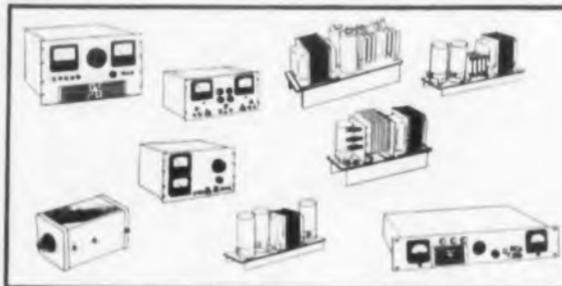
MODEL 62-141

Same as Model 62-142 except: 0 to 5 amps Output; 7 in. H.



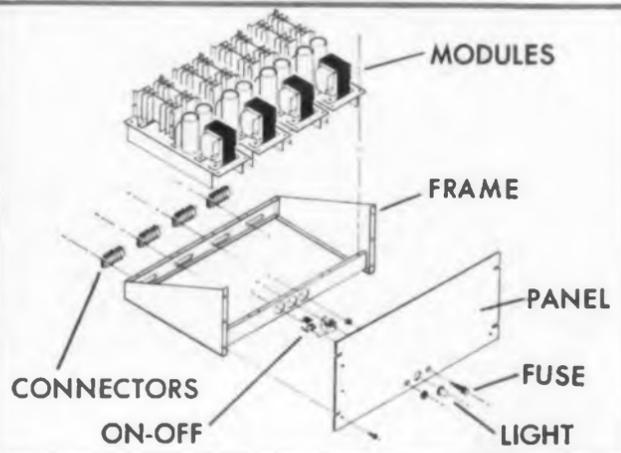
SOLID STATE, ELECTRON TUBE, MAGNETIC AMPLIFIER & UNREGULATED STANDARDS ON DISPLAY

Several D/B standard DC Power Supplies will be on display and in operation. The standard line includes 70 units — Modular, Rack or Bench Mounting and Plug-In construction. Hundreds of modified standards are also available. The power supply you are designing may be available as a D/B modified standard. Circle the number below on the reader service card for new catalog.

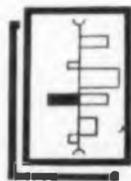


NEW MOUNTING KIT FOR D/B MODULAR SUPPLIES

The Model 70-101 Rack Mounting Kit facilitates the combining of D/B DC modular power supplies to provide hundreds of combinations of multiple outputs. One kit will mount up to four modules. The D/B standard line includes a wide range of modularized DC power supplies, many of which will be on display at Wescon.



D/B DC power supplies are manufactured by skilled craftsmen using advanced production methods. Quality is built-in at every stage of production. Specialized test and run-in facilities guarantee long trouble-free operation.



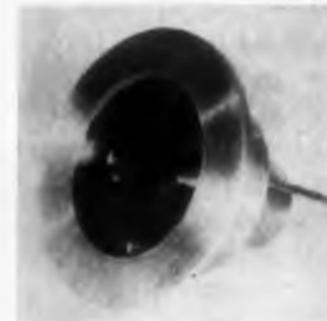
WESCON LITERATURE

Your 1959 Wescon literature will be mailed to you if you will turn to the reader service card and circle the number below.

DRESSEN BARNES CORPORATION, 250 N. VINEDO AVE., PASADENA, CALIF., MU 1-0643, TWX: PASA CAL 8499

CIRCLE 214 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON



Miniature Fan

Produces 45 cfm at 17,000 rpm

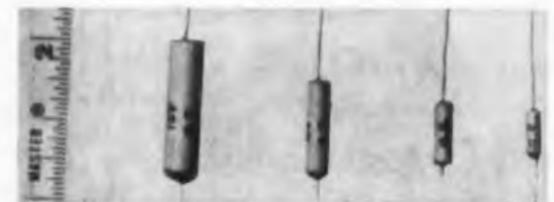
Model F2-17 miniaturized fan produces 45 cfm of air at 17,000 rpm. Powered by a 28 v dc motor, it is designed for electronic or avionic applications. It measures less than 2 in. in diam and 2 in. in length.

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 μ f 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

ELECTRONIC DESIGN • August 5, 1959

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

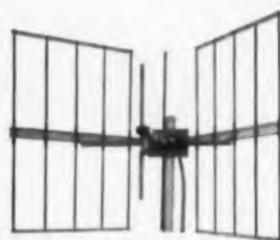
This gain set allows for precise measurement of gain, loss, swr or other properties of a microwave system from as low as 0.025 to 95 db. It consists of four components placed on separate rack panels. Preamplifier 621-A has an insertion gain adjustable between 45 and 50 db; input and output impedances 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 $\pm 10\%$, 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



ENLARGED VIEW OF ONE CORNER REFLECTOR ELEMENT

LONG RANGE REMOTE CONTROL

ANDREW engineers regularly solve difficult antenna problems. An example is the 32-element array recently designed for The Trans-Arabian Pipe Line Company for long range communication and control.

REQUIREMENT: A 160 mc antenna system for use at four unattended radio-controlled gas-turbine pumping units located 60 to 100 miles away from the main pump stations along 754 miles of pipeline. Minimum forward gain of 20 db over a dipole and maximum VSWR of 1.5 across 156-174 mc band were required. Existing towers dictated that the design feature minimum weight and wind loading together with maximum mechanical stability.

SOLUTION: ANDREW engineers specified, designed, and produced a rectangular array of 32 aluminum corner reflectors that met all electrical and mechanical requirements of this system for telemetry, control, and voice communication.

Installations like this demonstrate our ability to handle difficult antenna assignments. ANDREW engineers are ready to apply their know-how to your antenna system problems.

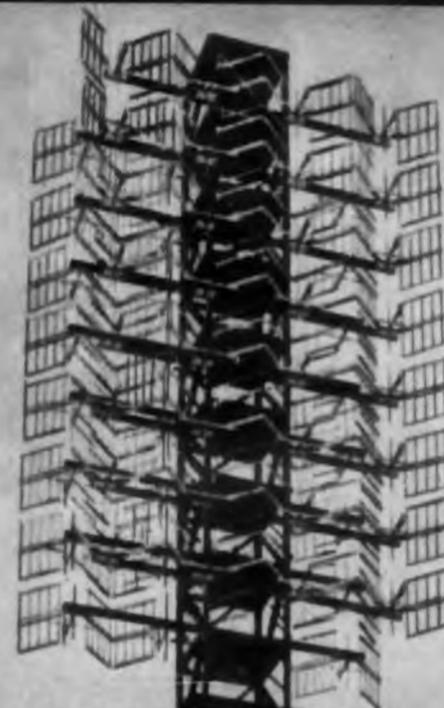
Andrew
CORPORATION

363 EAST 75TH STREET • CHICAGO 19
New York • Boston • Los Angeles • Toronto



Visit Andrew Booth No. 2001 at the WESCON Show.

ANTENNAS • ANTENNA SYSTEMS • TRANSMISSION LINES



WHY ENCAPSULATED?

Up to 250 KVA and no bulky case! Electro builds high reliability high power into half the size...half the weight. But this is no ordinary open coil construction—the coils are thin and solid...100% encapsulated with epoxy inside and out...sealed completely against dirt, damp and damage. One result: Fast cooling with high overload capacity for built-in reliability... temperature rise is 50% less! Another: Less size and weight simplifies equipment packaging...permits smaller cabinets and more efficient layout. Get the whole story of *Electro* encapsulateds for heavy-duty industrial applications (Class A or B); or on *HR/Epsal* ultracapsulateds for extreme environments (Mil-T-27A Grade 5 Class T). Electro engineers to your requirements... from microwatt to megawatt.

ENCAPSULATED HIGH POWER TRANSFORMERS

SEE WESCON BOOTH 2514

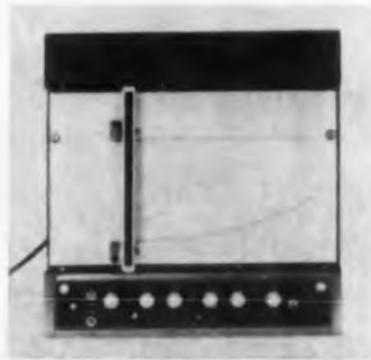
Opportunities for Experienced Transformer Engineers. Write to Personnel Manager

ELECTRO
high reliability transformers

ELECTRO ENGINEERING WORKS, 401 PREDERSTREET, SAN LEANDRO, CALIFORNIA

CIRCLE 222 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

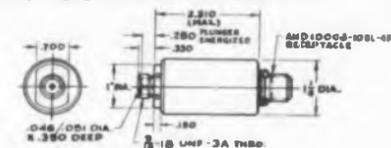
SPECIAL REPORT ON 400 CYCLE SOLENOIDS:



**400 Cycle AC Solenoid
With Internal Rectifiers
Developed by PSP**

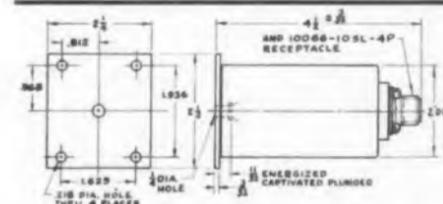
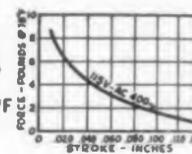
AC Solenoids using internal rectifiers, the most efficient approach to the 400 cycle problem, are now being manufactured by PSP Engineering Company, Maywood, California. Rectified 400 cycle solenoids gain the efficiency of an AC transmission system, yet retain the magnetic efficiency of DC solenoids, are quiet in operation, and lend themselves to pressurization better than AC types.

The PSP 400 cycle solenoids are manufactured in general accordance with MIL-S-4040C and meet the environmental requirements of MIL-E-5272B and MIL-E-5400C. Following are general specifications on two types of PSP 400 cycle solenoids and their accompanying performance curves:



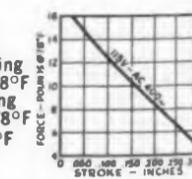
AC PULL, SINGLE COIL CONSTRUCTION

PART NO. 13SD769-1
VOLTAGE: 112 to 118 VAC.
RANGE: 400 cycle continuous duty
CURRENT: 0.1 amp @ 115 VAC @ 78°F
DRAIN: VAC @ 78°F
TEMP. RANGE: -65°F to +250°F
WEIGHT: Unit 7.8 oz
Plunger 0.34 oz



AC PUSH, TWO COIL CONSTRUCTION

PART NO. 20SD820-1
VOLTAGE: 98 to 115 VAC
RANGE: 400 cycle continuous duty
CURRENT: 0.9 amp actuating @ 115 VAC @ 78°F
DRAIN: 0.09 amp holding @ 115 VAC @ 78°F
TEMP. RANGE: -65°F to +125°F
WEIGHT: Unit 28 oz
Plunger 2.0 oz



Information on PSP solenoids, as well as complete information on synchro components and step-servo motors manufactured by our company, is available when requested on company letterhead.

PSP engineering company

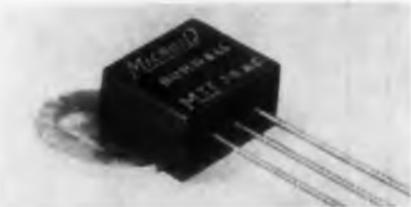
**SOLENOIDS DIVISION OF
IMC MAGNETICS CORP., N.Y.**
6060 Walker Avenue, Maywood, California
LUdlow 3-4785

Representatives in principal cities

CIRCLE 225 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 $1/2 \times 19/32 \times 15/16$ 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 hobbin; 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 $\pm 10\%$ or $\pm 20\%$ 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

.005 μ sec. to 5,000 μ sec.

ESC DELAY LINES TAKE GIANT STEPS!



From the smallest to the largest—.005 μ sec. to 5,000 μ sec.—ESC's research staff has custom-designed delay lines for virtually every military and commercial application! And with every delay line prototype comes a comprehensive laboratory report, which includes submitted electrical requirements, photo-oscillograms (which indicate input and output pulse shape and output rise-time), the test equipment used, and an evalu-

ation of the electrical characteristics of the prototype.

In addition, an extensive factory rep organization spans the nation, ready to provide on-the-spot assistance in specification and installation.

For complete technical data, write to ESC—America's leading manufacturer devoted to the design, development and production of custom-built and stock delay lines!



ESC

WRITE TODAY FOR COMPLETE TECHNICAL DATA.

exceptional employment opportunities for engineers experienced in computer components... excellent profit-sharing plan.

SEE YOU AT THE WESCON SHOW—BOOTH #1513

534 Bergen Boulevard, Palisades Park, New Jersey

Distributed constant delay lines • Lumped-constant delay lines • Variable delay networks • Continuously variable delay lines • Pushbutton decade delay lines • Shift registers • Pulse transformers • Medium and low-power transformers • Filters of all types • Pulse-forming networks • Miniature plug-in encapsulated circuit assemblies

CIRCLE 229 ON READER-SERVICE CARD

MOTORIZED
Adjust-A-Volt
VARIABLE TRANSFORMERS
FOR ECONOMICAL REMOTE CONTROL OPERATION



- Control Variable Voltage with Push-Button or Switch.
- Full Range Travel Speeds 6, 13, 26 and 45 seconds (60 seconds on larger units).
- 12 Basic Models—Single or up to 6 Ganged Assemblies.
- Load Ratings from: 35 to 130 KVA 115 or 230 volt input. Single phase or three phase.
- Adjust A Volts are available at attractive prices from leading jobbers.



Send for 22 page Adjust-A-Volt Catalog containing full specification and application data

Fully militarized units for 60 or 400 cycle operation are available for aircraft, shipboard and other applications. Your inquiries are invited.



STANDARD ELECTRICAL PRODUCTS COMPANY
VARIABLE TRANSFORMER DIVISION
2240 EAST THIRD STREET, DAYTON, OHIO

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 insulation 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

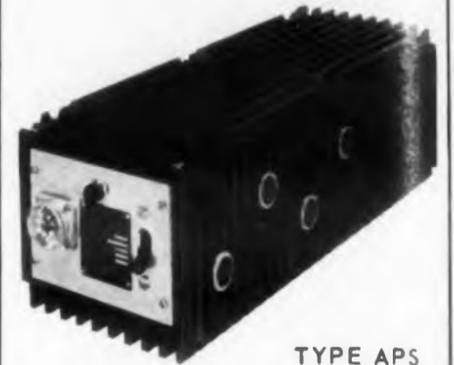
Designed for ac operation

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

Frequency Controlled
INVERTERS
 Transistorized



TYPE APS
 INVERTER

FROM
 30 VA
 UP

KILOWATTS
 with
CLOCK ACCURACY
 available to run

- CLOCKS
- SYNCHRONOUS MOTORS
- TELEMETERING SYSTEMS
- FREQUENCY DEPENDENT INSTRUMENTS

FREQUENCY TOLERANCES
 UP TO 0.005%.
HIGHER ACCURACY
 UPON SPECIAL REQUEST.

MODULAR CONSTRUCTION
 PROVIDES ANY POWER
 LEVEL THAT IS NECESSARY
 WITHOUT CUSTOM DESIGNS.

Standard Models — 60 or 400 CPS.
 Other Frequencies Upon Request.

Write for Catalog No. 4-59 MPL.

Manufactured by

ACCURATE

INSTRUMENT CO.

2418 W. Alabama
 Houston 6, Texas
 JA 3-2712

Visit our Booth 2623
 Wescon Show

CIRCLE 235 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959

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 $\pm 5\%$.

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

HIGH

POWER

SENSITIVITY



A MAJOR FEATURE OF RCA-50EH5

...a Preferred Tube Type that inspires
new designs for low-cost stereo amplifiers,
radios, and 1-tube phonographs!

Want to reduce the number of "pre-amp" tubes in your low-cost stereo-amplifier design...get more power output from a 1-tube phonograph...design good audio performance into a popular-priced radio...and reduce power-supply components as well? You can, with the RCA-50EH5 power pentode. This 7-pin miniature offers remarkably high transconductance...14600 micromhos...provides unusually high power sensitivity at very low plate and screen voltages.

Several tube features have placed 50EH5 on the Preferred Types list. The new N-132 cathode-base material minimizes interelement leakage, reduces hum and noise, increases tube reliability. An improved heater material extends heater cycling life and retards leakage. The plate material minimizes failures due to gas-current runaway. And each RCA-50EH5 is 100% tested for gas, power output, plate and screen current, hum, noise, shorts and continuity, and emission.

Visit the RCA Booth at WESCON!



RADIO CORPORATION OF AMERICA

Electron Tube Division

Harrison, N.J.

Another way RCA
serves you
through
Electronics

Typical Operation and Characteristics—RCA-50EH5

Plate-Supply Voltage	110 volts
Grid-No. 2 Supply Voltage	115 volts
Grid-No. 1 Signal Voltage	2.1 volts rms.
Transconductance	14600 micromhos
Total Harmonic Distortion	7 per cent
Max.-Signal Power Output	1.4 watts

Call or write your nearest RCA Representative for details. Ask him also about RCA-25EH5, another Preferred Tube Type. And for technical data, write RCA Commercial Engineering, Sect. H-18-DE1, Harrison, N. J.



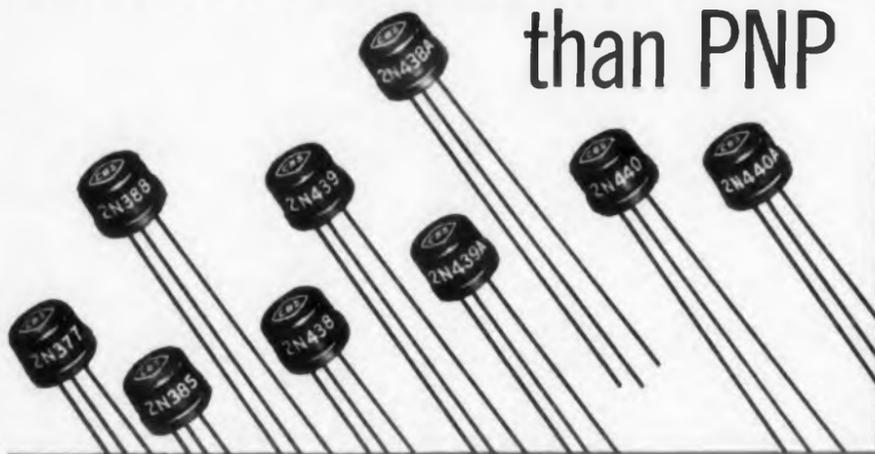
FIELD OFFICES

EAST: 744 Broad Street, Newark 2, New Jersey
Humboldt 5-3900

MIDWEST: Suite 1154, Merchandise Mart Plaza
Chicago 54, Illinois, Whitehall 4-2900

WEST: 6355 E. Washington Blvd.
Los Angeles 22, Calif., Raymond 3-8361

NPN switching transistors PROVE MORE RELIABLE than PNP



CBS NPN Switching Transistors

Type	Minimum V_{CE0} (Volts)	Dissipation (@ 25°C) (Milliwatts)	Minimum h_{FE} @ I_C (Ma)	Typical f_{ch} (Megacycles)	Application
2N306	20	50	16*	1	Audio Driver
2N312	15	75	25	10	Switching
2N356	20	100	20	100	Core Driver
2N357	20	100	20	200	Core Driver
2N358	20	100	20	300	Core Driver
2N377	25	150	20	200	Core Driver
2N385	25	150	20	200	Core Driver
2N388	25	150	30	200	Core Driver
2N438	30	100	20	50	Logic Circuit
2N438A	30	150	20	50	Logic Circuit
2N439	30	100	30	50	Logic Circuit
2N439A	30	150	30	50	Logic Circuit
2N440	30	100	40	50	Logic Circuit
2N440A	30	150	40	50	Logic Circuit
2N444	15	100	10*	1	Switching
2N445	15	100	20*	1	Switching
2N446	15	100	30*	1	Switching
2N447	15	100	50*	1	Switching
2N556	25	100	15	10	Core Driver
2N558	15	100	20	10	Core Driver
2N634	20	150	15	200	Switching
2N635	20	150	25	200	Switching
2N636	20	150	35	200	Switching
2N1000	40	150	25	100	Core Driver
2N1012	40	150	40	100	Core Driver

* h_{FE} (a.c. gain)

Operating and storage temperature, $T_j = -65$ to $+85^\circ\text{C}$

A comprehensive line of these reliable CBS NPN high-speed switching transistors is available now in production quantities. Check the table. Order types you need . . . or write for Bulletin E-353 giving complete data . . . today.

More reliable products through Advanced Engineering



semiconductors

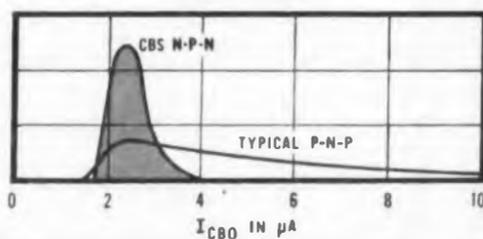
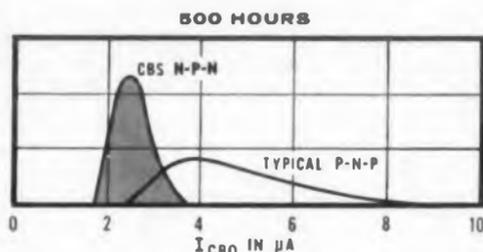
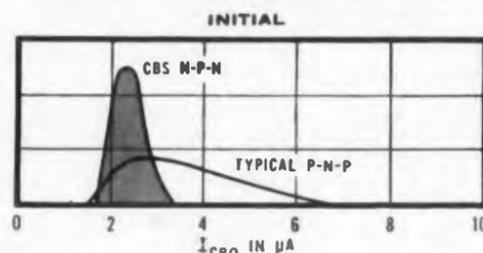
Sales Offices: Lowell, Mass., 900 Chelmsford St., GLENVIEW 4-0446 • Newark, N. J., 32 Green St., MARKET 3-5832 • Melrose Park, Ill., 1990 N. Mannheim Rd., ESTEBROOK 9-2100 • Los Angeles, Calif., 2120 S. Garfield Ave., RAYMOND 3-9081

CBS ELECTRONICS, Semiconductor Operations
A Division of Columbia Broadcasting System, Inc.

CIRCLE 239 ON READER-SERVICE CARD

Some design engineers specify PNP switching transistors because they consider them inherently more reliable. Actually NPN transistors can give you superior reliability along with their well-known higher speed. Life tests covering hundreds of thousands of CBS NPN alloy-junction germanium switching transistors proved this during the past year. See graphs comparing these transistors with typical military-approved PNP transistors.

Comparative Life Tests
NPN vs. PNP Switching Transistors.



The superiority of CBS NPN transistors is achieved by special processing: For example, advanced surface chemistry techniques seal out moisture and contamination. Precise control of alloying produces high back voltages. Thorough bake-out stabilizes gain. The result is reliable NPN computer-type switching transistors featuring fast switching . . . high voltage . . . low cutoff current . . . and low saturation resistance . . . in a welded JETEC TO-9 package

NEW PRODUCTS

Power Supplies

Deliver 30 w



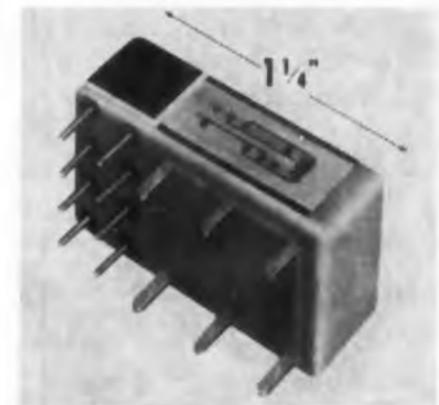
The SE series power supplies deliver 30 w with germanium transistors. Rated at 12 v from 0 to 3 amp continuous duty, the units have a voltage regulation of $\pm 0.1\%$ for both line and load. Ripple is 2 mv peak to peak and the units can be operated for moderate periods without cooling at ambients of 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 $+125^\circ\text{C}$ 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

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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

ELECTRONIC DESIGN • August 5, 1959

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

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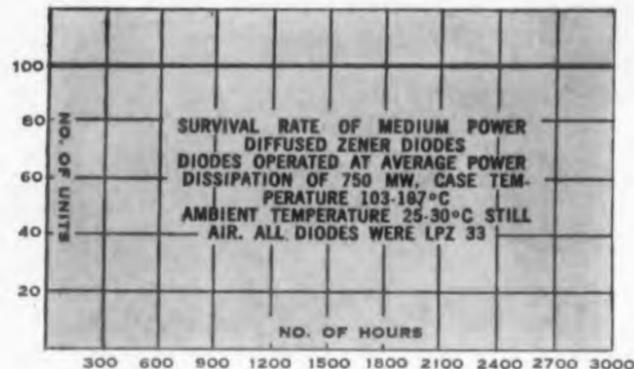
Factories in Los Angeles; Salem, Mass.; Toronto; London; Melbourne; Paris; Tokyo. Representatives and distributors in all principal cities. Please see your Telephone Yellow Book or write factory.

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.

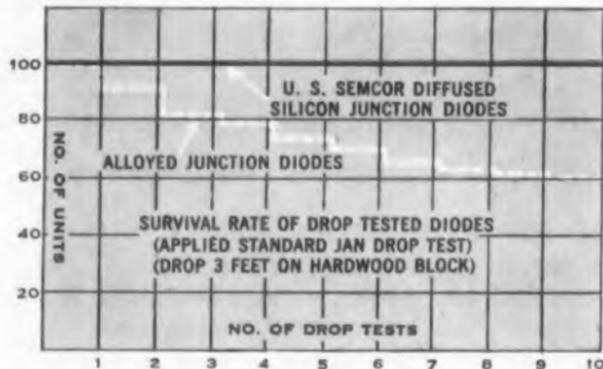
The savings to you are dramatically emphasized by test results. For example: 500 diodes accumulated approximately 2,000,000 hours in tests ranging up to 4,000 hours each of continuous operation . . . with only 8 failures! To be specific, observe the graph below, showing results for one group:



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

U. S. SEMCOR PERFORMANCE AND RELIABILITY AT LOWER COST!



- SOLID TANTALUM CAPACITORS
- HIGH POWER RECTIFIERS
- HIGH VOLTAGE RECTIFIERS
- MEDIUM POWER RECTIFIERS
- LOW POWER RECTIFIERS
- COMMERCIAL RECTIFIERS
- HIGH POWER ZENER DIODES
- MEDIUM POWER ZENER DIODES
- LOW POWER ZENER DIODES
- DOUBLE ANODE ZENER DIODES
- VOLTAGE REGULATING DIODES
- INFRARED PRISMS
- INFRARED LENSES
- INFRARED CORRECTING PLATES
- INFRARED RETICLES
- PHOTOCELL WINDOWS
- INFRARED TUBES

ACROSS-THE-BOARD PERFORMANCE... RELIABILITY... SAVINGS

Cost vs Quality? U. S. Semcor's diffused junction techniques, exacting standards of quality control, and higher yield combine to provide superior reliability at lower cost. The company's concentration of engineering brains, using precision equipment in a brand new plant, assures you of both high performance and low price. Specify U. S. Semcor for economical, reliable solid state devices.

Pure Silicon Boules and Ingots are made in production quantities by U. S. Semcor's revolutionary crystal-growing furnace. These unusually large silicon crystals make possible rugged, low cost diffused junction diodes for reliable performance under the most adverse circumstances.



U. S. SEMICONDUCTOR PRODUCTS
3540 West Osborn Road • Phoenix, Arizona • BRowning 2-1341

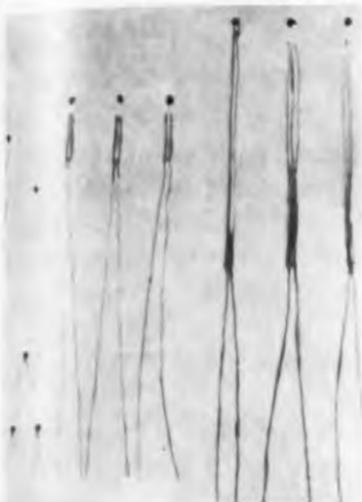
A Division of
TOPP
Industries, Inc.



SEE OUR COMPLETE LINE AT WESCON BOOTH NO. 2817-2819

CIRCLE 244 ON READER-SERVICE CARD

NEW PRODUCTS



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 $\pm 50\%$ 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

Now

A NEW 50 VOLT SUBMINIATURE PAPER CAPACITOR



WESCON Booth #2923

meets requirements of MIL-C-25A K characteristic

FOR TRANSISTORIZED APPLICATIONS

Astron's new 50 volt hermetically sealed subminiature paper capacitors have the reliability required by specification MIL-C-25A.

These units operate at temperatures from -65°C to $+125^{\circ}\text{C}$ without derating. The capacitance variation is less than $\pm 3\%$ over the entire operating temperature range. High insulation resistance, low power factor, unusually low resonance loss are combined in this new light-weight subminiature unit.

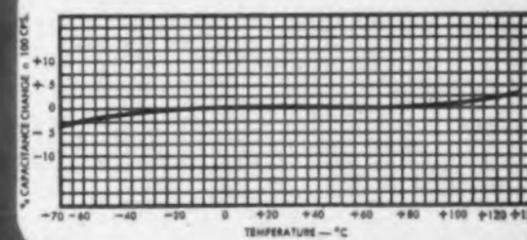
In response to a definite engineering need, Astron's new type AQF is compactly designed and offers superior performance characteristics for low voltage transistorized applications.

Write today for complete technical information.

PARTIAL LIST OF RATINGS AVAILABLE

CAP. MF	DIA. x LENGTH
0.027	.235 x 3/4
0.068	.312 x 7/8
0.1	.312 x 7/8
0.27	.400 x 1-3/8
0.47	.500 x 1-1/4
1.0	.562 x 1-5/8
2.0	.750 x 2-1/8

TYPICAL CAPACITANCE VS. TEMPERATURE



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NEW YORK, N. Y.

IN CANADA:
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& ALCHINA AVE.
TORONTO, ONTARIO

CIRCLE 247 ON READER-SERVICE CARD

New Product Announcement

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., Folcroft, Pa.
Booth 304

CIRCLE 249 ON READER-SERVICE CARD

Electronic Multiplier

Has accuracy of $\pm 0.05\%$

Model MC-701 am/fm electronic multiplier has a dynamic accuracy of $\pm 0.05\%$ 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

STEMCO TYPE MX* THERMOSTATS

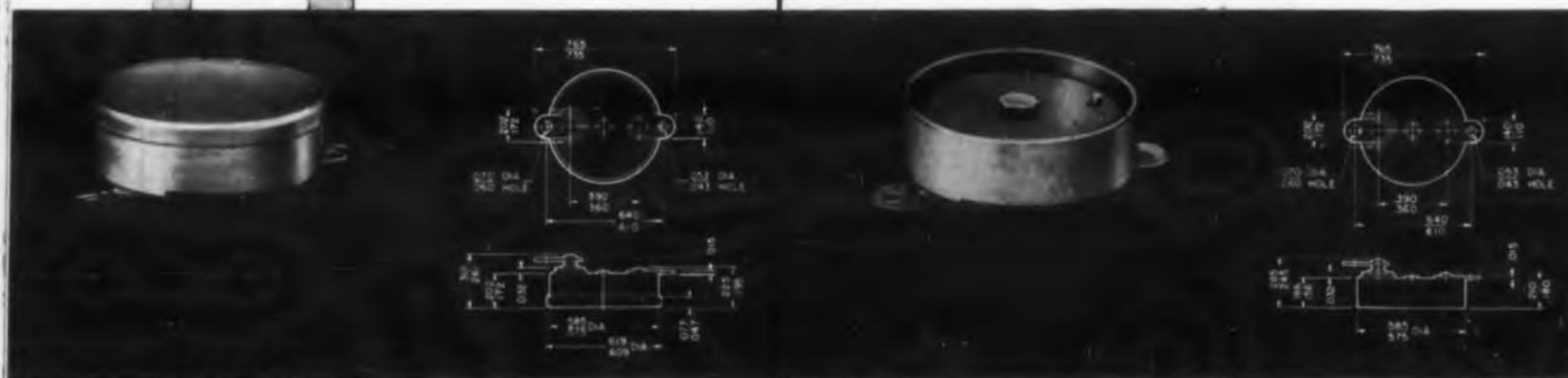
especially designed for missile, avionic
and electronic applications

New Stemco Type MX Thermostats are miniature snap-acting units designed to open on a temperature rise. Being compact, lightweight units able to withstand high G's under wide ambient temperature ranges, Type MX thermostats are ideal for missile, avionic and other electronic applications where close temperature control is mandatory.

Basic design flexibility of the Stemco Type MX Series means the units can be supplied from regular production runs in a wide variety of models, both semi-enclosed or hermetically sealed. Ceramic or metal bases for semi-enclosed units, round enclosures or CR-7 crystal cans for hermetically sealed units. Several types of terminal arrangements, mounting provisions, brackets, etc., are available.

Stemco Type MX thermostats give you performance . . . small cubage . . . rugged reliability . . . at a production price.

* 2° to 6°F differentials available



AA-7286

STEVENS manufacturing company, inc.
Mansfield, Ohio

STEMCO

THERMOSTATS

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 arrangements 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

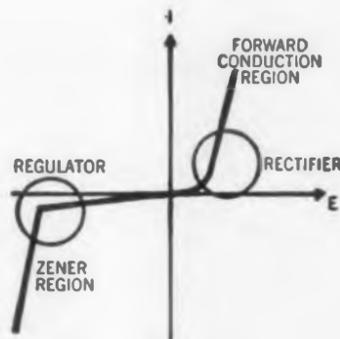
Has copper cooling coil construction

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

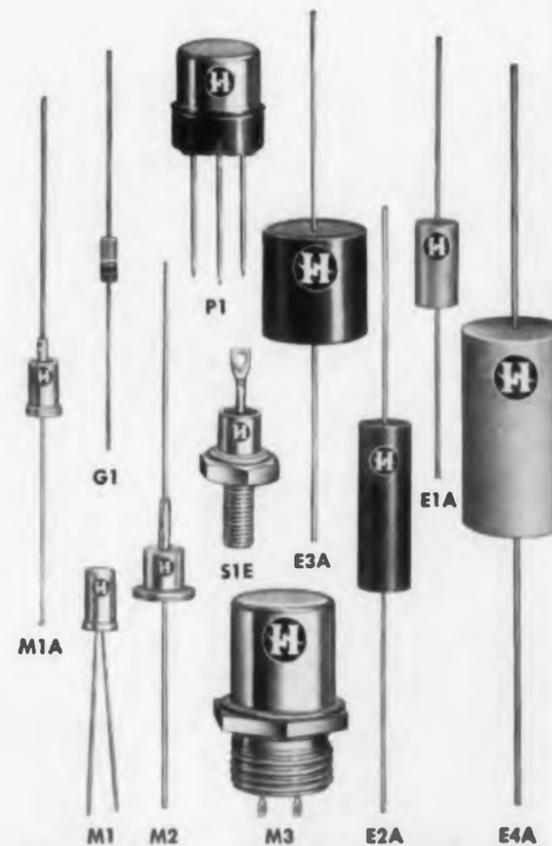


typical I-E characteristic curve for Hoffman Silicon Diodes

Hoffman

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180 Zener Devices	6 ZENER LOW VOLTAGE DIODES • 200mW • Zener Voltage Range: 2.0V — 8.0V	6 ZENER MICRO-MINIATURE GLASS LOW VOLTAGE DIODES • 250mW • Zener Voltage Range: 2.0V — 8.0V	5 ZENER "DOUBLE ANODE" LOW VOLTAGE DIODES • 200mW • Zener Voltage Range: 3.0V — 8.0V	15 ZENER "SINGLE ANODE" MEDIUM VOLTAGE DIODES • 150mW • Zener Voltage Range: .5V — 145V	9 ZENER "DOUBLE ANODE" MEDIUM VOLTAGE DIODES • 150mW • Zener Voltage Range: 7.5V — 45V	6 ZENER REFERENCE DIODES & ELEMENTS • Operating Zener Voltage: 1N429-6.2V ± 5% 1N430, 1N430A, 1N430B, 1N1530, 1N1530A: 8.4V ± 5% • Dyn. Imp.: 1N429-30 ohms, 1N430-15 ohms	4 ZENER REFERENCE MICRO-MINIATURE DIODES • Operating Zener Voltage: 3.3V to 6.5V • Dyn. Imp.: 15 ohms	15 ZENER REFERENCE STRINGS • Operating Zener Voltage: 6.2V thru 49.6V ± 5% • Dyn. Imp.: 20 ohms to 180 ohms (over the entire line)	38 ZENER VOLTAGE REGULATORS 10 WATT • Zener Voltage Range: 5.6V to 200V ± 10% • Dyn. Imp.: 1 ohm to 140 ohms (over the entire line)	38 ZENER VOLTAGE REGULATORS 1 WATT • Zener Voltage Range: 5.6V to 200V ± 10% • Dyn. Imp.: 1.2 ohms to 1100 ohms (over the entire line)	38 ZENER VOLTAGE REGULATORS 1/4 WATT • Zener Voltage Range: 5.6V to 200V ± 10% • Dyn. Imp.: 3.5 ohms to 1400 ohms
	Case Type	M1	G1	M1	M1	M1	M1, M3, P1	G1	E1A, E2A, E3A, E4A	S1E	M1A
45 Diodes	26 GENERAL PURPOSE SILICON DIODES • 150mW • PIV Range: 6.8V thru 470V		6 HB GENERAL PURPOSE SILICON DIODES • 150mW • PIV Range: 6.8V thru 270V		8 GLASS GENERAL PURPOSE DIODES • 200mW • PIV Range: 25V to 175V		5 GLASS FAST RECOVERY SILICON DIODES • 200mW • PIV Range: 25V to 175V				
	Case Type		M1		M1		G1				
26 Rectifiers	11 SILICON DIFFUSED JUNCTION MEDIUM POWER RECTIFIERS • PIV Range: 50V to 1000V			7 SILICON DIFFUSED JUNCTION MEDIUM POWER RECTIFIERS • PIV Range: 50V to 500V			8 SILICON DIFFUSED JUNCTION MEDIUM POWER RECTIFIERS • PIV Range: 95V to 570V				
	Case Type			M1A			M2				
17 Solar Cells	9 SILICON SOLAR CELLS • Typical Power Output Range: .072mW to 34.0mW (at 10,000 ft. candles—sunlight) • Spectral Response: Range: 4000 to 11,500 angstroms; Peak: 8500 angstroms			8 PHOTO-VOLTAIC READOUT CELLS • Number of readout positions: from 4 to 10 • Spectral Response: Range: 4000 to 11,500 angstroms; Peak: 8500 angstroms							
	Case Type			M1A			M2				

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CORPORATION
SEMICONDUCTOR DIVISION

Design Parameter Data Available On All Above Items Upon Request.

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Radio Receptor silicon diodes

IN ANY COMBINATION OF CHARACTERISTICS

high speed • high conductance • high temperature
high voltage • high back resistance

General Instrument semiconductor engineering has made possible these Radio Receptor diodes with a range of characteristics never before available to the industry.

The types listed here are just a small sampling of the complete line which can be supplied in volume quantities for prompt delivery. Write today for full information.

Including the industry's most versatile diode with uniform excellence in all parameters

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GENERAL PURPOSE TYPES		FAST RECOVERY TYPES	HIGH CONDUCTANCE TYPES	
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1N457*	1N462	1N626	1N482A	1N484B
1N458*	1N463	1N627	1N482B	1N485
1N459*	1N464	1N628	1N483	1N485A
		1N629	1N483A	1N485B
			1N483B	1N486
			1N484	1N486A

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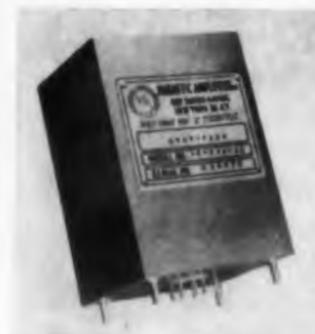
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CIRCLE 256 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON



Solid State Switch

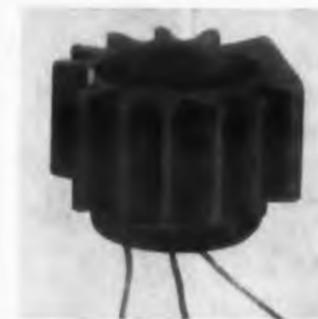
Weighs 9 oz

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



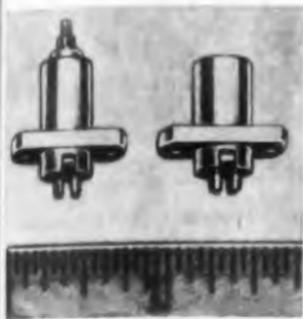
This line of 1.25 in. diam permanent magnet dc motors comes in three frame lengths with

ELECTRONIC DESIGN • August 5, 1959

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. 300th 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 transversely 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

...how to prevent heart failure at 1,500 m. p. h.



To perfect escape from supersonic aircraft, Coleman Engineering Company, Inc., has created Hurricane Sam, an amazingly real 6-ft., 180-lb. "man". Internally, a YARDNEY SILVERCEL® Battery—a power pack smaller than a human heart—runs strain gauges, accelerometers and a telemetering transmitter, that measure and transmit his almost-human reactions when ejected from a sled traveling at 1,500 m. p. h.

on Utah's Hurricane Mesa. Throughout the high acceleration, supersonic travel, ejection and parachute fall to the valley floor 1500 feet below the mesa, Sam's YARDNEY SILVERCEL® Battery heart must continue to power vital instruments to provide those necessary answers that will mean survival for human flyers under actual emergency conditions.



HURRICANE SAM'S HEART

IS A YARDNEY SILVERCEL® BATTERY!

In this dramatic application, where reduced size and weight, and increased power were prime factors, only YARDNEY SILVERCEL® Batteries could have been used. Up to 5 times smaller and 6 times lighter than any other battery of equal capacity, it offers the designer of electrical equipment

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There is a wide variety of standard YARDNEY SILVERCEL® Batteries for such applications as remote-control work, communications equipment, portable power supplies, telemetering and instrumentation, as well as custom-built batteries for particular requirements.

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CIRCLE 262 ON READER-SERVICE CARD



Patents granted and pending.

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SILICON TRANSISTOR CORPORATION
NEW SILICON DIODE

GUARANTEED TOLERANCE

FORWARD BIAS FROM
0.7 TO 1.4 VOLTS



SILICON TRANSISTOR CORPORATION

NEW PRODUCTS AT VESCON

Silicon Diodes

Have low leakage

These silicon diodes have maximum leakage currents as low as 5 μ ma 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., Folcroft, 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/sec², and torque/inertia of 23,000 oz-in.-sec².

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 $\pm 5\%$.

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

SEE US AT WESCON
BOOTHS 2810 - 2812



NEW PANEL MOUNT TRIMPOT®

Now, Bourns combines the convenience of a panel mount potentiometer with all the advantages of a rectangular unit—**Small Size:** requires 1/12 sq. in. or less of panel area—**Setting Stability:** self-locking shaft with no cumbersome locknuts—**Adjustment Accuracy:** multi-turn shaft provides up to 9000° rotation.

All of the many Trimpot models are now available with the panel mount feature as a result of a unique design that permits quick attachment of a panel mounting assembly to standard "on-the-shelf" potentiometers. Rugged stainless steel construction assures compliance to Mil-Specs for vibration, shock, salt spray, etc. Screwdriver adjustment is easily made from the front of the panel...recessed head prevents accidental changes of setting...silicon rubber O-ring and Teflon washer provide moisture barrier from outside elements.

Specify the panel mount Trimpot. Get reliability backed by years of engineering, manufacturing and field experience. Write for complete data and list of stocking distributors.



CHASSIS MOUNTING, PRINTED CIRCUIT OR PANEL MOUNTING—whatever your need, Bourns has a military or commercial potentiometer to meet your exact requirements. Choice of terminal types...resistances from 10 ohms to 1 Meg.

BOURNS, Inc.

P.O. Box 2112K, Riverside, California

Plants: Riverside, California
and Ames, Iowa

In Canada: Douglas Randall (Canada), Ltd., licensee

Exclusive manufacturers of Trimpot®, Trimit®, Pioneers in potentiometer transducers for position, pressure and acceleration.

REGATRAN[®] SEMICONDUCTOR POWER SUPPLIES...

Here's reliability . . . Since their introduction, over 18 months ago, not one Regatran has lost a series transistor due to short circuits or overloading.



Regatran Semiconductor Power Supplies are available in various ratings up to 0 to 60 V dc and 0 to 30 amperes, depending on model. Write for Bulletin 721.

SEE THEM AT WESCON BOOTH 323



©Regatran is a registered trademark of Electronic Measurements Company of Red Bank. Patents Pending.

CIRCLE 271 ON READER-SERVICE CARD

- hermetically sealed
- short circuit proof
- super-regulated
- overload protected
- low output impedance
- lowest ripple
- High-speed regulation
- null balance control

- moving terminations
- front panel calibration
- any grounding arrangement
- small size, light weight

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 $\pm 0.25\%$, 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 μ v metered output

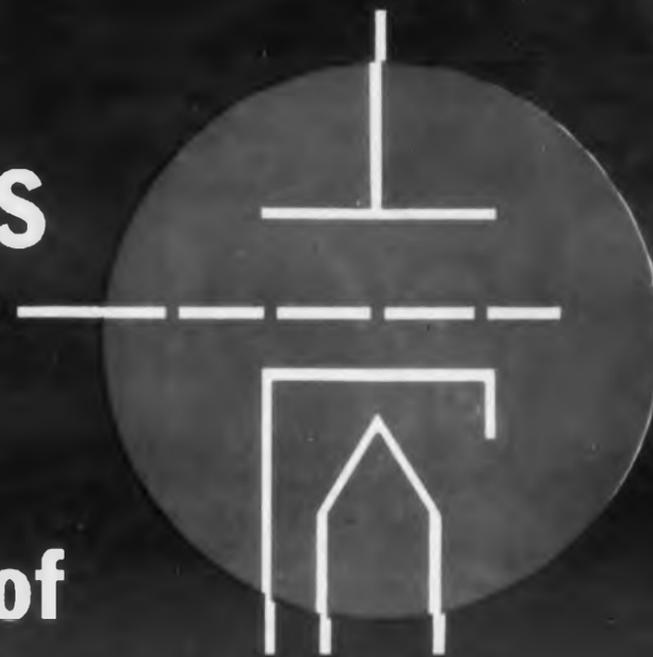


Microvolt and crystal controlled generator model 295X affords continuous frequency coverage from 125 kc to 175 mc in eight calibrated bands, both modulated and unmodulated. It provides a metered output from 0.1 to 100,000 μ v and does not require an external attenuation pad. The direct reading unit has 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

DRIVER-HARRIS manufactures the World's Largest Variety of Electron Tube Alloys for



This fact is of the utmost importance to every engineer engaged in the design and manufacture of tubes with greater reliability regardless of size.

Whenever tube engineers needed alloys of particular characteristics for cathodes, plates, grids, seals, etc., D-H has developed the proper metal compositions to meet their specifications.

Through vacuum melting and other types of close analysis control techniques, D-H research continues at an accelerated rate to improve the reliability of melt-approval techniques.

This is the reason for the great diversification of D-H electronic alloys . . . the reason why so many engineers turn to Driver-Harris for the production of the exact special-purpose alloys they need.

Prominent alloys of this group are: Nichrome*, Karbo-met*, Gridnic*, Therlo*, 499, 599, 152 Alloy, 142 Alloy, 146 Alloy and INCO Alloys 220, 225, 330.

Now several of these are supplied *exclusively vacuum melted*; others can be on specification. In all there are now over 132 D-H alloys available for electronic and electrical applications. If your alloy need cannot be satisfied by any of these, send us your specification and depend on it . . . Driver-Harris will produce it.

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

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MAKERS OF THE MOST COMPLETE LINE OF ALLOYS FOR THE ELECTRICAL, ELECTRONIC, AND HEAT-TREATING INDUSTRIES

CIRCLE 292 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

SILICONE NEWS from Dow Corning

Toward Greater Reliability



Silicone-Glass Laminate Proves More Dependable in Rough Environments

Schlumberger Well Surveying Corporation, makers and operators of geophysical well-logging instruments, found terminal boards of silicone-glass laminate more reliable in service and easier to fabricate. The instrument shown has a working range up to 194 C amid high humidity environments. In Schlumberger's evaluation tests, here's how a laminate based on Dow Corning silicone resins stacked up against other materials.

Silicone vs. phenolic: Silicone laminate had superior and more uniform dielectric properties at high environmental temperatures. Silicone laminate had lower moisture absorption: approximately 0.02% as compared with 2% for phenolic. Silicone laminate had much better dimensional stability than phenolic laminates.

Silicone vs. bonded mica sheeting: Once again, silicone-glass was chosen for its satisfactory dielectric characteristics. Silicone laminate also proved easier and less expensive to fabricate and install than mica because of mica's fragility.

Other plus properties of silicone-glass laminates include stability at 250 C, low loss factor, good physical strength, ease of fabrication, light weight, resistance to arcing, ozone and corona, and permissibility of adjacent soldering.



TYPICAL SILICONE LAMINATE PARTS

What all these add up to is greater reliability. If you are faced with the problem of engineering an electronic unit that will remain failure-free in difficult environments, investigate silicone-glass laminates. Manufacturers of quadradar sets, rotary switches, test chambers, and radio transmitters, to name but a few, have found these laminates meet or exceed their needs.

CIRCLE 600 ON READER-SERVICE CARD

Here are some sample data:

Properties of Silicone-Glass Laminates

Property	Range
Flexural Strength, flatwise, psi, 1/2-inch thickness	
Lengthwise	20,000 - 40,000
Crosswise	18,000 - 33,000
Izod impact strength, edgewise, ft-lb per inch notch	
Lengthwise	6.5 - 17.0
Crosswise	5.5 - 14.0
Bonding strength, lbs., 1/2" thickness	
Condition A	650 - 1100
Condition D-48/50	550 - 950
Dielectric breakdown parallel to laminations, step-by-step test, kv.	
Condition A	32 - 50
Condition D-48/50	15 - 35
Dielectric constant at 1 megacycle, 1/2-inch thickness	
Condition A	3.90 - 4.20
Condition D-24/23	3.95 - 4.20
Dissipation factor at 1 megacycle, 1/2-inch thickness	
Condition A	.0015 - .003
Condition D-24/23	.008 - .022
Arc resistance, seconds	
Condition A	180 - 292
Condition D-48/50	180 - 248
Volume resistivity, meg-cm.	
Condition C-96/35/90	$1 \times 10^9 - 4 \times 10^9$
Surface resistivity, megohms	
Condition C-96/35/90	10 - 10,000

first in
silicones

Dow Corning
CORPORATION
MIDLAND, MICHIGAN

...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.

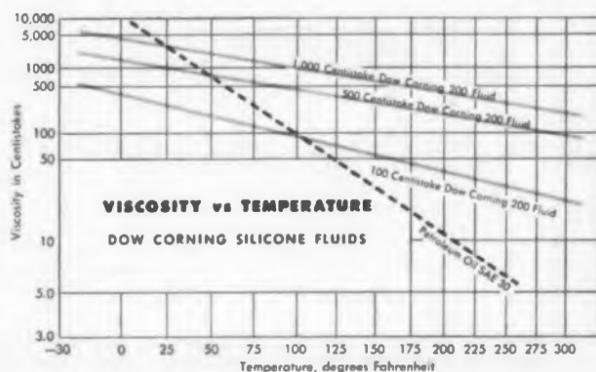
PHOTO COURTESY VARIAN ASSOCIATES

CIRCLE 601 ON READER-SERVICE CARD

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.

Head office: MIDLAND, MICHIGAN / branches: ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D.C.



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

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

Weights 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 μ v 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 $\pm 0.25\%$ 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

See us at Wescon—Booth 1715-1717

Available now from Dymec! A complete array of versatile

“BUILDING-BLOCK” INSTRUMENTS FOR DIGITAL DATA SYSTEMS

Here is a practical approach that gives you, at no sacrifice in quality, a custom digital system at uniquely low cost.

The Dymec instruments shown here are specialized. Yet they are compatible, permitting a fully integrated system. Many can be used directly with printers, card punches, tape perforators and standard input/output equipment of other manufacturers. Dymec instruments are quantity-produced for obvious economies to you. Yet they are of finest quality, meeting the most rigid laboratory standards.

Many different systems can be assembled from these and other standard Dymec instruments. Dymec offers the instruments separately, as sub-systems, or as completely engineered, ready-to-use systems.

For specific information, call the Dymec engineering representative listed below, or write direct.

For further information on Dymec instruments or systems, contact:

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CALIFORNIA: North Hollywood (Los Angeles area.) Neely Enterprises, 3939 Lankershim Blvd., TRiangle 7-0721. Sacramento 14, Neely Enterprises, 1317 - 15th Street, Gilbert 2-8901. San Carlos (San Francisco area), Neely Enterprises, 501 Laurel Street, LYtell 1-2626. San Diego 8, Neely Enterprises, 1055 Shafter Street, ACademy 3-8106. CONNECTICUT: Bridgeport 8, Yewell Associates, Inc., 1101 East Main Street,

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Rockville, Horman Associates, Inc., 941 Rollins Avenue, HAZelwood 7-7560. MICHIGAN: Detroit 35, S. Sterling Company, 15310 West McNichols Road, BRoadway 3-2900. MINNESOTA: St. Paul 14, Crossley Associates, Inc., 842 Raymond Avenue, MIDway 6-7881. MISSOURI, St. Louis 17, Harris-Hanson Company, 2814 South Brentwood Blvd., MIssion 7-4350. Kansas City 30, Harris-Hanson Company, 7916 Paseo Avenue, HILand 4-9494. NEW JERSEY: Asbury Park, I. E. Robinson Company, 905 Main Street, KElllogg 1-3150. Englewood, RMC Associates, 391 Grand Avenue, LOwell 7-3933. NEW MEXICO, Albuquerque, Neely Enterprises, 107



DY-2500 COMPUTING DIGITAL INDICATOR, variable gate time electronic counter permitting normalized direct reading with minimum controls, automatic setability. Measures frequency, period. Displays degrees/hr, gpm, RPM, etc.; also shows ratios of unlike variables. \$1,330. One line readout, \$1,505.



DY-2507 DUAL PRESET COUNTER, multi-purpose precision counter producing an output signal when either of two preset numbers is reached. Instrument is ideal for industrial control, sorting, packing, Go/No Go testing, control of coil winding, machine limits. \$700 to \$895.



DY-2542 TAPE PUNCH SETS record data from electronic counters on punched tape. High speed—recording rate 60 characters/second. Standard model: 5-level output code, 11 character format. Available with internal tape punch (\$4480) or for use with external punch (\$3240). For lower rates (20 characters/second) DY-2540 Scanner/Coupler, transfers counter data to serial entry machines. DY-2540, \$890.



DY-2210 VOLTAGE TO FREQUENCY CONVERTER AND INTEGRATOR provides precision dc voltage measurements and integration with electronic counters. Multiple input ranges, either polarity. Input 0 to 1 v produces 0 to 10,000 cps output. \$650. AC and remote models available.



DY-2504A PHOTOELECTRIC TACHOMETER measures shaft speeds, revolutions, position from 0 to 10,000 RPM. Six models, offering 60, 100, 120, 180, 200 or 360 pulses/revolution. High resolution, low torque. \$250.



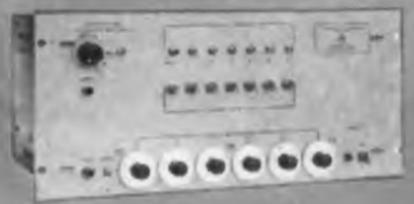
DY-2512 CARD PUNCH COUPLER permits direct entry of counter information onto punched cards, eliminating manual key punch. Operates unattended. Readily connects Dymec or -hp- counters to IBM 523 Summary Card Punch. \$1,890.



DY-2508 DIGITAL CLOCK continuously displays and provides parallel, multiple-contact closure, representing time-of-day in hours, minutes, seconds. 1-, 4- or 10-line code output. Inherent short time storage permits independent clock and recorder operation. \$1,350 plus code wiring.



DY-2538 PROGRAMMED DIGITAL COMPARATOR. Unique, error-free comparison circuit, no drift or calibration; visual and electrical output; use with Go/No Go systems. Preset high and low tolerance limits selected electrically. Also manual-selection models. \$950.



DY-2513 COUNTER SCANNER. Gathers multiple electronic counter data for printing on a single digital recorder. Simplifies simultaneous data measurements. For all Dymec or -hp- counters. \$1,750.



DY-2530 BINARY/DECIMAL REGISTER. Universal output coupler connecting electronic counters to digital displays, comparators, printers, computers. Stores parallel binary-coded-decimal information in multi-contact relays. 10 models, dual or single output, 3 to 7 registers. \$565 to \$1,230.



DY-2533 DIGITAL DISPLAYS. Luminous, one-line indicator panels visually presenting multi-digit numeric data. Clear, high contrast, easy-to-read numerals. Five models, 3 to 7 digits. \$140 to \$300.



DYMEC INC.

Electronic Instrumentation Systems
Dept. D8, 395 Page Mill Road
Palo Alto, California
DAvenport 6-1755

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

Washington St. S.E., ALPINE 5-5586. Las Cruces, Neely Enterprises, 126 S. Water Street, JACKSON 6-2486. NEW YORK: New York 21, RMC Associates, 236 East 75th Street, TRafalgar 9-2023. Poughkeepsie, Yewell Associates, Inc., 806 Main Street, GROVER 1-3456. ROCHESTER 10, Edw. A. Ossmann & Associates, 830 Linden Avenue, LUDLOW 6-4940. SYRACUSE, Edw. A. Ossmann & Associates, 2363 James Avenue, HEMPSTEAD 7-8446. VESTAL, Edw. A. Ossmann & Associates, Box 392, ENDICOTT 5-0296. NORTH CAROLINA: High Point, Bivins & Caldwell, Inc., P. O. Box 5167, High Point 2-6873. OHIO: Cleveland 24, S. Sterling Company, 5827 Mayfield Road, Hill-

crest 2-8080. DAYTON 19, Crossley Associates, Inc., 2801 Far Hills Avenue, AXminster 9-3594. OREGON: Portland 9, ARVA, 1238 N.W. Glisan St., CAPITOL 2-7337. PENNSYLVANIA: Upper Darby (Philadelphia area), I. E. Robinson Company, 7404 West Chester Pike, SHERWOOD 8-1294. Camp Hill, I. E. Robinson Company, 2120 Market Street, REgent 7-6791. PITTSBURGH 27, S. Sterling Company, 4024 Clairton Blvd., TUXEDO 4-5515. TEXAS: Dallas 9, Earl Lipscomb Associates, P. O. Box 7084, Fleetwood 7-1881 and EDison 2-6667. Houston 5, Earl Lipscomb Associates, P. O. Box 6646, MOhawk 7-2407. UTAH: Salt Lake City, Lahana & Co., ZENith

123 (Direct line to Denver). WASHINGTON: Seattle 9, ARVA, 1320 Prospect Street, MAIN 2-0177. WASHINGTON, D.C., AREA: Rockville, Maryland, Horman Associates, Inc., 941 Rollins Avenue, HAZELWOOD 7-7560. CANADA: Vancouver, British Columbia, Atlas Instrument Corp., Ltd., 106-525 Seymour Street, MUTual 3-5848. Winnipeg, Manitoba, Atlas Instrument Corp., Ltd., 72 Princess Street, WHitehall 3-8707. Toronto 19, Ontario, Atlas Instrument Corp., Ltd., 50 Wingold Avenue, RUSSELL 1-6174. MONTREAL, Quebec, Atlas Instrument Corp., Ltd., 3333 Cavendish Blvd., HUNter 9-8495 and 8496.

5685

CIRCLE 299 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

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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

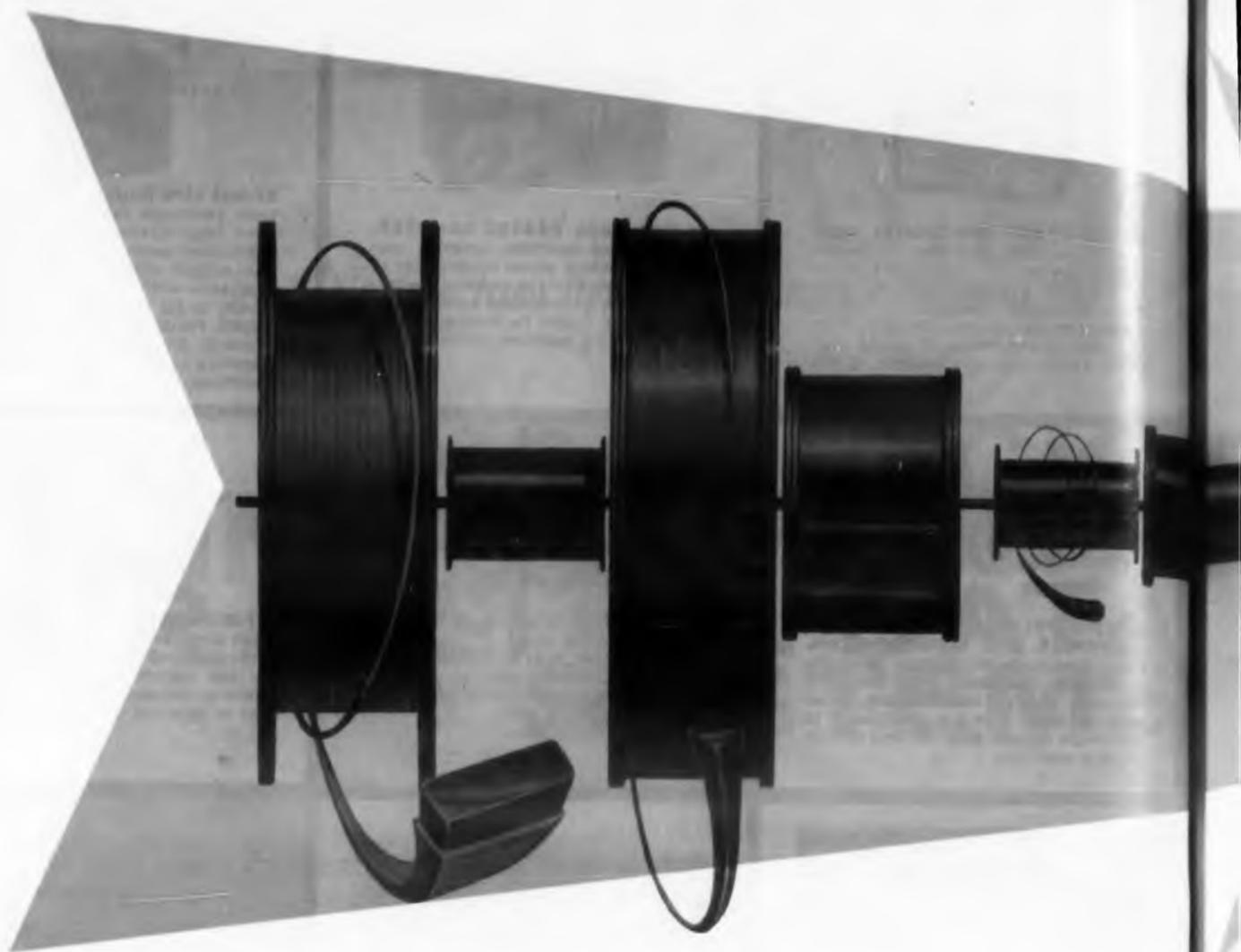
Energizes waveguide components

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 $5.5 \text{ v } 10^6$ 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



Phelps Dodge Applied Research has developed many outstanding magnet wires that anticipate the requirements for advanced insulation system designs. This widely diversified group of Phelps Dodge "firsts" includes:

CLASS A (106°) SODIUM COPPER GRIP

Any time your problem is magnet wire, consult Phelps Dodge for the quickest, surest answer.

*Magnet Wires that
pace the Industry
come from
Phelps Dodge!*

BONDEREZE® (solderable); **FORMVAR** (square and rectangular)
A (105°C) BONDEREZE® (self-bonding); **S-Y BONDEREZE**® (solderable self-bonding)
GRIP-EZE® (solderable self-gripping)

CLASS B (130°C) **NYLEZE**® (solderable); **THERMALEZE**® B (round film)

CLASS F (155°C) **THERMALEZE**® F (round, square, rectangular film)
DAGLAS® (flexible glass)

CLASS H **DAGLAS**® H (flexible glass)

FIRST FOR
LASTING QUALITY
—FROM MINE
TO MARKET!



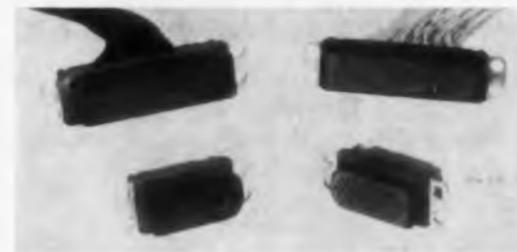
PHELPS DODGE COPPER PRODUCTS
CORPORATION

INCA MANUFACTURING DIVISION
FORT WAYNE, INDIANA

CIRCLE 306 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 μsec rise time

For use in trigger or free-running pulse generators, this secondary-emission pulse tube has a 3 μsec 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

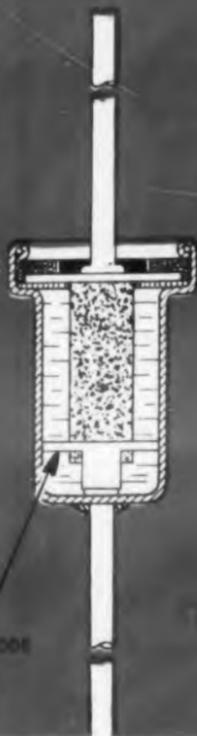
NEW FANSTEEL

"PP" TYPE

Tantalum Capacitor

NOW

**VIBRATION
and SHOCK
RESISTANT**



NEW ANODE
BASE
SUPPORT

At No Increase In Price!

Now, with more rugged construction and specially designed anode base support, the new Fansteel Type "PP" Capacitor is especially adaptable for circuitry where exceptional resistance to vibration and shock is required... *at no increase in price.* The new "PP" also has better low temperature characteristics.

The Fansteel Type "PP" retains all its high performance features—outstanding frequency stability, negligible electrical leakage—proved in countless applications demanding unquestionable reliability and dependability. It occupies minimum space, and yet provides extremely high capacity ratings for its size.

Get complete information today. Write for Bulletin 6.100

Visit Us at Booth 222
WESCON SHOW

FANSTEEL

RELIABILITY

C595A

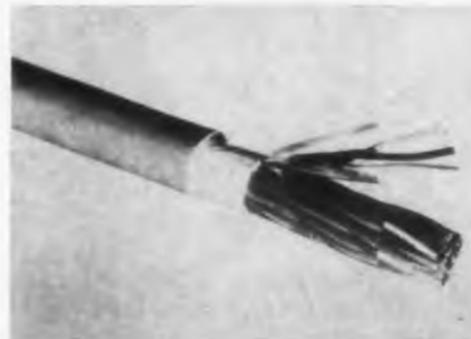
FANSTEEL METALLURGICAL CORPORATION North Chicago, Ill., U. S. A.

CIRCLE 310 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

HERE'S A MANUAL FOR
QUALIFIED PERSONS!

INTERESTED IN
**Reliable
Printed
Circuits...**



Where performance is critical and failure unforgivable, there is only one way to make printed circuits. It is with quality control in depth, as developed by the Bureau Of

Engraving, Inc., and as described in our new U.S. Air Force Approved QUALITY CONTROL MANUAL FOR PRINTED CIRCUIT BOARDS AND BOARD ASSEMBLIES.

For instance, it is not enough that every circuit be gaged to a very close tolerance. Consideration must also be given to the fact that the gage itself wears in use. Under GAGE CONTROL our manual states, "The Gage Control procedure insures that all gages, measuring and test equipment being used are within the tolerances required to maintain manufacturing specifications... gage is to be inspected according to the wear policy and frequency as specified on the gage control card."

Procedures, functions, definitions and maintenance of materials specifications are discussed in detail. Our QUALITY CONTROL MANUAL meets MIL-STD-105A and MIL-Q-5923C standards.

If you are a qualified person (engaged in the development or manufacture of products requiring printed circuits), write for our manual on your company letterhead. Copies will be sent out free as long as our limited supply lasts.

WRITE TO:

Member of the
Institute of Printed Circuits

BUREAU OF ENGRAVING, Inc.

Industrial Division

502 S. 4th St., Minneapolis 15, Minn.
Telephone FEderal 9-8721

CIRCLE 314 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959

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CARD
1959

"I've
found . . .
the perfect
source for

VITREOUS ENAMEL RESISTORS!"

Eliminate production bottlenecks due to poor delivery cycles! PRECISE-OHM Vitreous Enamel Resistors are available in a wide range of styles and sizes—can be easily and quickly modified by our engineers to meet your particular electrical and mechanical requirements!



Types include fixed, adjustable, tapped, multi-section and pigtail—manufactured to rigid specifications! Highest quality ceramic tubes, alloy wire, and specially compounded vitreous enamels used—yet prices are LOW—delivery is FAST! If your product design calls for Vitreous Enamel Resistors . . . specify PRECISE-OHM.

Precision, Inc. also manufactures a complete line of precision wire-wound resistors under the Precise-Ohm label. Types available in open or encapsulated styles, radial or axial leads, tolerances up to 1/50%—built to your specifications.



Custom Manufacturing
Facilities for Miniature
Wire-Wound Components . . .

- High Temperature Magnetic Coils
- Miniature Stators and Rotors
- Toroidal Reactors and Transformers
- Specialized Solenoids

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facilities brochure.

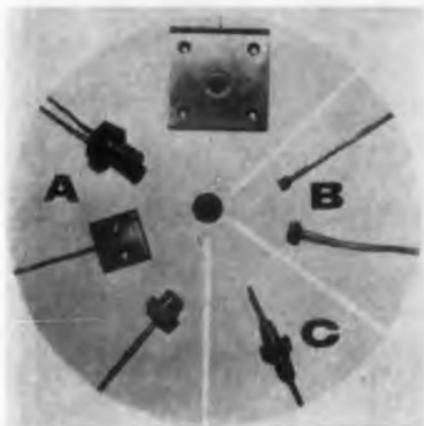


precision, inc.
4746 France Ave. No. • Minneapolis, Minn.

CIRCLE 315 ON READER-SERVICE CARD
ELECTRONIC DESIGN • August 5, 1959

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

FANSTEEL
TESTED AND PROVEN
RELIABILITY

Fansteel (Type 6A) 1N Series



22 AMP.

Silicon Power Rectifier

Fansteel 6A Silicon Rectifiers undergo the most complete and rigid testing ever devised to assure reliability . . . to assure performance that matches or exceeds expected service. painstaking thoroughness, and care . . . 100% testing . . . and exacting production methods in contamination-free surroundings assure unquestionable reliability in every Fansteel 6A Rectifier.

The highly stable 6A carries a full 22 amp. load in half-wave circuits; up to 66 amps in bridges. It has peak reverse voltages from 50 to 400 v. in 50-volt multiples. It operates at ambient up to 165°C.—unaffected by storage temperatures from —65 to +200°C.

Rugged, compact, hermetically sealed construction . . . exceptional shock and vibration resistance. The 6A can be mounted in any position.

Ask for Bulletin 6.304.

FANSTEEL

RELIABILITY

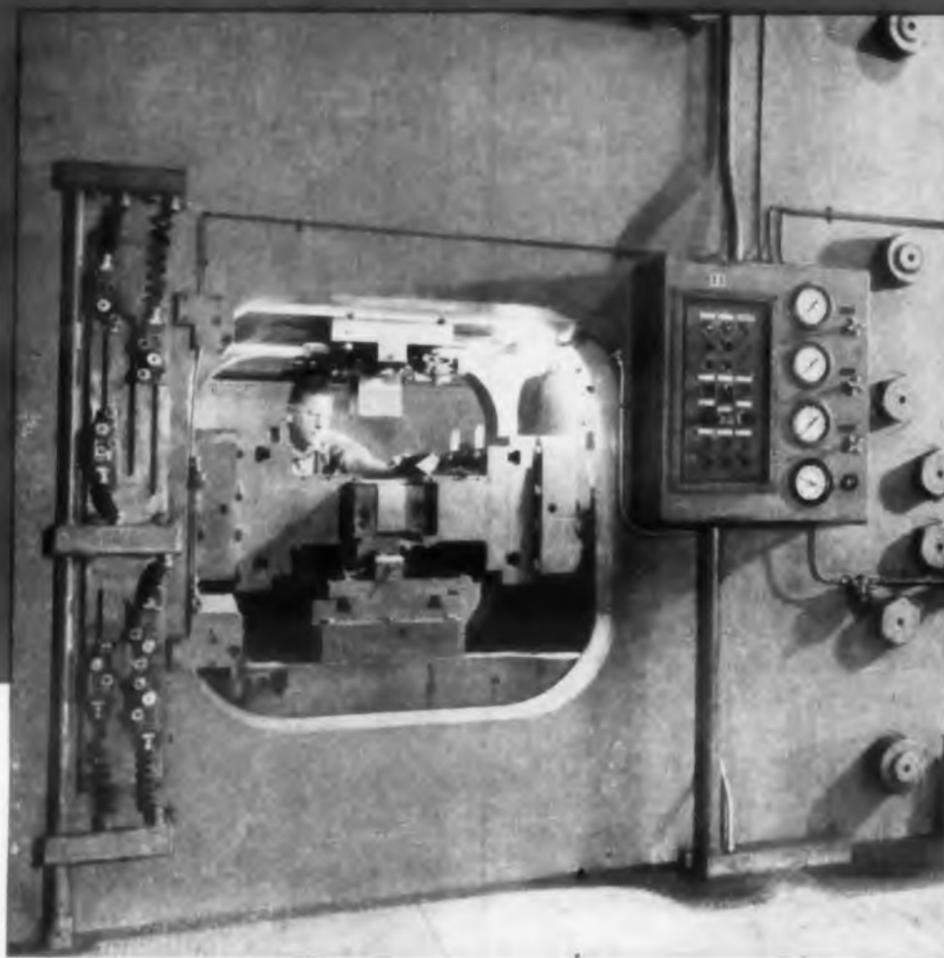
FANSTEEL METALLURGICAL CORPORATION North Chicago, Ill., U.S.A.

CIRCLE 318 ON READER-SERVICE CARD

TANTALUM

*Reliable
Capacitors
Start
With
Reliable
Tantalum*

Capacitor Grade Tantalum metal powder is compacted in this giant 3000-ton, 4-way action hydraulic press (the largest of its kind ever built) in the Fansteel North Chicago plant.



IN PRESENT DAY electronics, reliability cannot be overstressed. To attain high reliability, basic materials in components must not only be of the highest quality; they must be designed for their particular purposes. Certainly this is true of tantalum capacitors.

In the early development of tantalum capacitors, Fansteel found out that a special grade of tantalum is necessary. Other leading capacitor manufacturers followed suit, and used only Fansteel Capacitor Grade Tantalum in the form of foil, sheet, wire and sintered anodes. They rely completely on the quality of Fansteel Capacitor Grade—quality achieved through the experience of 37 years of tantalum pioneering and research.

Capacitor Grade Tantalum grew up at Fansteel

—right along with the tantalum capacitor and tantalum metal itself. It is a premium grade produced under the strictest laboratory standards to insure uniformity of its improved properties. It was developed especially for capacitor applications. Fansteel research continues to work to make Capacitor Grade an even better tantalum, and Fansteel manufacturing facilities and ore resources assure continuous supply for your expanding needs.

Built-in reliability for your capacitors is attained by starting out with the best materials only. Fansteel Capacitor Grade Tantalum is your first step in that direction—it's sure to be the strongest "link" in your capacitor's make-up. Fansteel Metallurgical Corporation, Rectifier-Capacitor Division, North Chicago, Illinois.

Visit us at Booth 222 WESCON SHOW

FANSTEEL[®]

CAPACITOR GRADE
TANTALUM

A Premium Grade of Tantalum available to capacitor manufacturers in these forms:

FOIL • SHEET • STRIP • WIRE • ROD • FABRICATED WIRE LEADS
SINTERED POROUS ANODES • METAL POWDER

CIRCLE 319 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 μ sec or any six special fixed lengths between 0.5 and 10 μ sec. Rise time is adjustable from 100 to 175 kv per μ sec. 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



SPAGHETTI TUBING

MADE FROM
TEFLON*



For SLIP-ON INSULATION BUNDLE SHEATHING BUSHING INSULATION BARRIER INSULATORS, PIGTAILS

And Similar Applications Where
Only PF TEFLON* Can Do The Job

ADVANTAGES . . .

- good dielectric strength (500 to 1000 volts/mil)
- lowest dielectric constant (2.0) and dissipation factor (0.0002) of any solid dielectric
- no change of electrical properties with temperature (-25°C to +250°C) or frequency (60 cycles to 100 mc).
- zero moisture absorption
- unaffected by any commercial chemical

PF spaghetti tubing is stress relieved for minimum shrinkage and carefully inspected and controlled dimensionally. A full range of sizes and colors are available to meet your specific needs. Write, wire or call for further information, competent engineering assistance and information on special sizes and wall thickness. PF flexible tubing, heavy-walled tubing and rod stock made from Teflon* is also available.

**PENNSYLVANIA
FLUOROCARBON CO., INC.**
1115 N. 38th Street, Philadelphia 4, Pa.
EVergreen 6-7680

*"Teflon"—Du Pont trade name for Tetr. difluoroethylene resin

CIRCLE 322 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959

Oscilloscope

Monitors color TV sync pulses



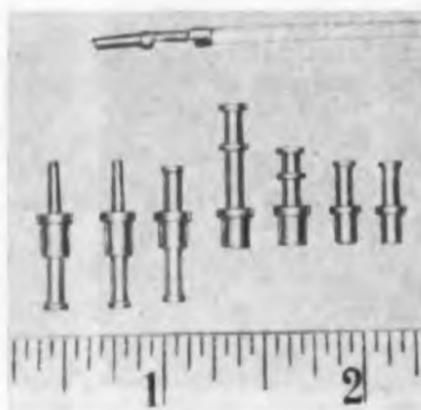
Designed to monitor color or black and white TV sync pulses, the model P1B7X2 Panelscope has a switch that selects one of three TV sync signals to be viewed at sweep rates of 1/2 the line or frame frequencies. Another selector position permits connection of an external calibrating signal to the vertical 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

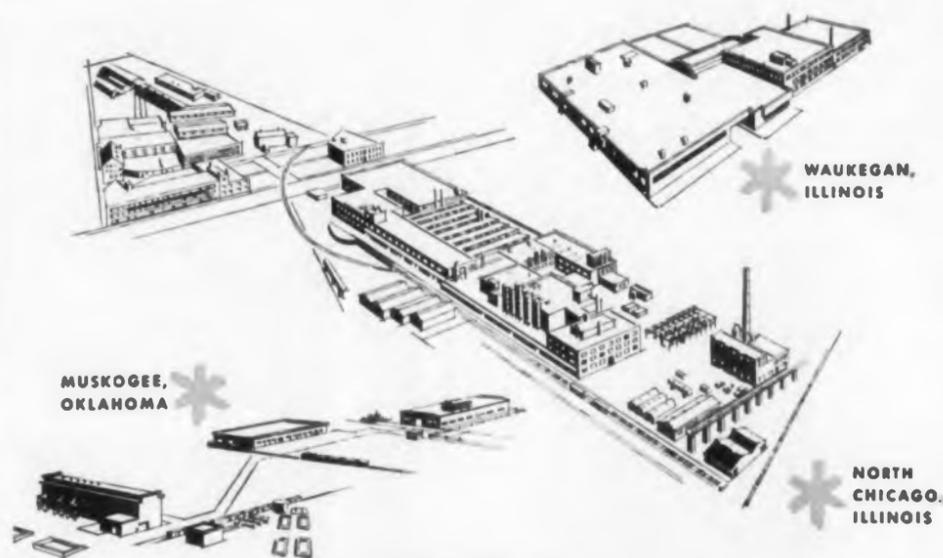
Feedthrough type



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



FANSTEEL

Grow with a "Growth Organization" in the field of semiconductor devices

The Rectifier-Capacitor Division of Fansteel offers responsible assignments in these areas:

RESEARCH AND DEVELOPMENT—Physicists,
Chemists, Metallurgists

DESIGN AND PROCESS ENGINEERING—Electronic,
Electrical, Chemical

SALES ENGINEERING—Electronic and/or Electrical

EXPERIENCED OR GRADUATES. Whether you have specialized experience—or are a recent graduate pondering your first all important move—find out about a career with Fansteel, pioneers, developers and producers of semiconductor devices. These include selenium and silicon rectifiers and tantalum capacitors which Fansteel introduced to industry in 1949.

If you're inquisitive and like to dig deep for answers to electronic problems dealing with rockets and missiles, aircraft, automobiles and appliances—if you want exciting challenges in your everyday work—if you'd like the advantages of learning through the exchanging of ideas with other experienced professionals—if your plans include sound, long term views on position and stature—then, you'll like being associated with Fansteel.

SECURITY & PROGRESS. Fansteel offers the security but you alone will determine how fast you advance. Relocation (on us) to Chicago's beautiful North Shore area means suburban living at its best.

IMMEDIATE OPENINGS. Fansteel's rapidly moving expansion program has opened many new staff positions. If you'd like to have a part in history-making space age advancements, contact Fansteel.

... Send resume, in confidence,
to Personnel Officer for Professional Employees, Fansteel
Metallurgical Corporation, North
Chicago, Illinois.

FANSTEEL

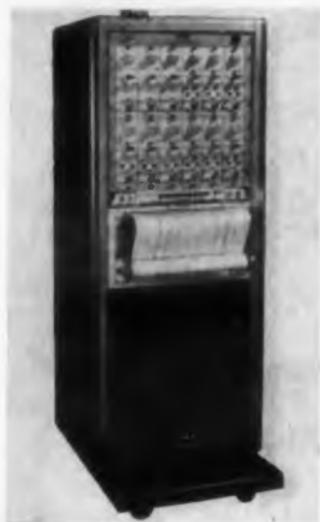
X598A

Write to Advertiser mentioning Electronic Design

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, Heliac 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

156

Frequency Range: 1.5-4.5 kmc
Bandwidth at 3 db points: 30 mc max.
Bandwidth at 35 db points: 75 mc max.
Insertion Loss: 1 db max.
Input VSWR (with matched load): 1.5 max.
Number of Resonant Sections: 4
Number of Tuning Controls: 1
Mode: TE₀₁₁

Type: Absorption type waveguide
Frequency Range: 15.8-17.2 kmc
Loaded Q: 7000 min.
Absorption Dia: 10⁵ min.
Calibration: Direct reading drum, 1 mc markers
Frequency Resolution: 100 inch per mc
Accuracy at 70°F: ± 0.1% min.
Stability: ± 0.2% 70°F ± 70°F
RF Connectors: UG-41B/U

Frequency Range: 8000-8950 mc
Bandwidth at 3 db points: 9 mc min.
Bandwidth at 35 db points: 30 mc max.
Insertion Loss: 2 db max.
Input VSWR (with matched load): 1.5 max.
Number of Resonant Sections: 4
Number of Tuning Controls: 1
Mode: TE₀₁₁

Frequency Range: 100-1000 mc
Bandwidth at 3 db points: 9 mc min.
Bandwidth at 35 db points: 30 mc max.
Insertion Loss: 3 db max.
Input VSWR (with matched load): 1.5 max.
Number of Resonant Sections: 4
Number of Tuning Controls: 1
Mode: TE₀₁₁

Type: Plug-in laboratory cavity, transmission type
Frequency Range: Fixed tuned in band of 3.5-1.5 kmc
Loaded Q: 4000 ± 10%
Transmission Loss: 3 db max.
Accuracy at 70°F: ± 0.05%
Stability: ± 0.1% over temp. range of 0°C to 60°C
RF Connectors: Mates with 1 1/2 x 1/4 waveguide

Frequency Range: 2700-3150 mc
Bandwidth at 3 db points: 4.5 mc min.
Bandwidth at 35 db points: 40 mc max.
Insertion Loss: 1.5 db max.
Input VSWR (with matched load): 1.5 max.
Number of Resonant Sections: 2
Number of Tuning Controls: 1
Mode: TE₀₁₁

Frequency Range: 2.0-2.5 kmc
Bandwidth at 3 db points: 5 mc ± 1.5 mc
Bandwidth at 35 db points: 60 mc max.
Insertion Loss: 3.5 db max.
Input VSWR (with matched load): 1.5 max.
Number of Resonant Sections: 4
Number of Tuning Controls: 1
Mode: TEM_{2,4}

Frequency Range: 100-200 mc
Bandwidth at 3 db points: 4 mc min.
Bandwidth at 35 db points: 40 mc max.
Insertion Loss: 3 db max.
Input VSWR (with matched load): 1.5 max.
Number of Resonant Sections: 4
Number of Tuning Controls: 1 (setover/ver adjustment)
Mode: TEM_{2,4}

Frequency Range: 4.0-5.3 kmc
Bandwidth at 3 db points: 15 mc min.
Bandwidth at 35 db points: 200 mc max.
Insertion Loss: 3.5 db max.
Input VSWR (with matched load): 1.5 max.
Number of Resonant Sections: 2
Number of Tuning Controls: 1
Mode: TEM_{2,4}

Frequency Range: 5.3-7.0 kmc
Bandwidth at 3 db points: 15 mc min.
Bandwidth at 35 db points: 200 mc max.
Insertion Loss: 2 db max.
Input VSWR (with matched load): 1.5 max.
Number of Resonant Sections: 2
Number of Tuning Controls: 1
Mode: TEM_{2,4}

Frequency Range: 5400-8000 mc
Bandwidth at 3 db points: 10 mc min.
Bandwidth at 35 db points: 120 mc max.
Insertion Loss: 2 db max.
Input VSWR (with matched load): 1.5 max.
Number of Resonant Sections: 2
Number of Tuning Controls: 2
Mode: TE₀₁₁
RF Connectors: Type BNC male modified

Frequency Range: 10.8-11.6 kmc
Bandwidth at 3 db points: 9 mc min.
Bandwidth at 35 db points: 35 mc max.
Insertion Loss: 3 db max.
Input VSWR (with matched load): 1.5 max.
Number of Resonant Sections: 4
Number of Tuning Controls: 1
Mode: TE₀₁₁

*** EASILY FILLED ... your microwave frequency**

FREQUENCY STANDARDS

Division of Harvard Industries, Inc. Box 504, Asbury Park, New Jersey

Phone: PROspect 4-0500 TWX A PK 588

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 $\pm 2\%$. 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

157

Frequency 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

Ward William & Company, Advertising

NWL TRANSFORMERS

Outstanding in their fields for continuous research, development and design



Filament transformer for insulation up to 80 KV AC Test. Low secondary capacitance from 6 to 30 mmfd.



Same as opposite except with 2 or more secondary windings



High impedance type transformer from 0.01 to 50 KVA and up to 10 KV. This unit is used for applications where short circuit current must be limited.



High voltage plate transformers up to 30 KV for floating secondary and up to 50 KV with start of secondary c.t. at or near ground. Sizes to 300 KVA.



This transformer features low voltage high current secondary windings up to 4000 amps., and up to 300 KVA. Taps on the primary windings afford a wide range secondary current.



Through type instrument current transformer. Available in ranges from 1000 to 10,000 amperes.

NWL custom-built Transformers are made to fit the particular needs of the user. Each Nothelfer transformer is individually tested for core loss, polarity, voltage, corona, insulation breakdown and aging characteristics and must meet all customer's requirements before shipment. We shall be glad to receive your specifications and quote you accordingly.



ESTABLISHED 1920



Nothelfer

SAY: NO-TEL-FER

NOTHELPER WINDING LABORATORIES, INC., P. O. Box 455, Dept. ED-8, Trenton, N. J.

Specialists in Custom-Building

CIRCLE 330 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

NOW... A HIGH-HEAT NON-SLIP LACING TAPE



GUDEBROD'S TEMP-LACE H

Gudebrod synthetic rubber finish has now tamed slippery Teflon* by coating it with synthetic rubber. Once cables are laced with Temp-Lace H, they're laced for good... because there's no knot-slip; no harness slip. Assemblies stay tight and firm.

Flat-braided of pure, inert Teflon, Temp-Lace H is non-corrosive to hands or instruments. Now coated with Gudebrod's non-flaking, fungistatic rubber finish, it's non-slip, and flexible from -40° to 220°C. It won't cut through insulation.

Temp-Lace H is available in five sizes; or we will engineer a tape to meet your specifications. Write today for Data Book giving complete information on ALL Gudebrod Lacing Tapes and Drive Cords.

*Du Pont's TFE fluorocarbon fiber

See Gudebrod's Booth 1012 at The Wescon Show

GUDEBROD BROS. SILK CO., INC.

ELECTRONIC DIVISION
225 West 34th Street, New York 1, N.Y.

EXECUTIVE OFFICES
12 South 12th Street, Philadelphia 7, Pa.

CIRCLE 334 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959

A complete new line of quality instrument control knobs from Lerco, the quality source for terminals and electronic hardware...designed to mil-spec standards...high impact styrene with anodized aluminum inserts...two set screws...available in warm grey, midnight blue or black with mirror or matte finish...all standard sizes in stock!

LERCO

ON DISPLAY AT WESCON BOOTH 1606

WRITE FOR COMPLETE DATA SHEET TODAY! LERCO ELECTRONICS, INC., 501 S. VARNEY STREET, BURBANK, CALIFORNIA

NEW KNOBS

...to use

where

quality counts!

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 PIG9X1 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.

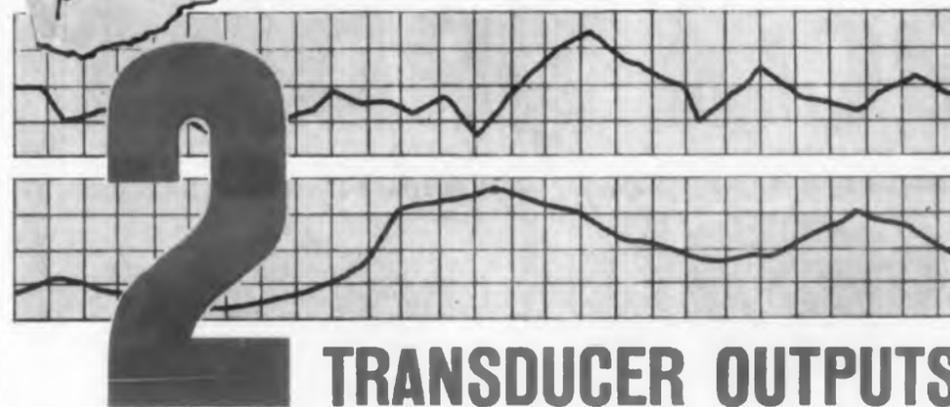
Radio Corporation of America, Semiconductor and Materials Div., Dept. ED, Somerville, N.J.
Booth 410-412

CIRCLE 338 ON READER-SERVICE CARD

CIRCLE 335 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959

product of the pioneer



TRANSUDCER OUTPUTS displayed simultaneously without preamplification



TYPE 411

FEATURING

- 1 millivolt full-scale sensitivity
- Identical Y-amplifiers
- Common calibrated sweeps, or simultaneous calibrated and expanded sweeps
- Large variety of true dual-beam displays
- Transistorized for stability
- Each signal channel independently controlled
- X-Y plots available through front panel switching

HIGH SENSITIVITY DUAL-BEAM SCOPE

The most sensitive dual-beam scope commercially available. The DuMont Type 411 will display low-level outputs from two transducers simultaneously, **without any external preamplification** — most important in electro-mechanical studies. Your transducer outputs can be displayed on common calibrated sweeps, or on a calibrated and an expanded sweep at the same time for simultaneous general and detailed studies. Each trace can be expanded 5 times full-scale horizontally and 3 times full-scale vertically for even greater resolution. Power supplies are regulated, and all critical amplifier circuits are transistorized for stability. The Type 411 Dual-Beam Oscilloscope is truly the most usefully-versatile laboratory instrument available for the electro-mechanical laboratory

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DU MONT®

SEE IT AT WESCON—
Booths 424 & 426.

precision electronics is our business

ELECTRONIC TUBES/INDUSTRIAL TV/MILITARY ELECTRONICS/MOBILE COMMUNICATIONS/SCIENTIFIC INSTRUMENTS/AUTOMOTIVE TEST EQUIPMENT

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INTERNATIONAL DIVISION • 515 MADISON AVENUE, NEW YORK 22, N. Y. • CABLES: ALBEEDU, NEW YORK

CIRCLE 339 ON READER-SERVICE CARD

ADVANCED MULTICHANNEL PCM TELEMETRY



PCM SERIES SOLID STATE COMPATIBLE
PCM MULTICODER.
Smallest and lightest available.

COMPLETE DIGITAL SYSTEMS
FOR TELEMETRY, DATA
LOGGING AND ON LINE
PROCESSING.

COMPACT PCM TELEMETRY
COMPATIBLE WITH EXISTING
PDM INSTRUMENTATION
EQUIPMENT AND STANDARDS.

PCM series PCM multicoder (shown
above) consists of a commutator,
solid state PAM/PCM converter and
power supply. These units provide
the advantages of PCM with the
compactness and economy of PDM.
Other high performance PCM
equipment is also available.



Digital data loggers for wind tunnel in-
strumentation, strain gage studies and
other ground based applications are avail-
able for use with magnetic tape equip-
ment or digital data processing systems.

We are always pleased to consult with
you on your particular theoretical and/
or practical problems. Please contact
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TWX 271X
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CIRCLE 340 ON READER-SERVICE CARD

160

ADVANCED MULTICHANNEL PDM TELEMETRY



SX SERIES MIXED HIGH AND
LOW LEVEL MULTICODER.
Smallest and lightest available.

COMPLETE PDM DATA
ACQUISITION SYSTEMS.
FIRST IN QUALIFIED ALL
ELECTRONIC SOLID STATE
MULTICODER PRODUCTION.

The SX series (shown above) of elec-
tro-mechanical PDM multicoder
combines a higher density pack-
aging and the new highly reliable
minicom commutator to provide
maximum data handling capacity
for high and low level signals in a
minimum of space.



Subminiature all
electronic 45 channel
multicoder with both
PDM and PAM out-
puts.

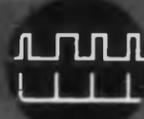


Standard low level
and mixed high
and low level PDM
multicoder for IRIG
channel configura-
tions ML and MX
series.

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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 μ sec 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.

Kepeco, 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 μ sec recovery time



Designed for computer switching applications, these miniature silicon diodes have a maximum recovery time of 0.3 or 0.5 μ sec, 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

IF YOU USE BWOs & TWTs



you need the NEW PRD 813

There is a "spanking" new BWO/
TWT power supply that's really a
work horse. PRD's latest con-
tribution to the test equipment
art, the Type 813 can supply
just the right kind of power for
driving a host of microwave
tubes ranging from voltage-tuned
magnetrons to travelling-wave
amplifiers.

Featuring the latest advances, the
PRD Type 813 has built-in time
delays for filament and grid, delay
line and collector, and anode
voltages...and includes other
frustration inhibitors, such as:

1. Individual adjustments of delay line, collector, anode, grid, and heater elements
2. Provisions for both internal and external sweep and amplitude modulation
3. AGC at the grid when used with external detectors
4. Digital read-out for delay line supply.

In addition to these features are
the (typical of all PRD equip-
ment) bedrock stability and high
sensitivity of the first truly
UNIVERSAL BWO/TWT Supply.
The remainder of the features
and full specs for the PRD Type
813 can be yours by writing to:
PRD—first in microwaves.



POLYTECHNIC RESEARCH & DEVELOPMENT CO., INC.

Factory & General Office:
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ULster 2-6800

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2639 So. La Cienega Blvd., Los Angeles 34, Calif.
Texas 0-1940

WESCON Booths 1805-1807

CIRCLE 344 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959

CHOOSE

Vulcanize
many spe
PHENOLITE
standard
cotton fa
fabric, c
phenolic,
reflon or
PEERLESS
corrugate

Extruded
pressure

Polyester
grades; c

PHENOLIT
10 standa

Combina
PHENOLIT
Metal-Fib
PHENOLIT

BACKED

Field Appl
Complete
Stock Prog

BY CAL

Baltimore
Boston
Chicago
Cincinnati
Cleveland
Dallas
Denver
Detroit
Griffin, G
Indianapo
Los Ange
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New Hav
Newark
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Pittsburgh
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St. Louis
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WIL
In Canada
NATIONAL PH
CIRCLE 3

ELECTR



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
Complete Fabricated Parts Service
Stock Program for Immediate Shipment

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NATIONAL VULCANIZED FIBRE CO

WILMINGTON 99, DELAWARE
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 $\pm 5\%$ 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



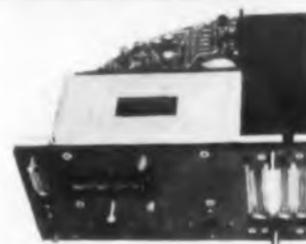
Test kit model E-8 is designed for instruction and experimentation in the thermoelectric heat pump field. It contains an assembled heat pump, four extra *p* and four extra *n* elements, and an instruction book. The kit can be used to determine the feasibility of heat pumps in various cooling, heat transfer, 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.

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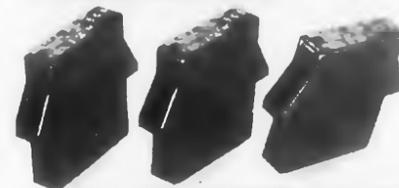


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Top positions available in new expansion planning.

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.

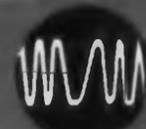


Rugged SCO shelf available in various lengths for mounting up to 12 FO-4 series SCO's including the power supply and mixer.

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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NEW PRODUCTS AT WESCON

Impedance Bridge

Wide range



Impedance bridge model 502-A has ratio ranges that extend to 120 billion to 1 for resistance and 12 billion to 1 for capacitance and inductance. It measures 6 x 7 x 9 in., weighs 10 lb. 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 five infinitely variable standard ranges (1000 g max). Maximum weight capacity is 2500 g-lb; wow is 0.5% max; drift is 0.2% of operating rate-per-minute max. It measures 32 x 32 x 38 in. Model B900 has a range of 1 to 100 g; maximum weight capacity is 5000 g-lb max. Wow is 0.5% max; drift is 0.2% of operating rate-per-minute max. It is 36 in. high, and has a diameter of 60 in.

Genisco Inc., Dept. ED, 2233 Federal Ave., Los Angeles 64, Calif.

Booth 3732-3734

CIRCLE 352 ON READER-SERVICE CARD

High-Voltage Power Supply

Produces 16 kv dc at 200 μ a

High-voltage power supply PS-28 produces 16 kv dc at 200 μ a from 26.5 v dc, 650 ma nominal input. Conversion is through a mechanical vibrator, transformer and voltage doubler. It is housed in a 4-7/8 x 6-3/8 x 6-7/8 in. aluminum case, and weighs 8 lb.

Southwestern Industrial Electronics Co., Dept. ED, 10201 Westheimer Rd., P.O. Box 1305, Houston 19, Tex.

Booth 420-422

CIRCLE 353 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959



Smallest of the Small. A pigmy beetle could easily crawl through the eye of an ordinary sewing needle, as shown by this equally magnified view of both. Among the tiniest of insects, some species of pigmy beetles reach about one-hundredth of an inch in length.

Miniature for Missiles. This tape recorder, shown one-sixth actual size, is a vital unit in the communications system of the Army's "talking satellite." Constant low-torque and quiet operation of MPB bearings in it maintain accurate tape position.

Man with Miracles. Like all MPB Sales Engineers, Dean Skillin makes a practice of showing people how small, precision-made MPB bearings reduce maintenance, increase economy, and solve miniaturization problems. He's ready to do the same for you.

Miracles in Miniaturization



ACTUAL SIZE OF THE MPB BEARINGS IN TAPE RECORDER SHOWN ABOVE

Little Things That Count. There's nothing new, in the larger sense, about ball bearings. But miniaturization of these familiar components is a wholly modern development. Forty years ago, for example, MPB was first to manufacture bearings with O.D.'s as small as 3/8", and with precision that brought new aid to science and industry. Today, after con-

tinual pioneering in miniaturization, MPB produces over 500 types and sizes of bearings, ranging down to 1/10" O.D., with specials as required. Our catalog brings you details on these bearings. Write for it, or for engineering advice, to **Miniature Precision Bearings, Inc.**, 908 Precision Park, Keene, N.H.

CIRCLE 350 ON READER-SERVICE CARD

MINIATURE PRECISION

MPB

BEARINGS, INC.

Helps you perform miracles
in miniaturization

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NEC
14806
Teleph
CIR



New
space-saving,
lightweight

differential DC amplifier

*amplifies low-level
telemetry signals
with high efficiency*

Smallest size available—only $2\frac{1}{2}$ " long
x $1\frac{3}{8}$ " 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 environ-
mental 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, vibra-
tion and shock. Designed with mag-
netic 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

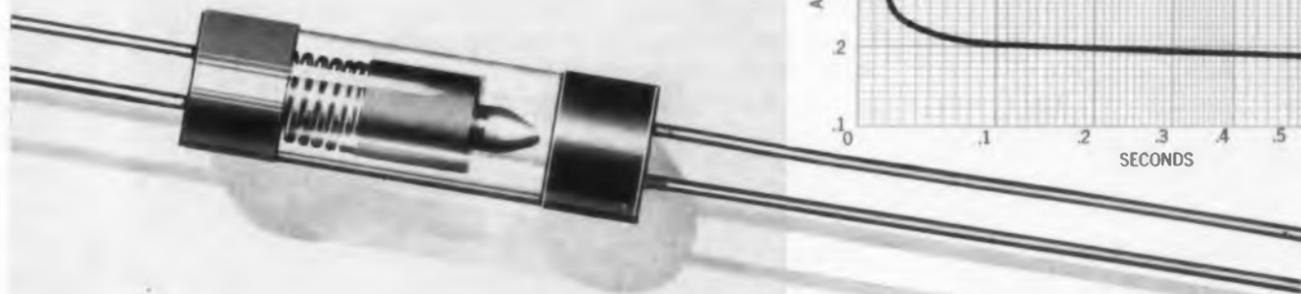
NETWORKS ELECTRONIC

*—originators of the
glass-enclosed thermal relay*

—announce

a **NEW**

LOW-CURRENT THERMAL RELAY



FOR
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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 $+400^{\circ}\text{F}$
Vibration: 20 to 2000 cps at 15 G's
Shock: 50 G's for 2 to 4 MS

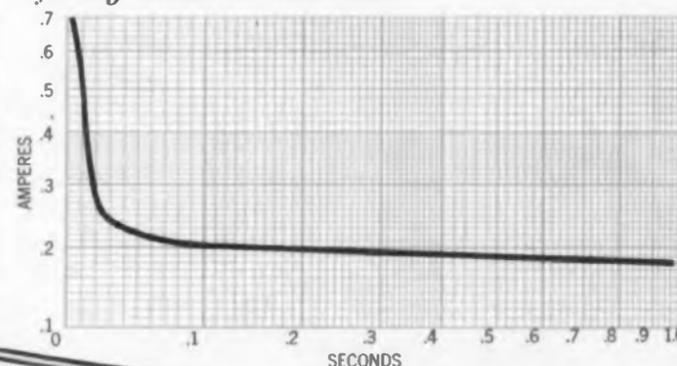
Higher ratings for Normally-closed type.

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

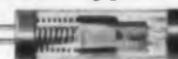


normally open type NO. M555 (Actual Size)



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**

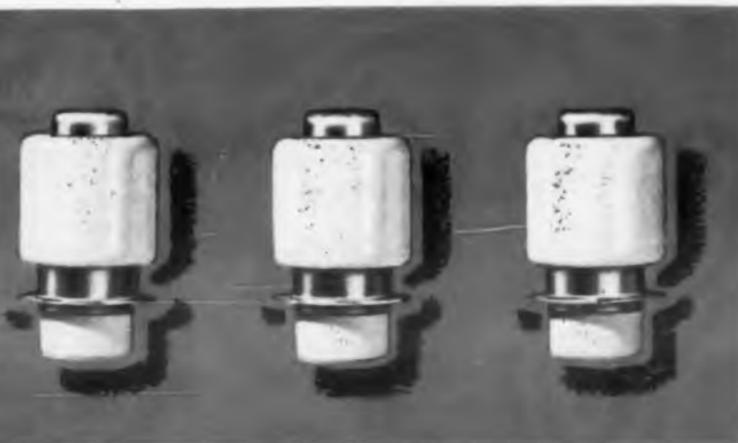
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Every manufacturing step is closely supervised in our own plant. Positive quality control assures strict adherence to specifications, absolute uniformity and reliability of completed components.

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FREE Technical Data



New Bulletins A-40 and A-35 describe Alite facilities and standard Alite High Voltage Bushings. Write for them now.

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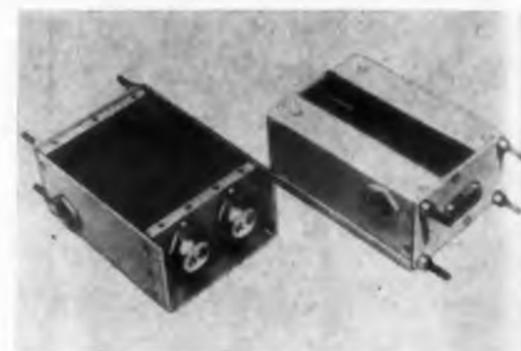
New York Office
60 East 42nd St.

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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-E-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 pup

ELECTRONIC DESIGN • August 5, 1959

series (2N1303, 2N1305, 2N1307, 2N1309) is 30 v and for the npn types (2N1302, 2N1304, 2N1306, 2N1308) 25 v. Collector current is 300 ma; emitter current 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.

Rud Radio, Inc., Dept. ED, 2118 E. 55th St., Cleveland 3, Ohio.

Booth 1311-1312

CIRCLE 366 ON READER-SERVICE CARD

boost reliability...
lower noise...
with the

extraordinary

CLAROSTAT SERIES 53



Get the extraordinary low noise, stability and reliability of the Series 53—don't settle for the ordinary. The exclusive Clarostat one-piece carbon contact design completely eliminates the inherent shortcomings of metal-to-metal moving contacts, resulting in lower noise, greater stability and longer life.

If your design deserves the best, specify Clarostat Series 53 molded carbon potentiometers. Write for complete technical details . . .

- Low noise, greater stability, longer life.
- Full 2-watt rating at 70 C.
- Gold-plated terminals molded in place.
- Grease seal around shaft.
- Zero backlash.
- Available in completely encapsulated units for maximum environmental protection.

SPECIFICATIONS

- ◆ POWER RATING: 2-watts at 70°C
- ◆ RESISTANCE RANGE: Linear—50 to 10 meg. Tapered—250 to 5 meg. (Right or left-hand)
- ◆ INSULATION BREAKDOWN: Between terminals and ground for 1 minute, 1000 v.d.c.
- ◆ SWITCHES: SPST, SPDT, DPST
- ◆ TORQUE: 1 to 6 oz. in. Up to 20 oz. in. with jam nut bushing.
- ◆ EFFECTIVE ROTATION: 312° ± 3°
- ◆ CONSTRUCTION: Meeting requirements of MIL-R-94 where applicable.



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CIRCLE 367 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

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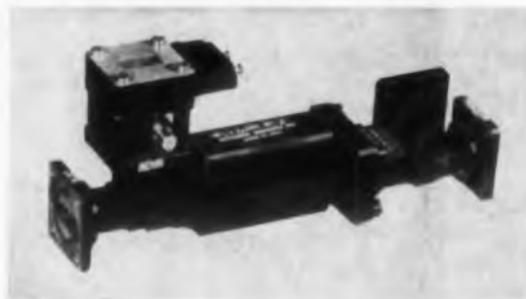
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MURRAY HILL, NEW JERSEY



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 μ sec, 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 μ pf.

International Telephone and Telegraph Corp., Components Div., Dept. ED, Clifton, N.J.

Booth 2510-2512

CIRCLE 377 ON READER-SERVICE CARD

Data Storage Units

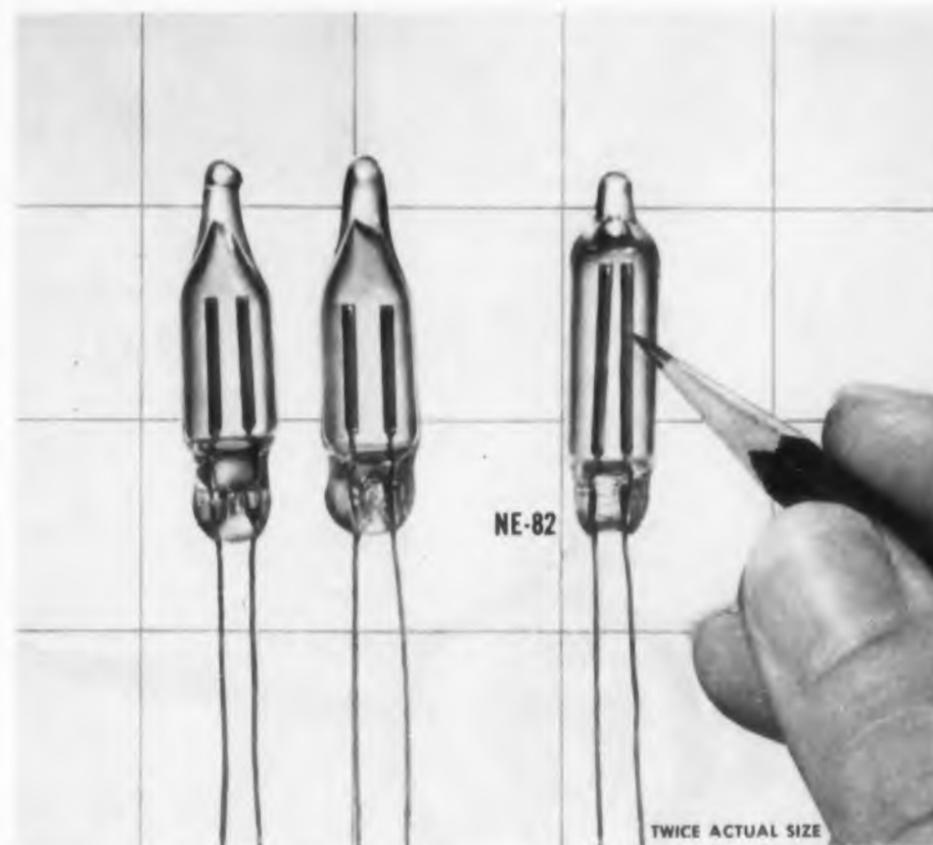
Have 200 kc operating rate

Series RB memory-buffer data storage units offer addressable random access, 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



New NE-82 shown with other G-E Glow Lamps

**LONGER ELECTRODES on G-E
NE-82 Glow Lamp permit up to
5 times higher current loadings**

(up to 1.5 m.a.)

The General Electric NE-82 Glow Lamp has controlled characteristics and was specifically engineered for higher current loadings—up to five times higher than most other circuit component glow lamps. Its lengthened electrodes insure a longer period of stable operation at higher loadings than glow lamps having shorter electrodes.

Special techniques developed by General Electric bring the G-E NE-82 a condition of stability; this helps the NE-82 provide uniform performance within established, predetermined limits. The leads of the G-E NE-82 have been plated for soldering ease. The NE-82 also uses the new "formed tip" construction for minimum over-all length.

DIRECT CURRENT CHARACTERISTICS

Starting Volts	62-78-Volts d-c
Operating Volts (up to 1.5 m.a.)	50-60-Volts d-c
Extinguishing Volts (in series with .25 megohms or more).	50-Volts d-c
Design Current	1.5 m.a.
Life—Change in Starting and Operating Volts at 1.5 m.a. + 5-Volts in 2,000 hours.	

Select the General Electric Glow Lamp best suited for your circuit requirements. For further information write for "Glow Lamps as Circuit Components", General Electric Co., Miniature Lamp Dept. M-903, Nela Park, Cleveland 12, O.

Progress Is Our Most Important Product

GENERAL  ELECTRIC

keyed for automation



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

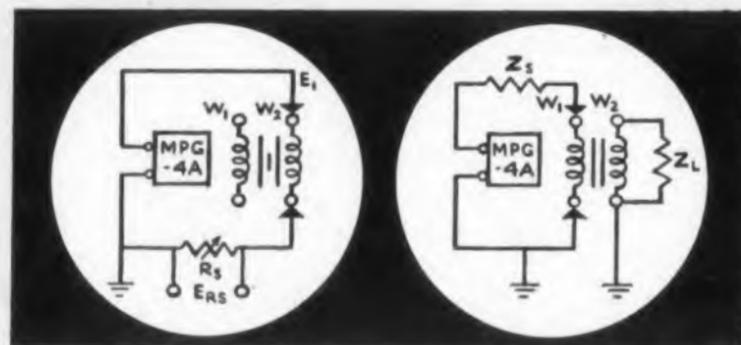
PM STYLE PULSE TRANSFORMERS by PCA ELECTRONICS are designed to serve a wide range of applications.

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

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**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

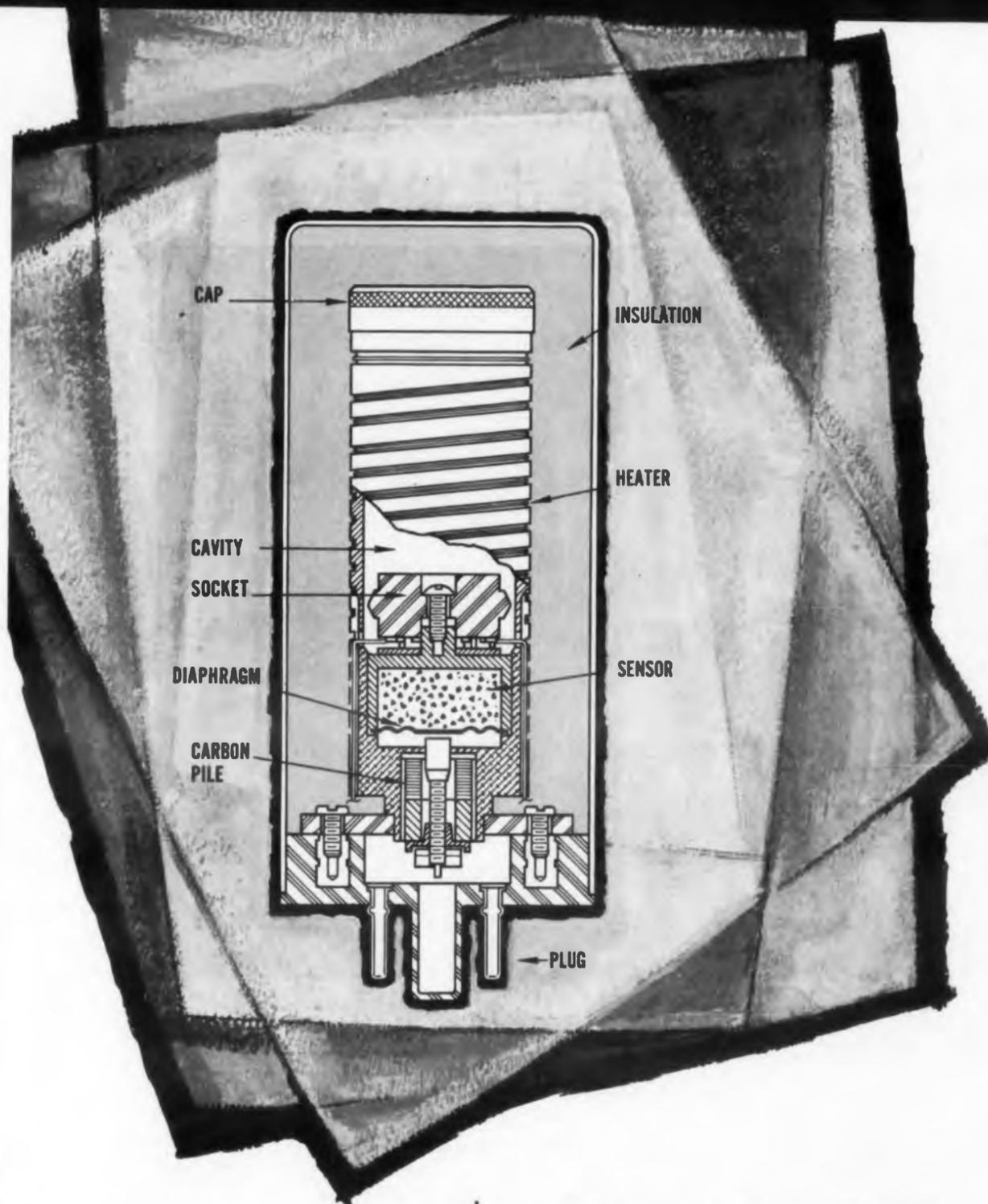
Has less than 8 μ sec rise time

Pulse generator B-5-A has a less than 8 μ sec rise time. It has an electronic pulse delay that can be set to zero or is continuously variable from 0.030 to 500 μ sec in five ranges. This generator has a fixed delay of 0.1 μ sec between the synchronizing pulse out and the main pulse. The pulse width is continuously variable from 0.02 to 12.5 μ sec 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 >



**NOW —
CIRCUIT
SIMPLICITY
THROUGH
ABSOLUTE
TEMPERATURE
CONTROL**

Robertshaw Crystal Oven Solves Temperature Compensation Problems

Design engineers can now eliminate temperature compensating circuits and still use inexpensive, temperature sensitive components by housing critical elements in Thermal-Set, Robertshaw's latest change-of-state crystal oven. The reason—Thermal Set's extremely accurate temperature control. To accomplish this, Robertshaw has incorporated two basic features uncommon to conventional ovens—thermal stability and thermal constancy. Thermal stability, or the absence of temperature drift with time, is attained by using the melting point of pure crystalline salt as an absolute and unvarying temperature reference standard. Thermal constancy, the absence of cyclical temperature variation, results from using a proportional heat control system. Combined, these features offer unmatched thermal accuracy... the key to optimum system performance.

SPECIFICATIONS Standard Cavity Temperature: 53°C, 70°C, 87°C. Temperature Control: 0.007°C average cavity temp. change per degree ambient change. Heater Voltage: 6.3 volts AC or DC \pm 5%. Heater Power: 4.0 watts max. @ 25°C. External Dimensions: 1-7/16" x 1 7/8" x 4-1/16" seated height. Cavity Dimensions: 0.92" dia. by 1.625" deep. Weight: Approx. 6.15 oz. Mounting: Octal Plug. Cavity Sockets Available: Standard 2 or 9 pin. Special configurations and more exacting performance characteristics available on special order. Complete information in Technical Bulletin RF-594. Robertshaw-Fulton Controls Co., Aeronautical and Instrument Division, Santa Ana Freeway at Euclid Avenue, Anaheim, California.

APPLICATIONS

Crystals
Crystal Oscillator Circuits
Zener Diodes
Thermocouple Reference
Junctions
Transistorized Circuitry
Tuning Forks
Thermistors
Reference Networks
LC and RC Oscillator Circuits

ON DISPLAY AT WESCON

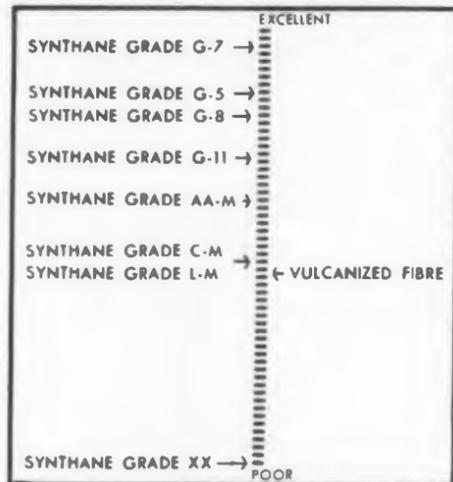
Booth 3405-07

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



Relative Arc Resistance of Several Plastic Laminates and Vulcanized Fibre.

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.

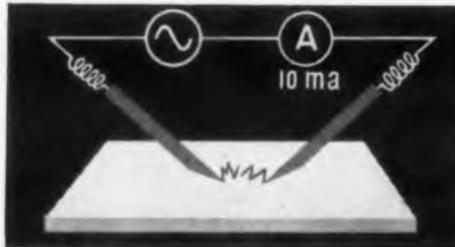
It is this failing of the phenolic grades which may have deterred you from thinking of laminates when arc resistance was required. But, outstanding progress has been made to supply laminates with excellent arc resistance. For example, Grades CM, LM, G-5 and G-7 have outstanding arc resistance properties.

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, $\frac{1}{4}$ " 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 Chamber:

Have ranges from -70 to $+320$ C



Bench type BC and rack type RC temperature test chambers are contained in metal cabinets $17\frac{1}{2} \times 12 \times 22$ 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 $8 \times 9\frac{1}{2} \times 8$ in. work chamber.

Satham 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.

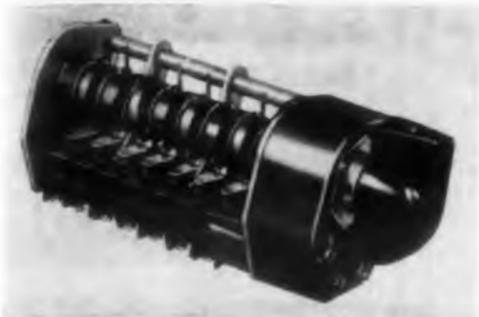
Menlo Park Engineering, Dept. ED, 711 Hamilton Ave., Menlo Park, Calif.
Booth 311

CIRCLE 385 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959

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 $\pm 1\%$ 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

Count, Read, Print

with CMC's
COMPLETE NEW PACKAGE

✓ UNIVERSAL COUNTER & TIMER

0 cps to 1 mc
3 microseconds to
1,000,000 seconds

✓ READABLE READOUT

Inline-Inplane, up to
12 presentations
per second

✓ FAST PRINTER

Permanent printed
record at 4 lines
per second



CMC's complete counting, timing, and frequency measuring system for laboratory and industrial use.

KEY SPECIFICATIONS

Model 226A Universal Counter & Timer		
Ranges		
Frequency	0 cps to 1 mc.	
Time Interval	3 μ sec to 10^6 sec	
Period	10 μ sec to 10^6 sec	
Accuracy	± 1 count \pm crystal stability	
Crystal Stability	± 3 parts in 10^6 per week	
Sensitivity (all functions)	0.2 v rms	
Oscilloscope Trigger Level Marker Signals	Start and stop channel trigger level adjustment for time interval measurement of complex wave forms; trigger level adjustment for amplitude discrimination in frequency and period measurement.	
Decimal Point Indication	Automatic	
Price (f.o.b. factory)	\$1100.00	
	Model 400C Digital Printer	Model 401A In-Line Readout
Capacity	6 digits — Up to 12 digits optional	6 digits
Max. Cycling Rate	4 lines per second	12 presentations per sec.
Digit Size		1 3/4" W x 2 1/4" H
Accuracy	Identical to counting instrument	
Input Requirements	4 line 1-2-2-4 code from counting instrument (adaptable to 1-2-4-8)	
Price (f.o.b. factory)	\$950.00	\$870.00

Now, at the lowest cost in the industry, you can get high quality advanced counting, timing, and frequency measuring instrumentation from CMC.

Using CMC's new readable readout and fast printer working in combination with the Model 226A 1 mc Universal Counter and Timer, you can measure, read, and record frequency, frequency ratio, period and time interval. Thru the use of standard transducers, basic physical quantities such as pressure, velocity, acceleration, displacement, flow, rps, and rpm can be measured, read, and permanently recorded. The Model 226A is also a convenient secondary frequency standard providing a time base for other instrumentation. All instruments feature unitized construction for structural strength and reduced weight.

Compare these key specifications before you choose.

For a demonstration, contact your nearest CMC engineering representative. For complete technical information, please write Dept. 198.



Computer- Measurements Corporation

A Division of Pacific Industries, Inc.
12970 Bradley Ave., Sylmar, California

CIRCLE 388 ON READER-SERVICE CARD

FOR MORE
INFORMATION

GREATER
ACCURACY

EASIER
READABILITY

Specify



Industrial
Products
Division



LARGE SCREEN OSCILLOSCOPES

Why squint at a conventional 5" scope when an ITT Large Screen Oscilloscope can assure you faster and more accurate observation and measurement without operator fatigue?

Use of magnetic deflection systems makes large-screen display practicable and permits close control over linearity and orthogonality. The large display provides vernier readability that increases speed of operation, reduces reading errors and operator eye strain, and permits observation of minute details that might remain unnoticed on a conventional scope.

APPLICATIONS

ITT Large Screen Oscilloscopes are precision engineered for effective use in such operations as Telemetry, Production Testing, Waveform Analysis, Computer Readout, X-Y Plotting, Data Plotting, and Medical Observation. Their large screen size makes them ideally suited for teaching, demonstration, or exhibition.

CHOICE OF MODELS AND SIZES

ITT Large Screen Oscilloscopes are available in either 17-inch or 21-inch rectangular tube models, cabinet or rack mounted. Models are also available without sweep and sync circuits for monitoring.

Write, Wire, or Phone for complete technical data and price information on Large Screen Oscilloscopes as well as other products of ITT Industrial Products Division, including Swept Frequency Generators, Storage Tube Scopes, Test Instruments, Custom Power Equipment, and Closed-Circuit Television.



Industrial Products Division

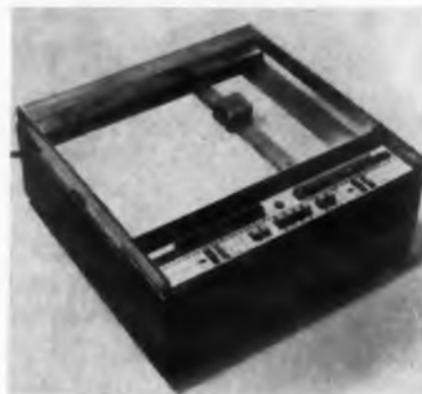
INTERNATIONAL TELEPHONE & TELEGRAPH CORPORATION
15191 BLEDSOE STREET • SAN FERNANDO, CALIFORNIA
TELEPHONE EMPIRE 7-6161

CIRCLE 389 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

X-Y Plotter

Has pushbutton controls



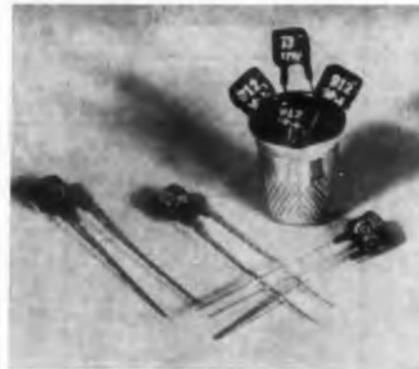
Featuring pushbutton controls and a full vernier control range, the model 210 X-Y plotter has a static accuracy of $\pm 0.1\%$ and a dynamic accuracy of $\pm 0.2\%$ at 10 ips tracing speed. Separate switching circuits for X and Y references permit translation of X and Y origins to any position in the 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

MEASURE
ATTENUATION

DIRECTLY
up to 30 db

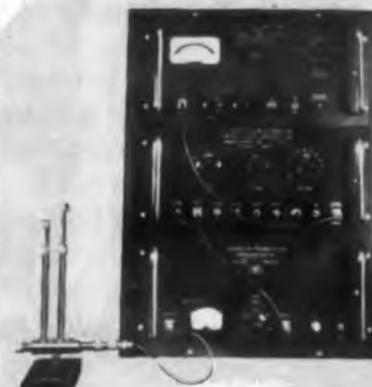
WEINSCHEL

single channel
INSERTION LOSS
TEST SET

Maximum systems error: .1 db
Resolution about .02 db
Frequency Range: 20 MCS to
90,000 MCS

KEY

INSTRUMENTS



**Bolometer Preamplifier,
Model BA-1B**

Features wide dynamic linear range, extremely low noise level, cannot burn out barretter.

**AF Substitution Attenuator for
RF Square Law Detector,
Model CF-1**

Calibrated directly in rf power ratios; has high input impedance, low output impedance.

**Audio Level Indicator,
Model IN-1**

Precharging circuit reduces required observation time. Has adjustable indicator time constant, low noise level.

Double Stub Tuner, DS-109

For theory, method, required instruments and recommended accessories, request Application Notes #1.

Weinschel Fixed Coaxial Attenuators cover the frequency range of DC to 12 KMC.

Write for complete catalog, specifying frequency range of interest.



Weinschel Engineering
KENSINGTON, MARYLAND

CIRCLE 392 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959

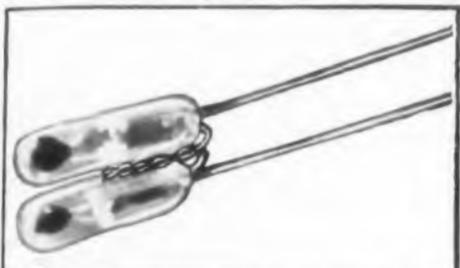
Using Thermistors

Edited by
FENWAL ELECTRONICS

NEW "IDENTICAL"
THERMISTORS PERMIT
COMPLETE INTERCHANGEABILITY

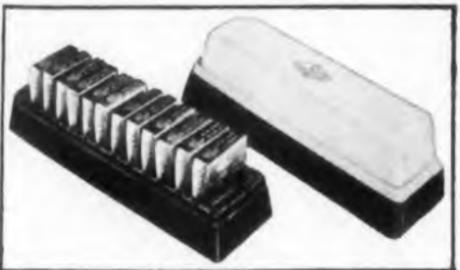
Now thermistor probes can be supplied with identical resistance temperature curves. These thermistors will meet a nominal curve tabulated in absolute resistance values at 1°F increments from 0°F to 350°F. All probes will be within ±2% of resistance at any temperature point on the curve.

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.

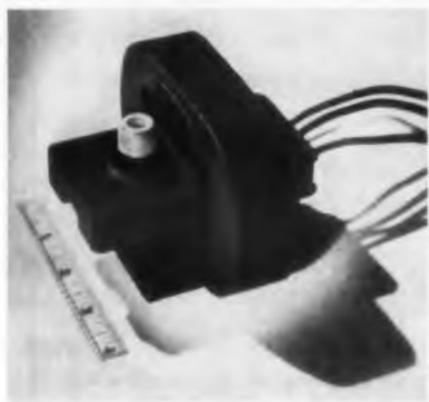


Making Precision Thermistors
Make Your Design Ideas Come True

CIRCLE 393 ON READER-SERVICE CARD

Magnetron Package

Voltage tunable



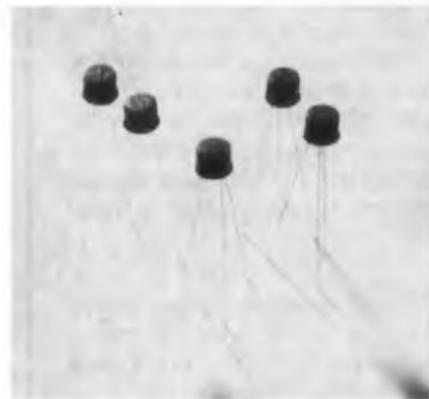
A complete radio frequency power source package, the model GL-7398 consists of a voltage tunable magnetron tube, a radio frequency circuit or cavity, and a magnet. It is voltage-tunable over part or all of a frequency spectrum from 2200 to 3850 mc with a minimum cw power output of 2 w across the full 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

BIRD

"Termaline"
DIRECT
READING
RF LOAD-
WATTMETERS
SERIES 6100



MODEL 612
Models 61 and 611
are identical in
appearance

These popular direct reading instruments measure and absorb power in 50 ohm coaxial line systems through the range of 30 to 500 mc.

They are portable and extremely useful for field or laboratory testing . . . checking installation of transmitters . . . trouble shooting . . . routine maintenance . . . production and acceptance tests . . . transmitter tune-ups . . . measuring losses in transmission lines . . . testing coaxial line insertion devices such as, connectors, switches, relays, filters, tuning stubs, patch cords and the like . . . accurately terminating 50 ohm coaxial lines, and . . . monitoring modulation by connecting phone, amplifier or audio voltmeter to the DC meter circuit.

Power scales for Model 61 Special are made to meet your requirements.

See us at
Wescon Show

WRITE FOR BULLETIN TW606

SPECIFICATIONS

RF INPUT IMPEDANCE: 50 ohm nominal.

VSWR: Standard specification 1.1 to 1 maximum over operating range.

ACCURACY: 5% of full scale.

INTERNAL COOLANT: Oil.

POWER RANGE: Model 611—0-15, 0-60 watts full scale. Model 612—0-20, 0-80 watts full scale.

INPUT CONNECTOR: Female "N".

EXTERNAL COOLING METHOD: Air Convection.

RADIATOR STRUCTURE: All Aluminum.

FINISH: Bird standard gray baked enamel.

WEIGHT: 7 pounds.

OPERATING POSITION: Horizontal.



"ThruLine"
Directional
RF Wattmeters



"Termaline"
RF Load Resistor



Coaxial
RF Filters



Coaxial
RF Switches



BIRD ELECTRONIC CORP.
EXpress 1-3535
30303 Aurora Road, Solon, Ohio

CIRCLE 396 ON READER-SERVICE CARD

Simpson's New VOM

featuring . . .

1½% Accuracy

Excellent Repeatability

Predictable Accuracy
over wide temperature range



Photo courtesy of Admiral Corp. Engineer shown is using the Model 270 in evaluating operating characteristics of developmental type deflection tube.

Do you need to check day-to-day variations in circuit operation? Or know what accuracy you're getting at different temperatures? If so, you especially will appreciate the capabilities of this new volt-ohm-milliammeter. For example, any particular voltage value will give identical readings today, next week, next month at an accuracy you can pinpoint from 67° to 87° F. The 270 is an engineer's VOM. Its base accuracy of 1½% DC (77° F, at full scale) covers a wide range of critical checks. It is portable, self-powered, built to have the rugged dependability typical of all Simpson VOMs. Accessories include carrying case and a variety of probes. Look it over at your Electronic Parts Distributor soon.

DC Voltage (20,000 ohms-per-volt): 0-250 mv; 0-2.5 v; 0-10 v; 0-50 v; 0-250 v; 0-1000 v; 0-5000 v. (Accuracy, 1½%)
AC Voltage (5000 ohms-per-volt): 0-2.5 v; 0-10 v; 0-50 v; 0-250 v; 0-1000 v; 0-5000 v. (Accuracy, 2%)
AF Output Voltage (With .1 microfarad internal series capacitor): 0-2.5 v; 0-10 v; 0-50 v; 0-250 v.
Volume Level in Decibels (Zero DB equal to 1 milliwatt across a 600-ohm

line): -20 to +10 DB; -8 to +22 DB; +6 to +36 DB; +20 to +50 DB.
DC Resistance: 0-2000 ohms (12 ohms center); 0-200,000 ohms (1200 ohms center); 0-20 megohms (120,000 ohms center).
Direct Current: 0-50 mu a; 0-1 ma; 0-10 ma; 0-100 ma; 0-500 ma; 0-10 amp.
Model 270, complete with test leads and Operator's Manual \$5995

Model 270

AC-DC VOLT-OHM-MILLIAMMETER

- MIRROR SCALE
- ½% RESISTORS
- GOLD BONDED DIODES
- FAMOUS "STAY ACCURATE" MOVEMENT
- POLARITY SWITCH

Simpson

ELECTRIC COMPANY

5202 W. Kinzie St., Chicago 44, Illinois
Phone: EStebrook 9-1121
In Canada: Bach-Simpson Ltd.
London, Ontario

WORLD'S LARGEST MANUFACTURER OF ELECTRONIC TEST EQUIPMENT

CIRCLE 397 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%.

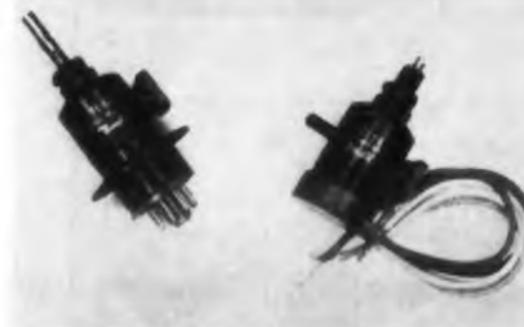
Southwestern Industrial Electronics Co., Dept. ED, 10201 Westheimer Rd., P.O. Box 13058, Houston 19, Tex.

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.

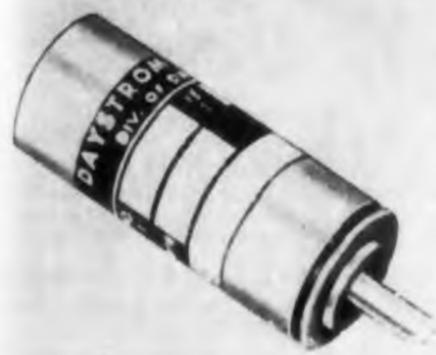
Booth 2007-2010

CIRCLE 399 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959

Damping Motor Generator

Weights 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 sec²; moment of inertia is 0.33 g-cm²; 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

reads easily, at a glance...



This new General Electric Type KT time meter measures operating time of any electrical equipment, speeds routine checking with "at-a-glance" readability. Big numbers are more than twice the size of ordinary meter digits. New low cost, too—in square, round, portable and sealed models. Totally enclosed construction means extra years of dependable operation. Increased operating temperature range (minus 67F to plus 150F) extends meter life, reduces maintenance. What's more, a **new sixth digit**—standard on all G-E models—offers more accurate range of measurement at **no extra cost!** Pass on these important benefits to your customers with time meters from the complete KT line. Also, specify G.E.'s Type TSA interval or process timers for dependable service on your automatic time-control applications. New BIG LOOK panel meters are available, too! For the full story on any of these instruments, contact your nearby G-E Apparatus Sales Office; or, write to Section 593-306, General Electric Co., Schenectady 5, N. Y. In Canada, contact Canadian General Electric Company Limited, 940 Lansdowne Avenue, Toronto 4, Ontario.

Other General Electric Instruments for Original Equipment Manufacturers
—Switchboard instruments; inking, inkless, switchboard and portable recorders; testing instruments; speed-measuring systems.

INSTRUMENT DEPARTMENT

GENERAL  ELECTRIC

CIRCLE 402 ON READER-SERVICE CARD



*your
Daily
guide*

at

WESCON



Late news, important announcements, meeting changes, new products . . . these are only a few of the features that make *Electronic Daily* in demand at WESCON.

Use *Electronic Daily* to plan your day at the show; select the booths you want to be sure to visit. If your company has a last-minute news item, get in touch with the *Daily's* editors. It's the main communication medium at the show. Look for your free copy each morning before breakfast in major hotels. Copies are also available at Hayden Booth 2311 at the Cow Palace.

NEW PRODUCTS AT WESCON

Hydrogen Thyatron

Carries 2000 amp peak current



Designed for switching service in radar modulators, the GL7390 hydrogen thyatron 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 30×10^9 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

new . . .

highest strength Aluminum Tubing

**ALUMINUM
ALLOY UT-58**



Readily Fabricated at room temperature without collapse or fracture in solution heat-treated form (55,000 to 60,000 psi tensile strength).

Precipitation Age-Hardened at very low temperatures without part distortion, to tensile strength of 70,000 psi min. in thin section; up to 83,000 psi in heavier wall section.

Extreme Resilience for an aluminum alloy in both tempers. Excellent strength-to-weight ratio.

Sizes from .010" O.D. to .625".

Wall Thicknesses from .042" to as thin as .001" in smaller sizes.

Tolerances from $\pm .0005$ " to $\pm .0002$ " on smaller sizes, if required.

Write for information on your requirements in tubing or tubular parts "fabricated at the mill," made from this latest addition to the Uniform line which includes many alloys of aluminum, copper, nickel, steel and the precious metals.

**UNIFORM TUBES,
INC.** 1200 Level Rd., Collegeville 2, Pa.
HUxley 9-7276



Chicago, Ill., HArrison 7-2215
Mishawaka, Ind., Blackburn 5-6439
St. Louis, Mo., PArkview 1-7784
Pasadena, Cal., RYan 1-9534
St. Paul, Minn., MIdway 5-4637
Ramsey, N.J., DAvis 7-5527
Cleveland, Ohio, WYoming 1-7900
Rochester, N.Y., HUbbard 2-3644
Kansas City, Mo., WEstport 1-2123
Clearwater, Fla., 32577

CIRCLE 406 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.

A discussion with permanent magnet specialists at The Indiana Steel Products Company may be just the stimulus your new design efforts need — or perhaps you'll find a way to improve your present products. In any case, you can be sure of this—*nobody knows permanent magnets like Indiana.* And, because Indiana produces all permanent magnet materials, Indiana design engineers are well qualified to recommend the one best material for your design. Why not call in an Indiana man today?

FREE CATALOG

Write TODAY for important, free, new catalog for microwave design engineers — "Alnico Load Isolator Magnets," which describes shapes, sizes and characteristics of this complete line of Indiana permanent magnets. Ask for Catalog No. 20M-8

THE INDIANA STEEL PRODUCTS COMPANY
VALPARAISO, INDIANA
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
ELECTRONIC DESIGN • August 5, 1959

HV Power Supply Has 0.01% per hr stability



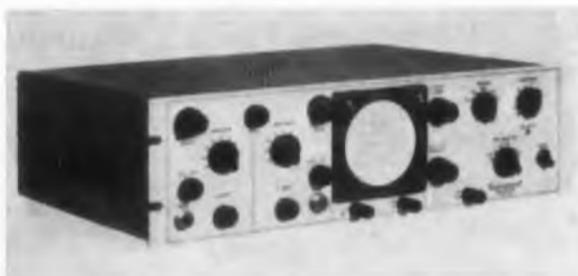
Power supply model 304 provides a continuously adjustable output of 500 to 2500 v at 25 ma. Load change is less than 0.002% for 0 to 25 ma output and regulation is 0.003% for line changes of 97 to 137. Ripple is less than 0.5 mv and stability is 0.01% per hr or 0.1% per day.

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

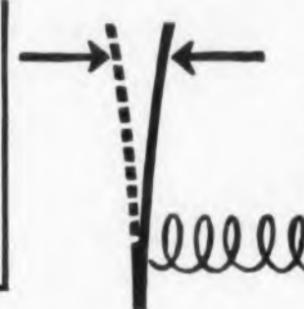
Subminiature indicator light socket 162-8430-931 accommodates T-1-3/4 incandescent lamps; socket 137-8536-931 holds NE-2D or NE-2J neon lamps. Both sockets mount in 15/32 in. clearance hole from front of panel.

Dialight Corp., Dept. ED, 60 Stewart Ave., Brooklyn 37, N.Y.

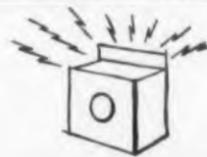
Booth 1404-1405

CIRCLE 410 ON READER-SERVICE CARD

Design Economies with Vibrating Reeds

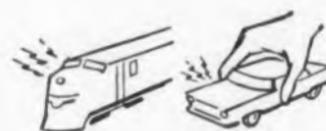


TIMING OR WARNING ALARMS



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



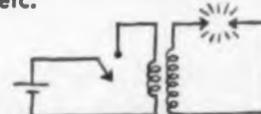
Typical application is for life testing devices such as relays which must be cycled rapidly. Cost is much lower than a geared motor with cam actuated switch performing a like function.

FREQUENCY SENSITIVE RELAY



Used with frequency generators as low cost remote controls for garage doors, television, etc.

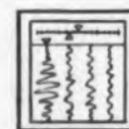
IGNITION DEVICES



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 source. Driving circuit isolated from chopper contacts. Now being used in medic and aircraft equipment. Frequency doubler chopper operates at 120 cps when driven by a 60 cps supply. Low cost 60 cps chopper for commercial use. Polarized, will follow a 60 cps source.

FREQUENCY GENERATOR



Typical uses include: 20 cps bell ringer, 60 cps timing motors for jobs such as operating taxi meters (eliminates ticking), 60 cps constant frequency unit ($\pm 1/2$ cps over a voltage range of 4 to 1) for precision timers, clocks, tape recorder meters, etc. The latter is an exclusive Oak patented design.

TEST EQUIPMENT



Used in instruments to check for "hot days" in insulation on pipe lines, measure insulation resistance, and test ignition systems and timing of cars.

HIGH POWER CONVERTER



In addition to units for all standard power ranges, Oak supplies a special high power vibrator (patented) which allows any number of vibrators to be operated simultaneously at the same frequency. Using this system, four vibrators can be handled as much as 500 watts on an intermittent duty cycle.

There are many ingenious ways to use vibrating reeds, which can lower costs through simplified design.

If you've got an idea you'd like to develop, Oak's engineering specialists will be glad to help you work it out. Contact them today.

Oak also supplies a complete line of conventional vibrators, custom-built for a specific application.

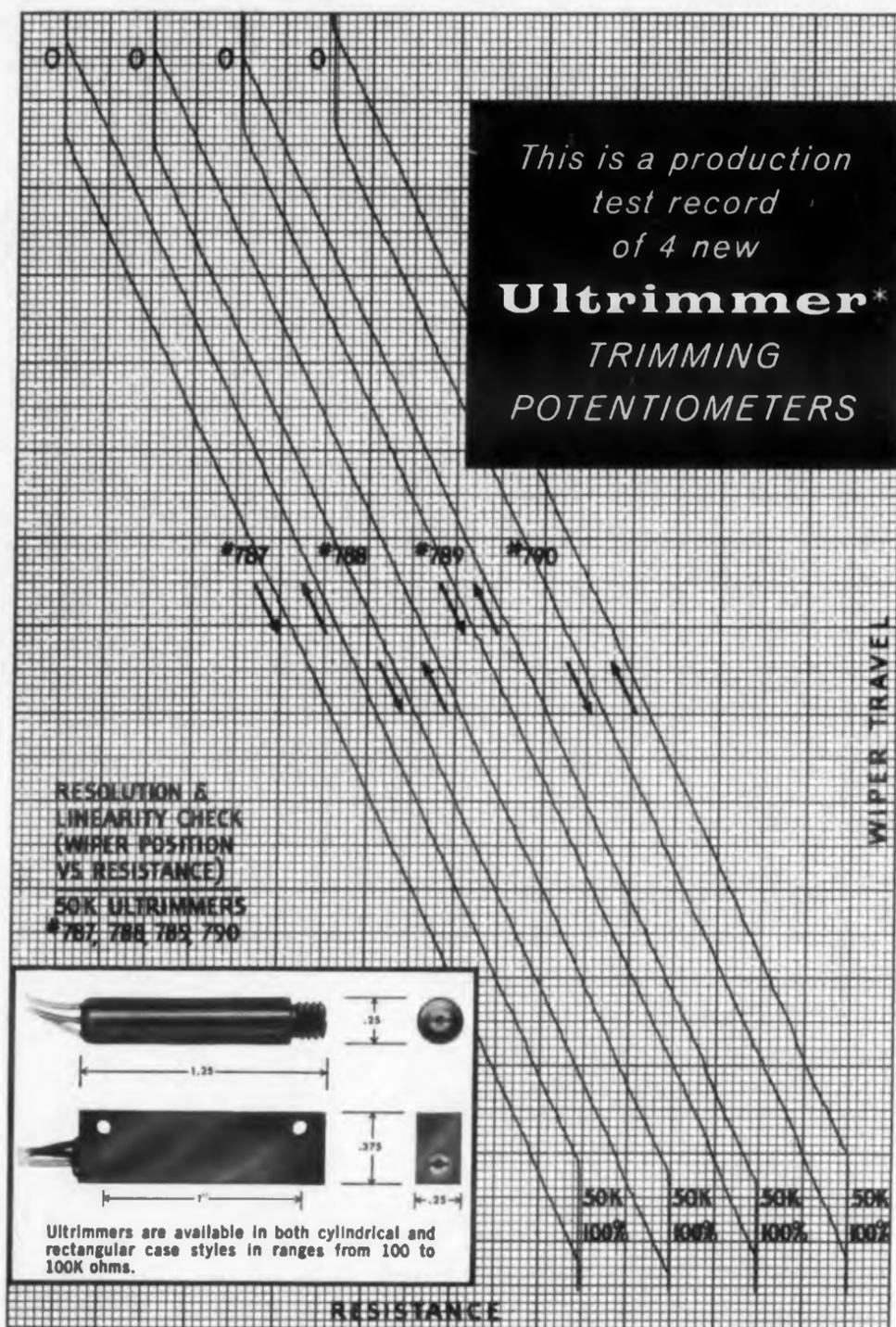
OAK

MFG. CO.



1260 Clybourn Ave., Dept. Chicago 10, Illinois
Phone: MOhawk 4-2222

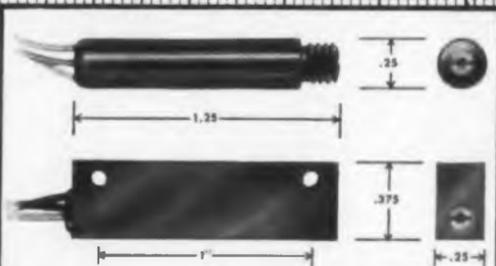
Specialized Applications with Vibrating Reeds



This is a production
test record
of 4 new
Ultrimmer*
TRIMMING
POTENTIOMETERS

RESOLUTION &
LINEARITY CHECK
(WIPER POSITION
VS. RESISTANCE)

50K ULTRIMMERS
#787, 788, 789, 790



Ultrimmers are available in both cylindrical and rectangular case styles in ranges from 100 to 100K ohms.

RESISTANCE

*REGISTERED TRADEMARK

- * Low temperature coefficient—25ppm per °C for finished trimmer
- * Moisture sealed
- * Zero end resistance—0.2 ohm max.
- * Closer tolerance—±5% standard, ±1% special
- * Encapsulated winding—±25 g vibration rating
- * Temperature range —65° to 150°C
- * Welded construction—element welded to terminal bands
- * Unique overtravel clutch
- * Adjust with Allen wrench or screwdriver
- * High resolution
- * Higher resistance for same wire size
- * Meets or exceeds all applicable military specifications

For complete information on the new Ultrimmer and the complete line of Ultrinix precision wirewound resistors, call your nearby Ultrinix engineering representative or write Dept. B8



Cutaway view of Ultrimmer

ULTRINIX



111 EAST 20th AVENUE
SAN MATEO, CALIFORNIA
Phone Florside 5-7921

CIRCLE 412 ON READER-SERVICE CARD

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

VISIT US AT THE
WESCON SHOW
Booth 610 Cow Palace,
San Francisco

*Electronics
Engineers!*

**YOU'D
BE
SURPRISED.**



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FREE technical
information available
to you... find
out by sending
for the FREE



VECO THERMISTOR-VARISTOR LITERATURE CATALOG

This handy reference catalog describes the VECO Technical Literature available for a variety of different applications of VECO Thermistors, Varistors and other VECO products.

CATALOGED IN EEM SEC. 4700

What You Should Know About

THERMAL-SENSITIVE
RESISTORS

THERMISTORS

AND

VOLTAGE-SENSITIVE

RESISTORS

VARISTORS

VICTORY
ENGINEERING CORPORATION

108 Springfield Road, Union, N. J.
MURdock 8-7150

CIRCLE 416 ON READER-SERVICE CARD

Locking screws with **LOCTITE** increases production **23%**



Assembling Hobbs hour meters

Mr. LeRoy L. Rasch
John W. Hobbs Div., Stewart-Warner Corp.
Springfield, Illinois, says:

"We all try to cut costs. For example, we used a resin-type product to hold screws in assembling Hobbs Hour meters. It was necessary for a girl to slip a little piece of wire into the compound, transfer it to the screw hole, and then assemble the screw. With 18 screws this was a slow and tedious job. We switched to LOCTITE Sealant and increased production while making the job easier for the girls. Operators now produce 23% more meters per hour thanks to LOCTITE! This increased production is accomplished by tumbling large batches of screws with LOCTITE in a polyethylene bag. The screws, treated and ready, are spread in front of the operator within easy reach. LOCTITE will not harden in air, but sets firmly when screws are assembled. LOCTITE saves us time and money by virtually eliminating the labor of applying the staking compound to the screws. LOCTITE cut costs for us with no effort at all."

LOCTITE is a thin liquid that hardens when confined between closely fitting metal parts. One drop replaces all size lock nuts, lock washers, lock screws, staking, jam nuts and interference threads. It forms a tough heat and oil resistant bond that resists any amount of vibration . . . yet ordinary tools will remove fasteners. LOCTITE requires no heating or mixing . . . treated parts can be stored for days . . . lock only when assembled. Write for literature and free sample.



LOCTITE SEALANT
AMERICAN SEALANTS COMPANY
183 Woodbine St., Hartford 6, Conn.
Distributed by bearing and industrial distributors

Capacitance Bridge

Measures 0.0002 to 1000 μmf



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 μmf . It can be used in temperature coefficient work, affording differential measurements with ± 1 ppm readability on nominal values above 200 μmf . 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

CIRCLE 417 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959

FILTERS for scatter systems



WHATEVER your requirements for large size filters, D. S. Kennedy can meet your most exacting specifications. Here are two recent developments for quadruple diversity scatter systems: *top* — a tunable low band duplexer for the 755-985 mc range. *Bottom* — a fixed-tuned double notch filter.

ANTENNA EQUIPMENT

D. S. KENNEDY & CO.

COHASSET, MASSACHUSETTS EVergreen 3-1200

West Coast Affiliate . . .

SATELLITE KENNEDY, INC. of CALIFORNIA

P. O. Box 1771, Monterey, California — FRontier 3-2461

Down-to-earth SOLUTIONS to out-of-this-world PROBLEMS

Tracking Antennas-Radar Antennas-Radar Antennas

"Trans-Horizon" Antennas-Troposphere Scatter,

Ionosphere Scatter

VISIT US AT THE WESCON SHOW—BOOTH #3527

CIRCLE 420 ON READER-SERVICE CARD

do you know...

that proper heat dissipation of a 10-3 type transistor operating at 12 watts would require a $\frac{3}{16}$ " thick aluminum heat sink the size of this $4\frac{1}{2} \times 10$ ad?

IERC TRANSISTOR HEAT DISSIPATORS

of the type shown here full size, are the thermal equivalent when mounted to a heat sink 60% smaller!

Proven design and heat dissipating effectiveness of the IERC components by conduction, radiation and convection assure you of time, cost, space and weight savings—plus reliability! Available in various heights. Write for IERC Test Report #114



IER



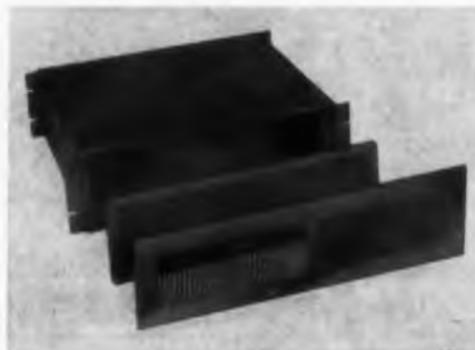
International Electronic Research Corporation
145 West Magnolia Boulevard, Burbank, California

CIRCLE 421 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Blower

Fits standard racks and cabinets

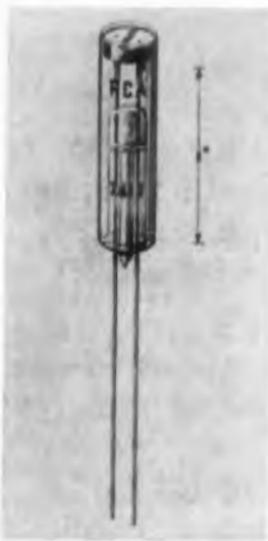


Depending upon its mounting position, the model B-25 Trans-aire can be used as an exhaust or intake blower. It has a two-speed 1/10 hp motor and operates on 110 v, 60 cps current, delivering either 550 or 250 cfm at 0 deg static pressure. The unit, which is 5-1/4 in. high, 14-1/2 in. deep, and 17 in. 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

Microwaves, Radar and Related Equipment

We are seeking an engineer with some experience to cover these technical areas editorially. If you know these fields and can write, you have an opportunity to join the rapidly expanding staff of the leading magazine in the electronic industry. Send resume with salary requirements to the address below.

Edward E. Grazda, Editor

ELECTRONIC DESIGN

830 Third Avenue

New York 22, N. Y.

CIRCLE 923 ON CAREER FORM, PAGE 77

dial any output



from 0-1000 volts



with 1% accuracy



Keithley Regulated High-voltage Supply gives you new speed and accuracy for a wide range of tests. Its many uses include calibration of meters and dc amplifiers, supplying voltages for photo-multiplier tubes and ion chambers, as well as furnishing potentials for high resistance measurements.

Three calibrated dials permit easy selection of the desired output in one volt steps, at up to 10 milliamperes. Polarity is selectable. Other features include:

- 1% accuracy above 10 volts.
- Line regulation 0.02%
- Load regulation 0.02%
- Ripple less than 3 mv RMS.
- Stability: within $\pm 0.02\%$ per day.
- Protective relays disconnect output at 12 milliamperes.
- Price: \$325.00.

Send for details about the Model 240 Supply.

KEITHLEY 
INSTRUMENTS, INC.
 12415 Euclid Ave., Cleveland 6, Ohio

CIRCLE 425 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

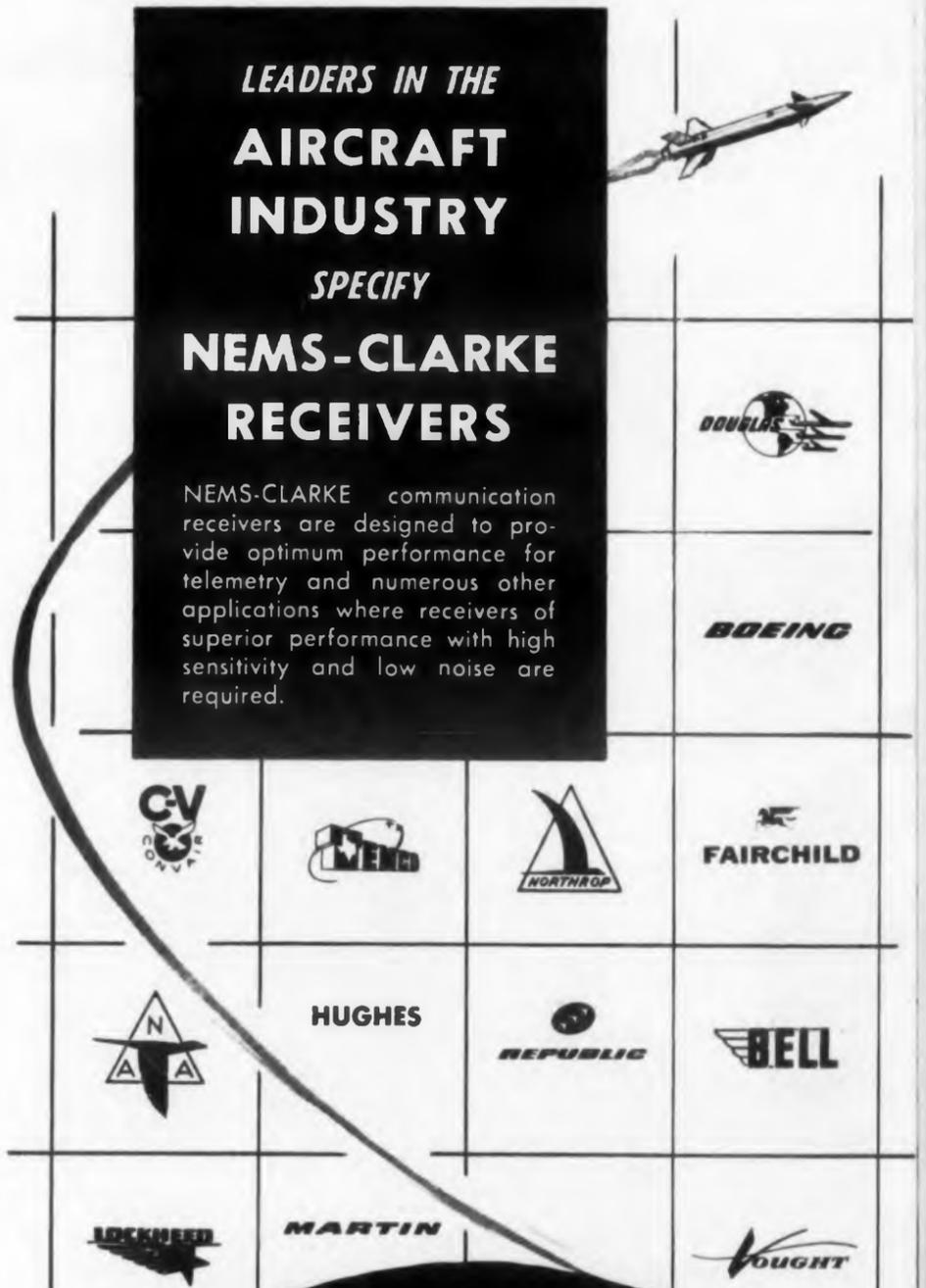
CIRCLE 427 ON READER-SERVICE CARD

LEADERS IN THE
**AIRCRAFT
 INDUSTRY**

SPECIFY

**NEMS-CLARKE
 RECEIVERS**

NEMS-CLARKE communication receivers are designed to provide optimum performance for telemetry and numerous other applications where receivers of superior performance with high sensitivity and low noise are required.



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VOUGHT

REU 300

PM 406

PR 203

PRECISION
 ELECTRONICS
 SINCE 1909

1432 RECEIVER

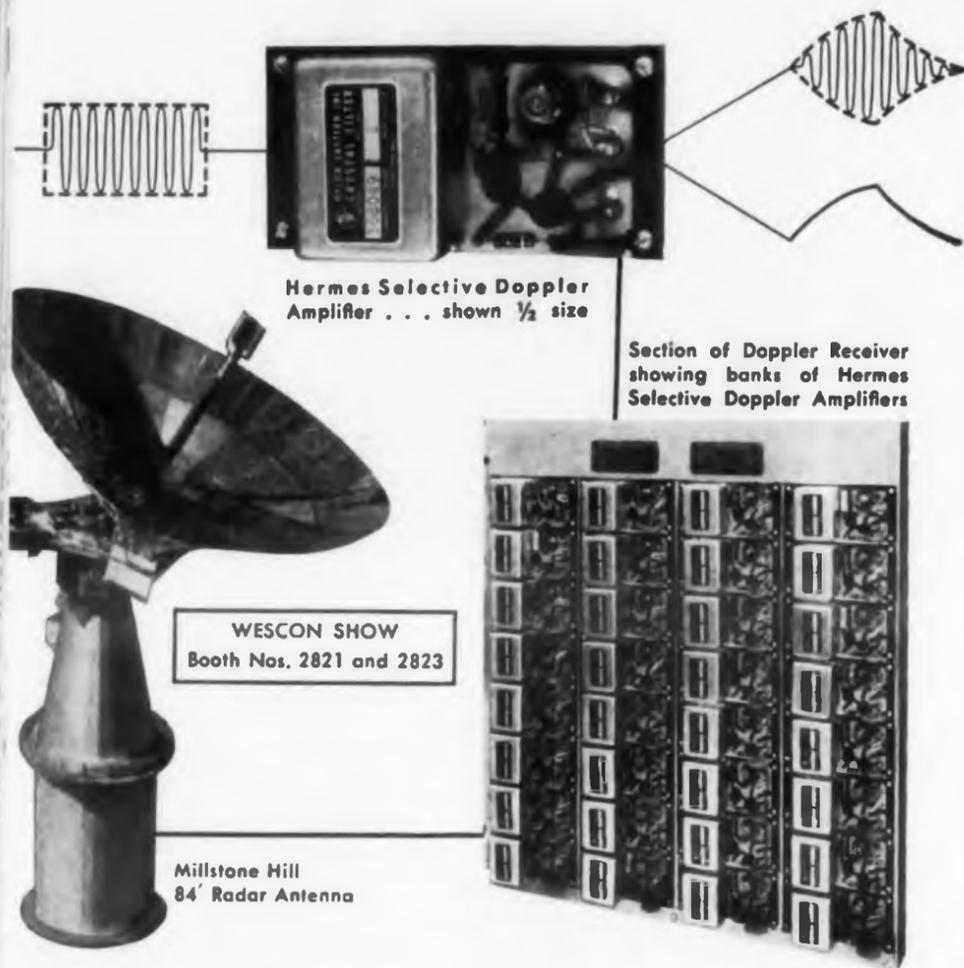
SDU 200

NEMS • CLARKE CO.

A DIVISION OF VITRO CORPORATION OF AMERICA
 919 JESUP-BLAIR DRIVE • SILVER SPRING, MARYLAND

CIRCLE 428 ON READER-SERVICE CARD

FIRST Radar System to Contact Venus Uses HERMES CRYSTAL FILTERS



Contact with Venus, a distance of 28,000,000 miles, was made by Lincoln Laboratory's powerful Millstone Hill Research Radar using low noise solid state maser preamplifiers. Exact pulse output and sharp noise rejection are made possible in the Millstone system through the use of Hermes "Comb Set" Crystal Filters and associated circuitry forming complete networks termed Selective Doppler Amplifiers.

Hermes offers a unique customer service by assuming total responsibility for exact pulse output when this is a system requirement. All crystal filters are tested and aligned under simulated operating conditions using a pulsed input. Transistor amplification, active impedance transformation, and detector circuitry are provided for complete compatibility with the total system. These integrated units are delivered ready for immediate use.

Hermes is presently supplying crystal filter banks for airborne intercept, bomber defense, shipborne and land based detection and tracking systems. *Write for Crystal Filter Bulletin.*

The new name for HYCON EASTERN, INC. is

Hermes Electronics Co.

75 Cambridge Parkway • Dept. F • Cambridge 42, Massachusetts



CIRCLE 429 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-16910A, 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

YTTRIUM-IRON GARNET



Actual Size

SINGLE CRYSTALS

for MICROWAVE APPLICATIONS

FERRIMAGNETIC SINGLE CRYSTAL YIG IS NOW AVAILABLE FOR MICROWAVE DEVELOPMENT.

LOW-LOSS YIG NOW ALLOWS GREATER FLEXIBILITY IN THE DESIGN OF

Pass or rejection band tunable filters

Compact circulators, isolators and gyrators

Ferrite parametric amplifiers

VHF and UHF components

Magneto-optical devices

Call or Write Department 12 for Data.

MICROWAVE CHEMICALS LABORATORY, INC.

282 SEVENTH AVE. - NEW YORK 1, N. Y.

CIRCLE 432 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959

Nixie display mon view and are a life ex design tubes. M minimum cathode Burro ED. Pla Booth 2

Used filter ne loy pow stability and +8 nominal Magn Booth 4

Solid- with all having a output. each dig match a four line standard quires 6 Comp Vineland Booth 20

ELECTR

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 $\pm 8\%$ 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



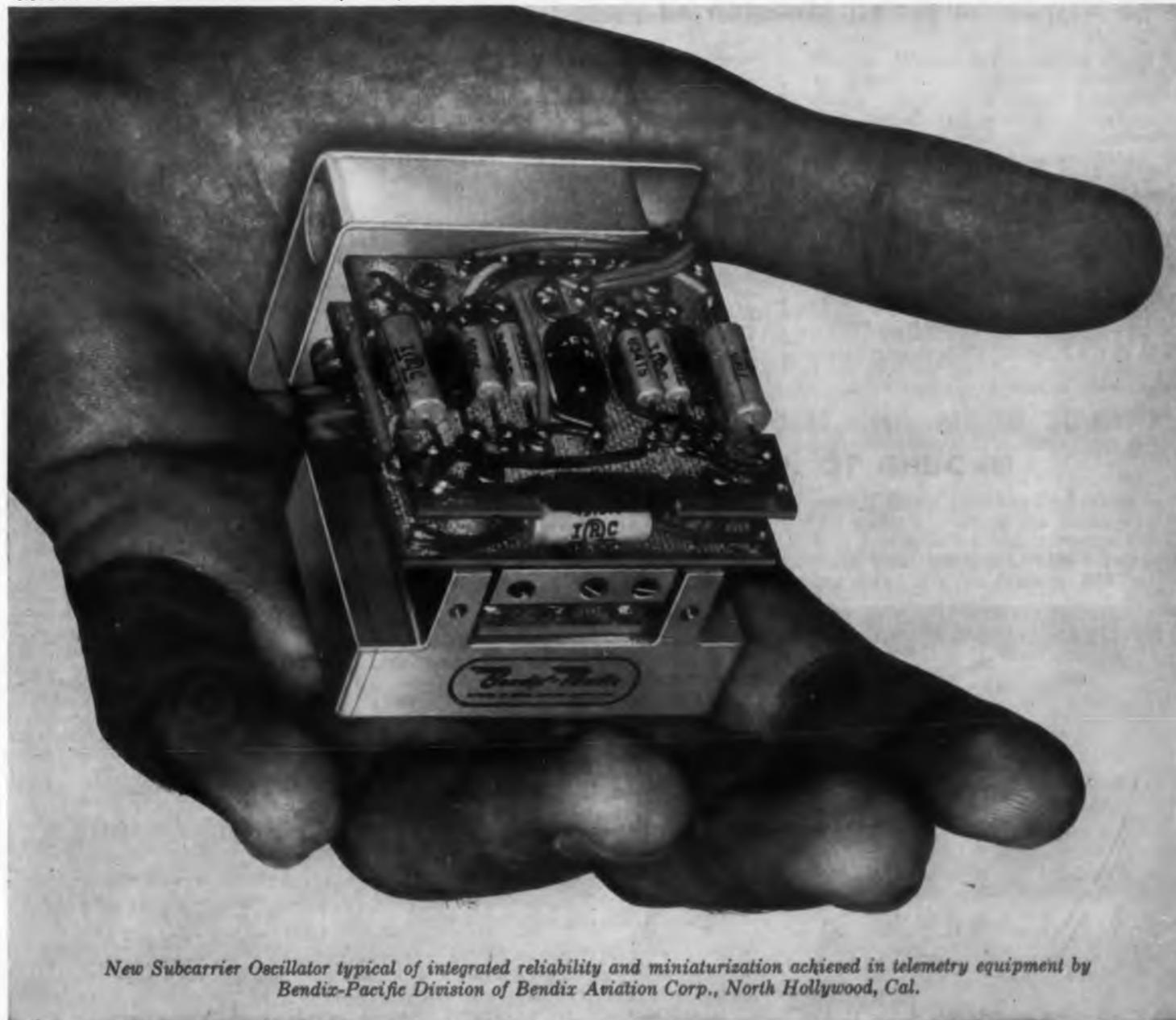
Small-World Resistors with out-of-this-world Reliability

Miniaturization is a severe test of performance, for reliability tends to shrink faster than size. Here, where critical equipment had to be made smaller, yet more reliable, Bendix-Pacific pinned performance to the reliability of IRC precision film resistors.

IRC Molded Metal Film Resistors combine excellent stability on load with a low, controlled temperature coefficient that is far superior to other precision film resistors. They exceed requirements for extremely close design tolerances and have excellent high frequency characteristics. Where these superior characteristics are not required, IRC Molded Deposited Carbon Resistors offer excellent all-around performance and economy. Both types available in $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1 and 2 watt sizes . . . and exceed MIL-R-10509B specifications. For design data, write for Bulletins B-3 and B-9.



INTERNATIONAL RESISTANCE CO. • Dept. 336, 401 N. Broad St., Phila. 8, Pa. In Canada: International Resistance Co., Ltd., Toronto, Licensee

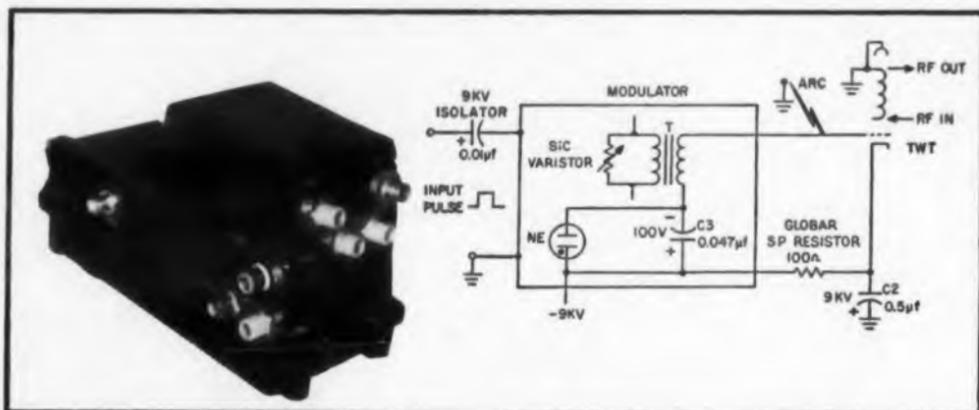


New Subcarrier Oscillator typical of integrated reliability and miniaturization achieved in telemetry equipment by Bendix-Pacific Division of Bendix Aviation Corp., North Hollywood, Cal.

CIRCLE 436 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 Global 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

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 Global Plant, Refractories Division, Dept. EDV89, Carborundum Co., Niagara Falls, N. Y.

CIRCLE 715 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



CERAMIC PARTS AND METALLIZED ASSEMBLIES GLASS-TO-METAL SEALS KOVAR ALLOY CERAMIC RESISTORS VARISTORS THERMISTORS

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 digital 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

Now DRY CIRCUIT TO HIGH LEVEL RELAYS

by Iron Fireman



The Iron Fireman 700, 780, 750 Series of Micro-miniature relays provide dry circuit and high level switching capacities in the same package (10 microamps at 10 millivolts to 2 amperes at 28 volts DC or 115 volts AC).

Available in a variety of header configurations and mounting styles, this latest Iron Fireman development provides excellent immunities to

high temperature, shock and vibration plus long life. Designed and tested to MIL-R-5757C, these relays have met and exceeded these specifications plus additional vibration and shock requirements and dry circuit loads.

Information on these new relays may be obtained by writing to the address below.

See us at WESCON booth 701-702



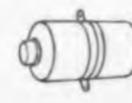
MICRO
MINIATURE
RELAYS



HIGH
SPEED
RELAYS



SLIP RINGS
AND
BRUSHES



FREE AND
VERTICAL
GYROS



IRON FIREMAN *Electronics* DIVISION

2838 S. E. NINTH AVENUE, PORTLAND 2, OREGON

CIRCLE 443 ON READER-SERVICE CARD

announcing

PROLENE

INSULATED WIRE AND CABLE

A Significant Advance in High Heat Resistant Insulation

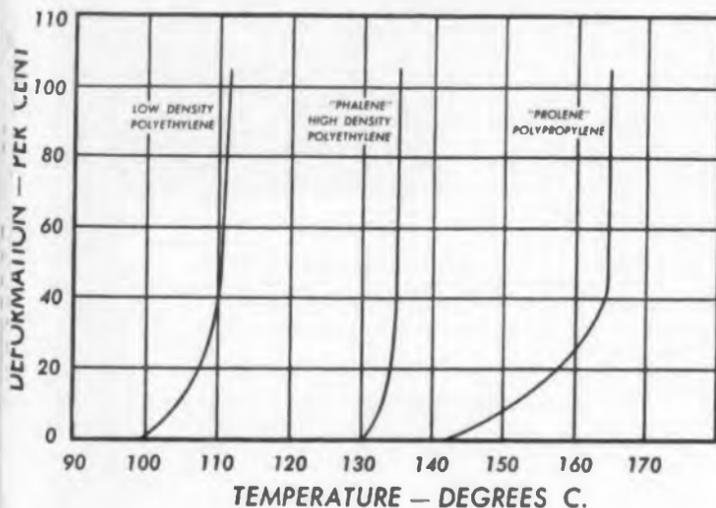
Phalo Plastics Corporation, through their program of research and development now offer "Prolene" insulated wire and cable to mark an important step forward in high heat resistant insulation.

Super light (0.9) specific gravity "Prolene" is tougher and harder and displays greater crush resistance than the two basic types of polyethylene in general use.

"Prolene" has good inertness and moisture resistance. It also resists solvents, greases, oils and many of the common acids and chemicals.

"Prolene" will find effective use where ambient temperature ranges have previously restricted wire and cable insulation to Teflon and Kel-F.

Chart shows typical comparative melt points of low density polyethylene—"Phalene" and "Prolene".



Ask for technical data on new "Prolene"

PHALO 530-7 BOSTON TURNPIKE
PLASTICS CORPORATION
SHREWSBURY, MASSACHUSETTS



Representatives in Leading Cities Throughout The U. S. A. 158-9

CIRCLE 444 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 band

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 than $\pm 2\%$, 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

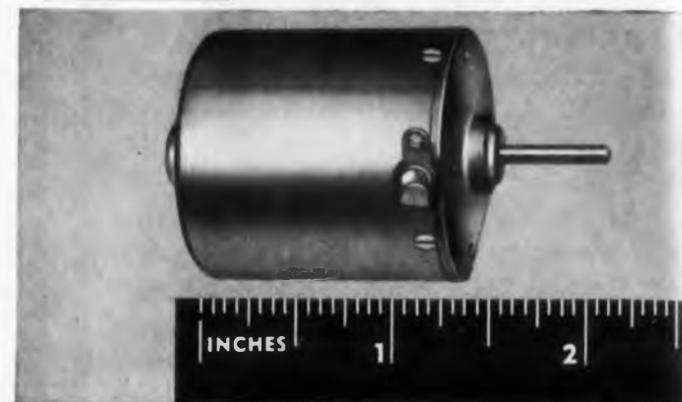
This 25 AWG shielded low-loss cable has a foam polyethylene insulation for lower capacitance and a spiral tinned copper shield to minimize interference. The conductor consists of four strands of tinned Copperweld and three strands of tinned copper.

Belden Mfg. Co., Dept. ED, 415 S. Kilpatrick, Chicago, Ill.
Booth 615-617

CIRCLE 447 ON READER-SERVICE CARD



can you use this miniature d-c motor in your product?



Inexpensive, yet high in quality, this compact governed d-c motor is available in speeds from 1500 to 5000 rpm. Designed to operate over a voltage range of about 4 to 30 volts d-c, it is ideally suited for many applications such as: drive mechanisms in photographic equipment . . . marine navigation equipment . . . portable dictating machines . . . signal-seeking radios . . . tape players . . . and many types of portable instruments. Is this the answer to your design problem, too?

WRITE FOR BULLETIN F-8792 for specifications and performance data.

BARBER-COLMAN COMPANY

Dept. T, 1883 Rock Street, Rockford, Illinois

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CIRCLE 449 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959



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



EXTREME THERMAL SHOCK

won't damage these
CERAMASEAL HERMETIC TERMINALS

SOME HAVE EVEN WITHSTOOD A SUDDEN 460°C CHANGE

With an alumina content up to 99%, CERAMASEAL terminals are not only mechanically strong, but some have even been transferred directly from liquid nitrogen into hot solder without cracking!

The CERAMASEAL molecular bond between the ceramic and metal flanges, caps or tubes is stronger than the high alumina ceramic.

Easy to install too, by conventional brazing, heli-arc welding or soldering techniques.

FOR COMPLETE INFORMATION, catalog and spec sheets, write Ceramaseal, Inc., New Lebanon Center, N. Y. or phone: West Lebanon 3-5851.

Hermetic Ceramic Terminals, Magnetron Wells, Sapphire-to-Metal Seals

CERAMASEAL, inc.



CIRCLE 452 ON READER-SERVICE CARD

specify ... G-E WET-SLUG TANTALYTIC* CAPACITORS

for miniaturized high capacitance, low-voltage transistor applications

- Completely sealed porous anode provides lowest impedance, per unit volume, of any capacitor.
- Insulated metal cases permit operating temperatures from -55 to +85° C.
- Meet 2000-cycle military vibration requirements.

FOR IMMEDIATE SPECIFYING INFORMATION contact your nearest G-E Apparatus Sales Office or write for free bulletin, GEA-7008, to General Electric Co., Section 449-10, Schenectady 5, N.Y.

*Registered trademark of General Electric Co.

GENERAL  ELECTRIC

CIRCLE 453 ON READER-SERVICE CARD

FREE!

from Alpha Metals

New Flux Finder Guide

A valuable aid, ALPHA's exclusive *New Flux Finder Guide* contains such data as:

- Coatings for reducing oxides in solder baths
 - Preventing reoxidation of base metals
 - High-speed fluxing for printed circuit dip soldering
- For your copy, act now!



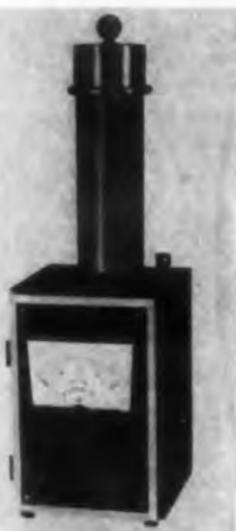
In Chicago, Ill.
ALPHA-LOY CORP.
2250 S. Lumber St.

Other ALPHA products:
Core & Solid Wire Solder
Solder Preforms
High Purity Metals

ALPHAMETALS, INC., 58B Water St., Jersey City 4, N.J.
Send me free your *New Flux Finder Guide*.

Name _____ Title _____
Company _____
Address _____
City _____ Zone _____ State _____

CIRCLE 454 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 μ amp. 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

relay delivery a problem?

Not when you buy from globe!

24 hour to ten day delivery on prototype relays

Engineering staff at your disposal Relays designed

and built to meet your specifications

Expanded production facilities for quantity
orders When delivery counts... call globe

Telephone, Telegraph or TWX-it collect



globe electrical mfg. co.

1729-45 west 134 street / gardena, california
FAculty 1-3311 TWX: COMPTON CAL 6092

relays / printed circuits / molded terminals
plastic fabrication / terminal boards

CIRCLE 455 ON READER-SERVICE CARD

188

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 cascable 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.

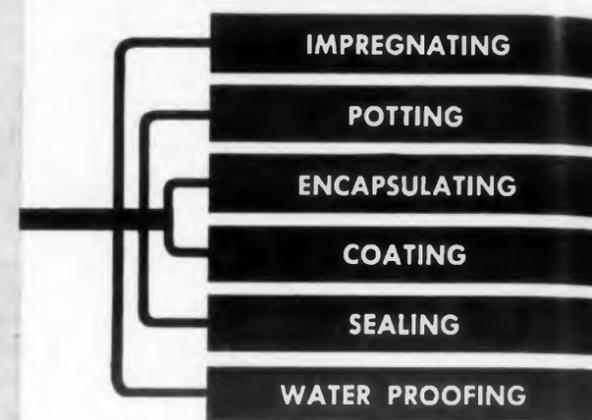
Lord Manufacturing Co., Dept. ED, Erie, Pa.
Booth 105-107

CIRCLE 458 ON READER-SERVICE CARD

specialists in **ELECTRICAL INSULATION FORMULATIONS**

Quality controlled formulations for
ELECTRICAL and ELECTRONIC MANUFACTURERS

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WRITE FOR BULLETIN NO. EP-56-48 (MOD 3)

4516 BRAZIL STREET
LOS ANGELES 39, CALIF.

furane plastics
INCORPORATED

FOR FUTURE TRENDS IN PLASTICS, FOLLOW furane

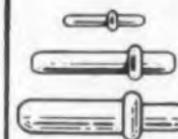
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50% SAVINGS

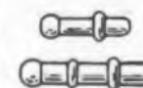
with

BEAD CHAIN® Multi-Swage Parts

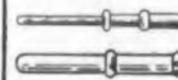
CONTACT PINS



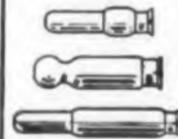
TERMINALS



JACKS



FRICION CONTACTS



also PRINTED CIRCUIT MINIATURE PARTS

Contact pins, terminals, jacks or
any small tubular parts. Maximum
1/4" diameter x 1 1/4" length.

Send sketch for quotations.

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Low-speed positive drives or motion transfer
... at far less cost!



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Bead Chain Drive Catalogs!

THE BEAD CHAIN MFG. CO.

58 Mountain Grove, Bridgeport, Connecticut
CIRCLE 460 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959 ELECTRO

a direct line
from **AEL**



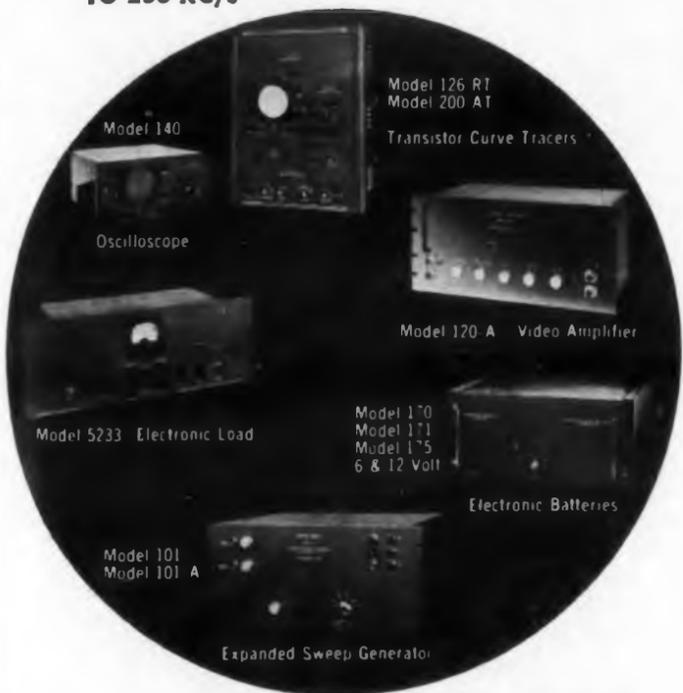
Model
138

PULSE GENERATOR
for use in

SONAR • VIDEO DESIGN • COUNTERMEASURES
• RADAR • ACOUSTICS • ANALOG and
DIGITAL COMPUTERS • PULSE THRESHOLD
CIRCUITRY • COMMUNICATIONS
• RELAY STUDIES • ETC.

The AEL "138"... A TRULY UNIVERSAL PULSER

- SINGLE OR RECURRENT PULSES
- PULSE PAIRS OR PULSE TRAINS
- PULSE WIDTHS FROM 1 μ SEC. TO 1 SEC.
- REVERSIBLE POLARITY
- 35 VOLTS into a 50 OHM LOAD
- ALL TYPES OF SYNCHRONIZATION
- REPETITION RATES FROM 1/2 CYCLE PER SEC. TO 250 KC/s



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121 N. 7TH ST. PHILADELPHIA 6, PENNA.

CIRCLE 461 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 pre-recorded 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



miniature - precision - wire wound
POWER RESISTORS

Extend the Range of
Power Unit Dependability



Actual Size

Now, to the famed "built-in" reliability of Silicon Resistors, Sage adds clip mounting assembly protection. Around a fully insulated resistor, Sage shrinks a nickel plated metal sleeve by its own specially developed process*. This shrinking process causes the sleeve to conform exactly to the resistor body, giving Sage Clippers these unique advantages over other metal sheathed units...

SMALLEST IN SIZE • Because the metal sleeve is shrunk around the resistor rather than being filled.

MOST POWERFUL • Because the close adherence of the sleeve to the resistor conservatively doubles Clipper power rating when heat sink mounted.

COOLEST • Because heat transfer to the metal shell is through a single medium of solidly packed insulation.

TOUGHEST • Because of Sage 100% silver brazed construction. *patent applied for

PLUS ADVANTAGES include precision to .05% tolerance, stability to within .5% for life, T.C. of ± 20 PPM/°C, dielectric strength of at least 1000 V-RMS.

Ready for delivery now in
3, 5, 7, 8 and 10 Watt Ratings

SPECIFICATIONS		DIMENSIONS		
Model	Power Rating	Max. Resistance	Length	Diameter
CS3W	3 Watts	30,000 Ohms	3/4" \pm 1/32"	1/4" \pm 1/32"
CSR5W	5 Watts	60,000 Ohms	1" \pm 1/32"	3/8" \pm 1/32"
CSS7W	7 Watts	80,000 Ohms	1 1/4" \pm 1/32"	3/8" \pm 1/32"
CSR7W	8 Watts	125,000 Ohms	1 3/8" \pm 1/32"	3/8" \pm 1/32"
CS10W	10 Watts	200,000 Ohms	1 7/8" \pm 1/32"	3/8" \pm 1/32"

Write Now for Descriptive Literature

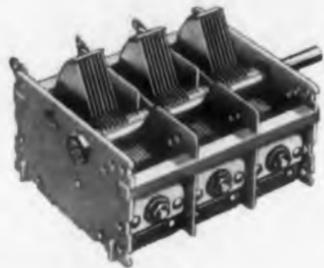


ELECTRONICS CORPORATION

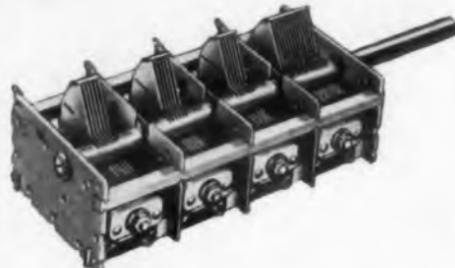
P. O. BOX 3926, ROCHESTER 10, N. Y.

CIRCLE 465 ON READER-SERVICE CARD

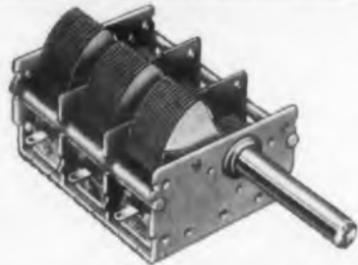
OAK Variable Capacitors



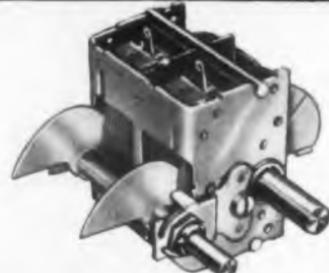
442.2 MMF max capacity per section; 13.5 MMF min (1, 2, 3, or 4 sections). Rugged frame has heavy tie-bars staked to end plates and shields. Soldered or brazed joints optional . . . MODEL 50



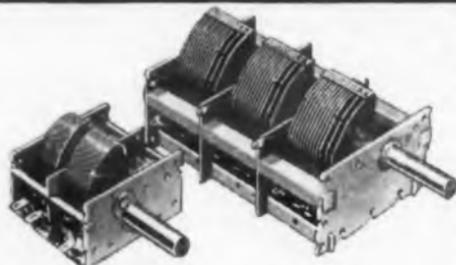
603 MMF max capacity per section; 13.5 MMF min (1, 2, 3, or 4 sections). Largest of Oak capacitors. Has same rugged construction as Model 50 shown at left MODEL 60



530 MMF max capacity per section; 14 MMF min (2 or 3 sections). High capacity in a medium size unit. Frame is strong, one-piece cradle type with reinforcing tie-bars MODEL 240



BAND SPREAD, MODEL 240—One or two sections only. Effective capacity of main section is 485.8 MMF max; of band spread section, 20.0 MMF max. Other data same as regular Model 240.



SPLIT STATOR, MODELS 240 and 60—Capacity must be worked out for each combination of split stator. Dimensions are the same as for regular Models 240 and 60, except terminal location.

Still Available as Quality Custom-Built Units

Yes, you can still get these well-known variable capacitors for your more demanding applications. Oak units meet today's most rigid electrical and mechanical requirements—including MIL specifications. They are widely used in quality test equipment and receivers for general communications. Designs are standard, but many variations are possible with little or no extra tooling. Call your Oak representative for a copy of the engineering bulletin shown at right or request one direct.

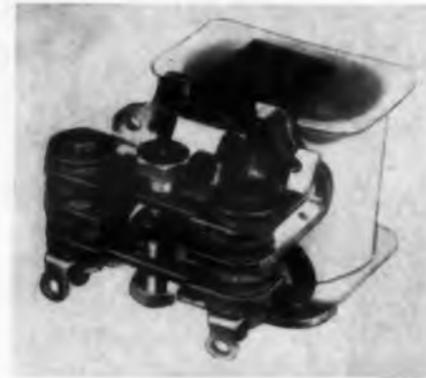


OAK MFG. CO. 

1260 Clybourn Avenue, Dept. D, Chicago 10, Illinois Phone MOhawk 4-2222

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.

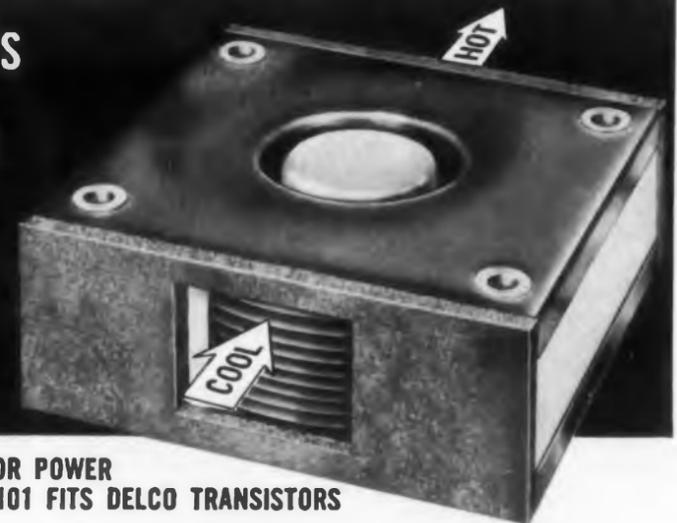
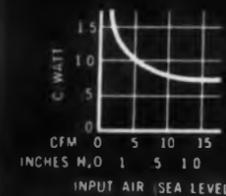
Emerson & Cuming, Inc., Dept. ED, 869 Washington St., Canton, Mass.

Booth 1105

CIRCLE 468 ON READER-SERVICE CARD

NEW-COOLS TRANSISTORS

GETS 46 WATTS AT ROOM TEMPERATURE



NEW HEAT EXCHANGER FOR POWER TRANSISTORS, MODEL LF-101 FITS DELCO TRANSISTORS

46 watts at room temperature are obtained under these conditions: 95°C junction temperature; thermal impedance of .8°C/W from junction to stud root, and .7°C/W between stud root and input air caused by the LF-101 (see above graph).

Send for complete data and informative paper, "Temperature Control in Electronic Equipment."

Gasket manufacturing company, inc.
DEPT. E 319 W. 17TH STREET, LOS ANGELES 15, CALIF.

This product featured in May 27, 1959 issue, pg. 122.

CIRCLE 469 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959

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



CLOSE-TOLERANCE PERFORMANCE



ON VERY TINY CURRENTS

WITHOUT SIGNAL AMPLIFICATION api VHS* MEASURING RELAYS SENSE AND SWITCH ON SMALL INPUT

*Very High Sensitivity with exceptional reliability are inherent characteristics of the A.P.I. measuring relay. It will actuate on inputs as small as 0.2 microampere or 0.1 DC millivolt to give you discrete switching action at the precise current or voltage value you specify.

The VHS measuring relay has the ability to differentiate between "normal and abnormal", "yes and no" on the basis of very minute electrical variations. In typical cases, it monitors 450 volts to $\pm 5\%$; in another, 14 microamps to ± 1 microamp.

Exceptional reliability and repeatability are achieved by the unique A.P.I. locking-coil design. At the point of contact, torque of the D'Arsonval movement is supplemented by the torque of the locking coil. Decisive switching action occurs with firm contact pressure. Contact resistance is low.

VHS measuring relays are available with high- and low-limit contacts, or either alone. Special models are available for excessive shock and vibration conditions.

Send today for Bulletin 104-D.



ASSEMBLY PRODUCTS, INC.
Chesterland 17, Ohio

CIRCLE 473 ON READER-SERVICE CARD

ALPHLEX®
ZIPPER
TUBING

NEWS

FROM ALPHA  WIRE

NEW CONSTRUCTIONS OF
ALPHLEX® ZIPPER TUBING
PROVIDE GREATER
VERSATILITY



stock sizes: 1/2" to 4" I.D.
IMMEDIATE DELIVERY
WRITE FOR FREE CATALOG ED-8

Alphlex Zipper Tubing is the modern way to harness, cable and protect wire. Just zip to close—and just zip to re-open! If you wish, permanent seal. Saves you time, labor, money. Strong, flexible, durable. Versatility unlimited.

ZIP-31: polyvinyl sheet made from MIL-I-631C materials. All-purpose type, for general applications to 105°C.

ZIP-44: polyvinyl sheet made from MIL-I-7444A materials. Extremely flexible; for aircraft and low-temperature uses to -67°C.

ZIP-50: "sandwich" of aluminum foil laminated between 2 sheets of polyvinyl. For 100% RF shielding applications to 105°C.

ZIP-90: polyvinyl bonded to woven fiberglass sheet per MIL-I-3190A. For rough usage, abrasion resistance, and high-temperature uses to 130°C.

ALPHLEX  TUBING

Division Alpha Wire Corporation
200 Varick Street
New York 14, N. Y.

CIRCLE 472 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 msec, with pulse delay and duration variable to 10,000 μ sec. 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

MICRO-MINIATURE precision wire-wound RESISTORS

fixed, noninductive

newly developed Kelvin "RELAXED WINDING" techniques practically eliminate resistance drift with age and "shorts" or "opens" due to thermal shock.

PLASTIC ENCAPSULATED SERIES "EP"

The 0.05W micro-miniature type EP-00 is .080" dia. x .325 long, 50K ohms max. resistance. Available with radial and axial lead wires. ALL CONNECTIONS ARE WELDED. High temperature epoxy plastic is used in an exclusive vacuum encapsulation process. Standard resistance tolerances to 0.1% (specials to 0.01%). Environmental temperature range: -65°C to +125°C.



CERAMIC SERIES "CB"

The 0.15W miniature type CB-05 is 1/4" dia. x 1/4" long, 500 K ohms max. resistance. Available with radial and axial lead wires. Standard resistance tolerances to 0.1% (specials to 0.01%). Environmental temperature range: -55°C to +85°C.



send for complete literature

KELVIN
ELECTRIC COMPANY

5907 Noble Avenue, Van Nuys, California

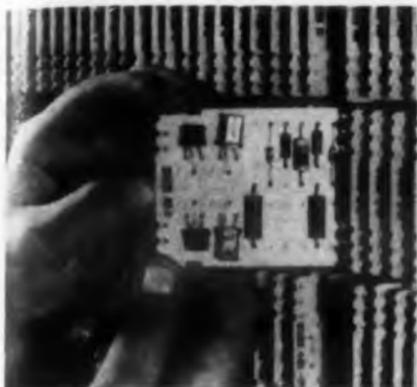
TRiangle 3-3430 • STate 2-6662

Visit us at the WESCON, booths L-2, L-4.
CIRCLE 478 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959

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, Coshoc-ton, 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

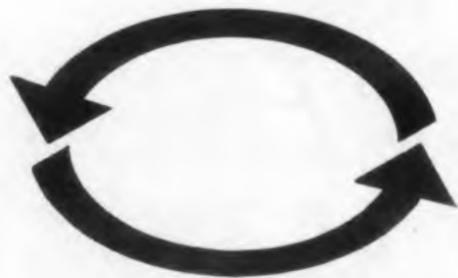
For X-band

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



A "communications engineer" at ELECTRONIC DESIGN resembles, in part, a communications engineer in the electronic industry. The half that is similar is the engineer—but the other half stands for communicating, clearly and cogently, in print. In fact, cross-communicating practical techniques, ideas for design, new developments, from the working electronic design engineer to the working electronic design engineer.

Our "communications engineers" get out in the field and find out what's going on—then convert technical doings to how-to-do-it articles.

If you have the working combination—use the Career Inquiry Service form to let our Editor know you are interested.

HAYDEN PUBLISHING CO., INC.
830 THIRD AVENUE,
NEW YORK 22, N. Y.

CIRCLE 922 ON CAREER INQUIRY FORM, PAGE 77

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
TElex 0-2761 - Vermont 9-2201

See Us At Booth #1502, 1504 at the WESCON SHOW

CIRCLE 503 ON READER-SERVICE CARD

Gertsch

5x10⁻¹⁰/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 1/4"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 1/4"W x 12 1/2"D. Write for literature on JKFS

1100T

Visit our WESCON BOOTH 1407

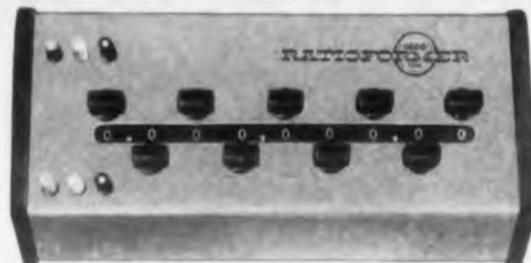
THE JAMES KNIGHTS COMPANY, Sandwich, Illinois



CIRCLE 504 ON READER-SERVICE CARD

LABORATORY ACCURACY for Production Line Testing...

Provides ratios of 3-to-1 step up to 10^{-1} step down.
0.001% Ratio Accuracy at a 1000:1 step down;
this is terminal linearity of 1 part in 10,000,000.
Easy-to-read, in-line numbers on sloping panel.
Adaptable to a wide range of test set-ups.



MODEL NO. 7600



RATIOFORMER

Ruggedly built, the OEKO Ratioformer provides over 300 million steps of precision ratio. The high input impedance, low output impedance, and extremely low phase shift make the OEKO Ratioformer a versatile and adaptable instrument.



MODEL NO. 7500



DEVIAFORMER

The OEKO Deviaformer gives direct readout of percent of deviation from specified voltage ratios. Used with a precision AC voltage divider such as the OEKO Ratioformer (or other ratio standard), it reduces the measurement to a % answer with extreme accuracy. Transformers, synchros, resolvers, computers, and meters can be tested on a simple "go/no-go" basis. Under rugged production line testing conditions, the accuracy level is maintained to 0.001%.

Saves Time—Eliminates Calculating and Transcription Errors

WRITE for illustrated folder.

SBORNE electronic sales corp.

712 S. E. Hawthorne Blvd., Portland 14, Oregon
13105 S. Crenshaw, Hawthorne, California

See Our Demonstration at the Wescon Show—
Booths No. 2122-2123

CIRCLE 505 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 $1 \mu\text{v}$ thermal drift



Miniature chopper model C1430 has a dry circuit to 100 v contact rating and less than $1 \mu\text{v}$ 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

ANOTHER FIRST...



THE ONLY

Electro-Reliable
A.C. TIMING MOTOR

Thinner... Quieter...

More Reliable... More Versatile

FINGER-THIN...

Only $9/16$ Inches Short... Only $1\frac{3}{4}$ Inches in Diameter... very compact... reduces the size of your equipment.

WHISPER-QUIET...

Strictly an electrical motor... practically noiseless... no rattling of gears or ratchets.

HIGH TORQUE...

$1/4$ oz. inch at the rotor with an instantaneous start and stop... requires only $2\frac{1}{2}$ watts... can replace larger motors in recorders, controls and telemetering equipment.

HIGHEST RELIABILITY...

Longer life... no one-way gears or ratchets to fail... provides millions of operations without any trouble.

© 1959



Send for Special Illustrated Bulletin AWH MO-806
A.W. HAYDON Company

227 NORTH ELM STREET
WATERBURY 20, CONNECTICUT

Custom Design & Manufacture Of Electronic
And Electro-Mechanical Timing Devices

CIRCLE 508 ON READER-SERVICE CARD



WITH
INTEGRAL
GEAR TRAIN

SPECIFICATIONS

Standard Voltage Ratings:
6, 12, 24, 115, 230 Volts
Frequency:
60 CPS Standard
25, 50 CPS Available
Power Input: 2.5 Watts
Maximum (60 CPS)

BASIC MOTOR

Weight: 4 ounces
Speed: 300 RPM
Torque: $1/4$ oz.-in.
Length: $9/16$ inch

WITH INTEGRAL GEAR TRAIN

Weight: 5 ounces
Speed: 300 RPM to $1/6$ RPH
Torque: 30 oz.-in. @ 1 RPM
Length: $7/8$ inch

ELECTRONIC DESIGN • August 5, 1959

Panel Oscilloscope

Has 100 mv rms sensitivity



The model PIB2X10 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

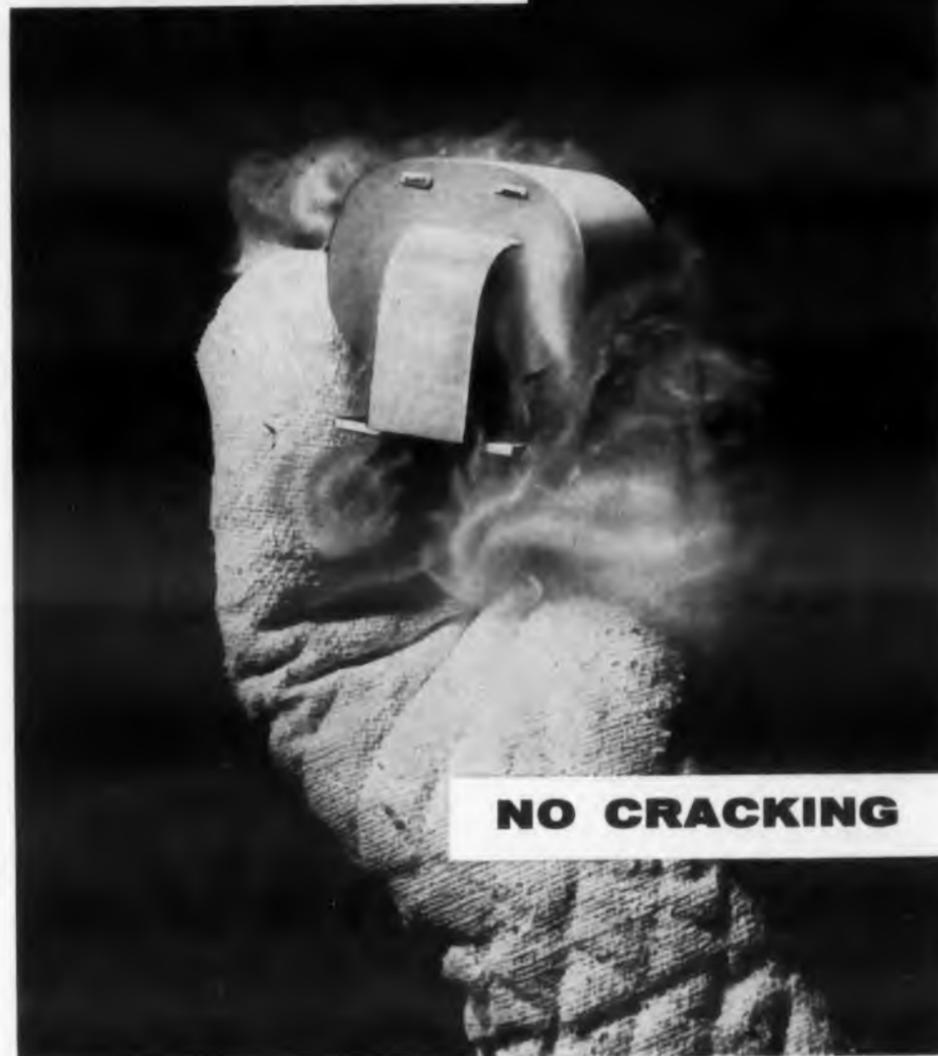
In high voltage and radio, radar, sonar, or other electronic cabinets, the miniature 17AC1-T door interlock switch automatically cuts the power off when the service door is opened. At 125 or 250 v ac, the 1.182 x 1.5 x 0.35 in. unit is rated at 5 amp. At 30 v dc, it is rated 3 amp inductive and amp resistive. 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

SMOKING COLD



NO CRACKING

This transformer cast with a HYSOL 6700 series, one-component epoxy, has just been removed from a cold box set at minus 60°C. IT IS SMOKING COLD!

The purpose of the test — to determine if the coating could be destroyed by ultra-severe thermal shocking (—60°C to +150°C). The result, after repeated cycles exceeding the requirements of MIL-T-27A, Class S, THERE WERE NO CRACKS or sign of breakdown.

IMPORTANT ADVANTAGES OF THIS NEW HYSOL SERIES

ONE-COMPONENT, NO WEIGHING OR MIXING
4 DEGREES OF FLEXIBILITY
WILL OPERATE OVER 2000 HOURS AT 150°C.
CURE TEMPERATURES ARE MODERATE AND SO IS PRICE

Whatever your epoxy requirements, check with HOUGHTON first.

Epoxy RODS, SHEETS and TUBES available from stock.

WESCON SHOW Booth 1206



HYSOL of California

1706 Potrero, South El Monte, Calif.

Phone CU 3-8461

A Division of

HOUGHTON LABORATORIES, INC., OLEAN, N. Y.

In Canada: HYSOL (Canada) Ltd., Toronto

KAY
KAY



NEW!

KAY

Ligna-Sweep

MODEL SKV

CAT. NO. 938-A

AUDIO-VIDEO SWEEPING OSCILLATOR

200 CPS to 11 MC

- Highly Stable Narrow Sweeps at Customer Specified Frequencies; Widths from 20 kc-12 mc on Variable Frequency Bands, 2 kc-20 kc on Fixed Frequency Bands
- Logarithmic Sweep Repetition Rate — 30 cps

- Sweep Repetition Rates — 0.2-60 cps
- High Output — 1.0 V rms into 70 ohms at Video, AGC'd; 1.0 V rms into 600 ohms at Audio
- Continuously Variable Center Frequency and Sweep Width on Variable Frequency Bands

SPECIFICATIONS

FREQUENCY RANGE: 200 cycles to 11.0 mc.

SWEEP WIDTH, BAND #1: 100 kc to 10 mc continuously variable; Sweep Widths 1 mc-10 mc, 200 kc-1 mc, 20 kc-200 kc.

SWEEP WIDTH, BAND #2: 200 cps-20 kc; Sweep Width 2 kc-20 kc variable.

SWEEP WIDTH, BAND #3-10: 50 kc-12 mc at 8 customer-specified ranges. Sweep Width 2 kc-20 kc variable.

SWEEP RATE: 0.2-30 cps in three ranges, 30 cps, and line lock.

LOGARITHMIC SWEEP: The 30 cps rate provides a nominally logarithmic sweep frequency response.

SWEEP VOLTAGE: Approximately 5.0 volts at low impedance out.

RF OUTPUT: Approximately 1.0 volts rms into 70 ohms; AGC'd flat within ±5.0%.

AUDIO OUTPUT: Approximately 1.0 volt rms into 600 ohms.

WEIGHT: 45 lbs.

POWER SUPPLY: 170 watts, 117-V (±10%), 50-60 cps, B+ electronically regulated.

PRICE: \$895.00, f.o.b. factory, including video and fixed audio bands. Narrow fixed frequency bands to customer-specified frequencies — add \$15. per band.

WRITE FOR KAY CATALOG 1859-A

KAY ELECTRIC COMPANY

DEPT. ED-8 MAPLE AVENUE PINE BROOK, N. J. Capital 6-4000

KAY
KAY

CIRCLE 511 ON READER-SERVICE CARD

CIRCLE 512 ON READER-SERVICE CARD

GROW WITH AIRESEARCH IN ELECTRONICS



• *AiResearch Central Air Data Computer for North American's A3J, Navy's first weapon system, provides information dealing with bombing, navigation, engine inlet control, radar, automatic flight control and cockpit instrumentation.*

Expansion in electronics and electromechanical activity is creating excellent openings at all levels for qualified engineers. Diversified programs include Central Air Data systems on Air Defense Command B-70 and F-108, North American A3J and McDonnell F-4H, as well as other commercial and military aircraft and missile projects.

Openings in the following areas:

- **FLIGHT SYSTEMS RESEARCH** General problems in motivation and navigation in air and space; required background in astronomy, physics, engineering.
- **DATA SYSTEMS RESEARCH** Experience with physical measuring devices using electromagnetic, atomic, thermionic and mechanical approaches.
- **CONTROLS ANALYSIS** Work in preliminary design stage involves servomechanisms analysis and analog computer techniques.
- **FLIGHT DATA COMPONENTS** Analysis proposal, design and development work in the following specialties: circuit analysis, servo theory, transducers, transistors, airborne instrument and analog development of high and low temperature problems.
- **ELECTROMAGNETIC DEVELOPMENT** Work with magnetic amplifiers requires knowledge of electromagnetic theory, materials and design methods.
- **INSTRUMENT DESIGN** Electromechanical design of force-balance instruments, pressure measuring devices, precision gear trains and servo-driven positioning devices. Experience in electrical and electromagnetic transducers desirable.
- **AIRBORNE INSTRUMENTATION ANALYSIS AND DESIGN** Work involves solving problems in accuracy, response and environmental effects.

Send resume to:
Mr. G. D. Bradley



AiResearch Manufacturing Division

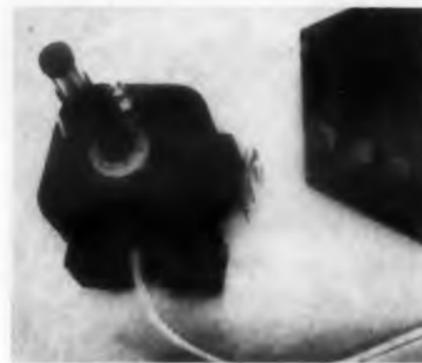
9861 SO. SEPULVEDA BLVD., LOS ANGELES 48, CALIFORNIA

CIRCLE 920 ON CAREER INQUIRY FORM PAGE 77

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

Amplitude modulated

Series 3000 amplitude modulated carrier system has solid state demodulator circuitry 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.

Wianco Engineering Co., Dept. ED, 255 N. Halstead, Pasadena, Calif.

Booth 2902-2904

CIRCLE 514 ON READER-SERVICE CARD

BEEDE-E-25 EDGEWISE METER

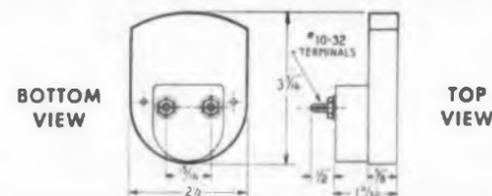


ACTUAL
SIZE

... can be used in either Horizontal or Vertical position — may be paired for comparative reading.

Conserves Space where panel area is limited

Contains the Magcentric Self Shielding Movement



BEEDE ELECTRICAL INSTRUMENT CO., INC.
PENACOOK, N. H.



CIRCLE 515 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1960

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 Powertron

AC ELECTRONIC GENERATOR

MODEL 150
\$495⁰⁰

PRECISION
AC POWER
SUPPLY FOR
LABORATORY &
PRODUCTION USE



SPECIFICATIONS

Power Output	160 V.A.	Total Distortion	Less than 1%
Fixed Frequency	400 CPS (other freq. avail.)	Regulation	Less than 1%
Variable Frequency	350-450 CPS	Operates with load of any power factor	
External Frequency	50-4000 CPS	Small size	8 3/4" x 19" Panel

Also Available — Model 250 — 250 VA Power Output

Representatives in Principal Cities



INDUSTRIAL TEST EQUIPMENT CO.
55 EAST 11th STREET • NEW YORK 3, N. Y.

CIRCLE 518 ON READER-SERVICE CARD



PUBLISHED BY ROME CABLE CORPORATION, ROME, N. Y.
PIONEERS IN INSTRUMENTATION CABLE ENGINEERING

THROW AWAY THAT SLIDE RULE. A new transistorized analog computer the size of a typewriter has been introduced for desk top use. It may some day become as familiar to engineers as today's slide rule, though cost is considerably higher. The basic computer weighs only 80 lbs, has ten operational amplifiers, handles five second-order differential equations simultaneously with an accuracy of 99.99 percent.

ELECTRONIC SURGERY. Recent investigations at two prominent institutions have advanced the development of instrumentation for ultrasonic neurosurgery. Instruments are used to focus high-intensity ultra sound on precisely located regions of the brain. Purpose is to produce changes ranging from circumscribed destruction of deep-seated ganglia in the brain to subtle alterations of the central nervous system. Also a possibility some day: a computer for diagnosis of other medical problems, which, when used by a single doctor, takes advantage of all the accumulated knowledge of medical science.

12-YEAR OUTLOOK. Military market for electronics should total more than \$100 billion from '59 to '70, says the Electronic Industries Association. Eventually, 25¢ out of every defense dollar will go for electronic equipment. Space activities play a part in the estimated jump in spending. Missiles alone should jump from \$3.9 billion in 1959 to \$8.2 billion in 1970.

RADAR MEMORY WANTED. Naval scientists want a radar with a memory system that will record and reproduce in some form what the radar has seen. Such a device would enable research men to study atmospheric background noise intensively, the object being to develop a system for suppressing background noises, e.g., ocean waves, when detecting enemy warships at considerable distances.

PROBLEMS, PROBLEMS, PROBLEMS. How would you propose converting light into magnetic energy without first transforming it into electrical energy? Or constructing a rugged, reliable rectifier that will operate at temperatures up to 500 degrees? Answers to problems like these are being sought by scientists at the Pentagon. Can you help?

If you have instrumentation problems of your own and want help, we suggest you talk to a cable specialist—at Rome Cable, of course. Rome pioneered instrumentation cable construction, knows the subject through and through. You can benefit from counsel—by mail or phone—from a Rome Cable specialist. Get in touch. (If you *don't* have a problem, write anyway and ask for Bulletin RCD-400. It gives the low-down on instrumentation cables for telemetering equipment, data-recording equipment, circuit control testing and electronic computers.)

CABLEMAN'S CORNER. In 1941, a new material, polyethylene, entered into the field of wire and cable manufacture. During the war years, the use of this material was almost wholly restricted to that of an insulation for solid dielectric coaxial cables operating as radio frequency transmission lines. Progress since the end of the war has resulted in the discovery of more and more applications and uses of this material. Electrically, even while immersed in water, it is probably one of the best dielectrics now available for insulated cables. Today we find that we now have a family of polyethylenes from which to choose including: conventional polyethylene, high-molecular polyethylene, high-density polyethylene, cross-linked polyethylene, expanded polyethylene, flame-retardant polyethylene and irradiated polyethylene. As with other materials, there are advantages and disadvantages to be found in each type. The choice of the best material for your job can be confusing and often expensive in its consequences. Call on a cable specialist.

These news items represent a digest of information found in many of the publications and periodicals of the electronics industry or related industries. They appear in brief here for easy and concentrated reading. Further information on each can be found in the original source material. Sources will be forwarded on request.

CIRCLE 519 ON READER-SERVICE CARD

NEW ENDEVCO VIBRATION SYSTEMS

Featuring: Transistorized charge amplifier and hermetically sealed accelerometer. You can use up to 300 feet of cable between amplifier and accelerometer — with no signal loss.

Complete Endevco system qualifies to Mil E-5272. Temperature range -40°F to $+230^{\circ}\text{F}$. Frequency response from below 10 cps to above 10 KC. Entire system isolated from ground.

Endevco System Amplifiers and Transducers are described in the "2200" and "2600" literature. Write for your copies today.

dynamic instrumentation



ENDEVCO CORPORATION

Department M
161 East California Boulevard
Pasadena, California

CIRCLE 520 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Multiturn Potentiometers

Operate from -55 to $+150\text{C}$



Housed in anodized aluminum cases with a $3/16$ in. wall thickness, these three and ten-turn precision wirewound potentiometers operate from -55 to $+150\text{C}$ 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

NEW

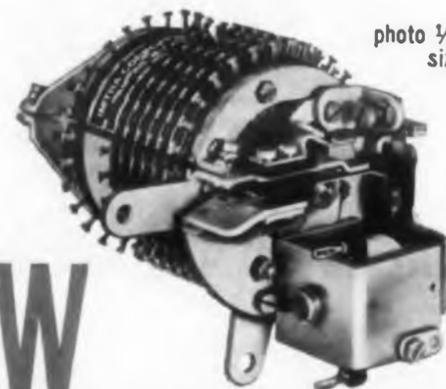


photo $1/2$ actual size

HIGH-SPEED, MINIATURE STEPPING SWITCH

For: Automatic switching, circuit selection, and timing-control

Featuring: • 80 steps per second on impulse drive • 30 contacts per bank • maximum 12 banks • only 17 oz. in weight • unique sequence switching

Write today for complete technical data on the unique Miniature Uniselector — ALSO on the Two-Way and One-Way Stepping Switches.



11 University Rd., Cambridge 38, Mass.

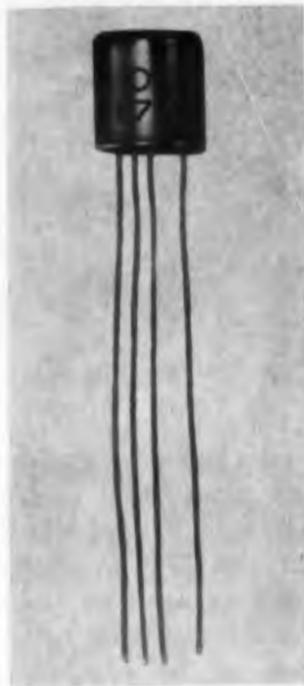
U.S. AGENTS FOR GENERAL ELECTRIC COMPANY, LTD. OF ENGLAND

CIRCLE 523 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959

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 μf with V_{cb} at -6 v; feedback base resist-

ance 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.

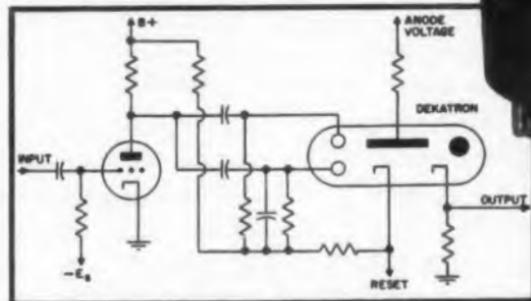
Booth 920

CIRCLE 525 ON READER-SERVICE CARD

Simplify Circuitry
using

dekatron®

Electronic Counting Tubes
(up to 20,000 counts/sec.)



Typical Drive Circuit

As a user of DEKATRON cold cathode glow-transfer counting tubes, you are welcome to use this and many other drive circuits designed by us. Circuits are patented (or applied for) but are available to DEKATRON customers.

Write to us for complete information.

Baird-Atomic, Inc.
33 UNIVERSITY RD., CAMBRIDGE 38, MASS



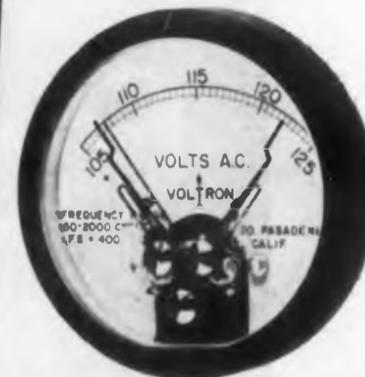
Instrumentation for Better Analysis

CIRCLE 526 ON READER-SERVICE CARD

api + **VOLTRON**

ADDS UP

**TO
4-10
TIMES
GREATER
ACCURACY**



**EXPANDED SCALE
METER-RELAYS**

Voltron and API combine the best features of their two top instruments . . . the resulting expanded scale Meter-Relays can monitor and control any electrical variable that is measurable. These instruments are now the most accurate and reliable Meter-Relays available.

- 10,000,000 make-break cycles, with 100% perfect contact
- Low current and voltage inputs required
- Eliminates problem of load isolation in measuring circuits
- Available in 2 1/2", 3 1/2" and 4 1/2" models

Many more advantages
— get complete data from either firm . . .

See them at Wescon — API Booth 3101
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api

Assembly Products, Inc.

Chesterland, Ohio

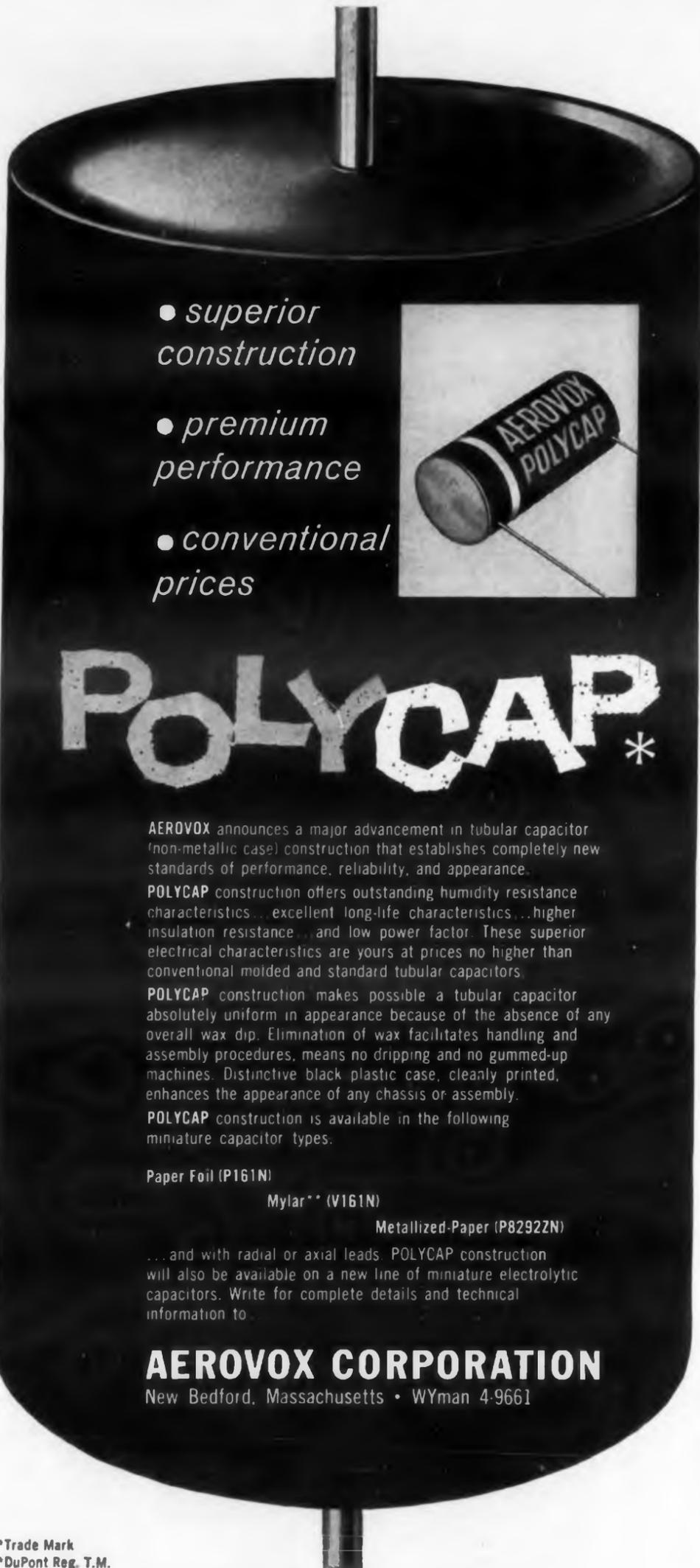


VOLTRON

VOLTRON PRODUCTS

1010 Mission St.
S. Pasadena, California

CIRCLE 527 ON READER-SERVICE CARD



- superior construction
- premium performance
- conventional prices



POLYCAP*

AEROVOX announces a major advancement in tubular capacitor (non-metallic case) construction that establishes completely new standards of performance, reliability, and appearance.

POLYCAP construction offers outstanding humidity resistance characteristics... excellent long-life characteristics... higher insulation resistance... and low power factor. These superior electrical characteristics are yours at prices no higher than conventional molded and standard tubular capacitors.

POLYCAP construction makes possible a tubular capacitor absolutely uniform in appearance because of the absence of any overall wax dip. Elimination of wax facilitates handling and assembly procedures, means no dripping and no gummed-up machines. Distinctive black plastic case, cleanly printed, enhances the appearance of any chassis or assembly.

POLYCAP construction is available in the following miniature capacitor types.

Paper Foil (P161N)

Mylar** (V161N)

Metallized-Paper (P82922N)

...and with radial or axial leads. POLYCAP construction will also be available on a new line of miniature electrolytic capacitors. Write for complete details and technical information to

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*Trade Mark
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VISIT AEROVOX AT WESCON BOOTHS 306-308
CIRCLE 528 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Winding Machine

For heavy gage toroidal coils

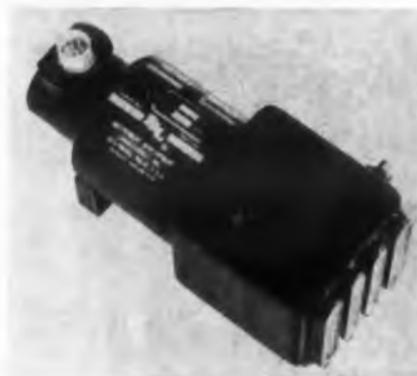
Designed to wind heavy gage wire on large toroidal forms, the Maxitor machine is available with three interchangeable heads. The HW-300 head winds AWG 20 to 7 wire on forms with finished OD's up to 14 in.; the HW-200 winds AWG 24 to 10 wire to a finished OD of 10 in.; and the HW-100 handles AWG 40 to 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



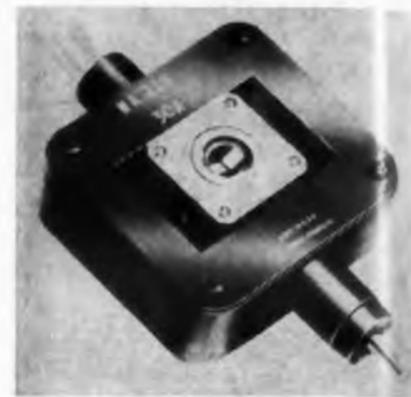
For application to fm/fm systems, this telemetering commutator has two poles with 30 make-before-break contacts and two with 60. With all 180 data channels available at hermetically sealed connectors, the unit may be externally wired for the sequencing required for each pole. Suited for missile environments, 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 msec 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 Readout 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.

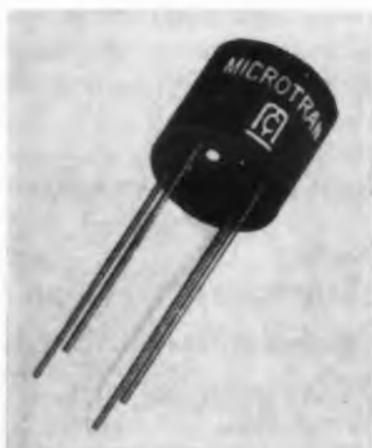
Union Switch & Signal, Div., of Westinghouse Air Brake Co., Dept. ED, Swissvale, Pa.

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 Microtomatic 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

'DIAMOND H' RELAYS



NEW . . . High Speed Polarized Relays

Fast action with freedom from bounce, plus high sensitivity and consistent operation with low distortion, are provided by small, rugged Series P Polarized Relays. SPDT, with two independent coils, they will handle over 1,000 pulses per second. Various coil resistances up to 5,000 ohms each coil. Contact ratings vary with switching speed but range from 60 MA to 2A with voltages to 120 AC or DC, dependent upon amperages employed.



Aircraft-Missile Series R & S Relays

Miniature, hermetically sealed 4PDT, Series R & S relays provide excellent reliability over their long service life. Electrically and physically interchangeable, the two series differ only in that Series S coils are separately sealed within the sealed cases, with organic matter eliminated from the switch mechanism for greatest reliability in dry circuits. Contacts MA to 10 A.



Special Mountings

Series R/S Relays are available with 10 standard mounting arrangements, plus a ceramic plug-in socket. MS-AN type connector mounting, illustrated at right, makes assembly, installation and field service extremely simple, while the connector provides a seal against moisture.



"Diamond H" engineers are prepared to work with you to develop variations on these relays to meet your specific requirements. Tell us your needs . . . by phone or letter.

THE
HART MANUFACTURING
COMPANY

210 Bartholomew Ave., Hartford 1, Conn.

Phone JACKSON 5-3491

CIRCLE 537 ON READER-SERVICE CARD



SHIELDED CABLES

designed for



**STEREO
HI-FI**



These low capacity cables are especially designed for use as leads between amplifiers, speakers and record changers of Stereo HI-FI units. Standard Two Conductor and Single Conductor cables are available and, where required, modifications of these cables can be developed to satisfy specific requirements.



LOW CAPACITY RECORD CHANGER TO AMPLIFIER EXTENSION CABLE

Two Stranded Conductors with clear polyethylene insulation extruded in parallel with a spiral wrapped tinned copper shield and a black extruded plastic jacket. Two styles available, with .030" wall insulation, 24 uuf per foot shield to conductor capacity and .017" wall insulation, 39 uuf per foot shield to conductor capacity.

LOW CAPACITY HI-FI AMPLIFIER INTERNAL SIGNAL CABLE

Two Solid Conductors in parallel with red and clear polyethylene insulation and spiral wrapped tinned copper shield with black extruded plastic jacket with 24 uuf per foot shield to conductor capacity.



STEREO RECORD CHANGER TO SPEAKER CO-AXIAL SINGLE CONDUCTOR LOW CAPACITY CABLE

Single Stranded Copper Conductors with polyethylene insulation, tinned copper full coverage shield and black or gray plastic insulation. Three styles available with shield to conductor capacities of 28, 31 and 33 uuf per foot respectively.

For complete specifications for these and other Lenz Wires and Cables write today for the new Lenz Catalog.



WIRES

and

CABLES

In Business Since 1904

LENZ ELECTRIC MANUFACTURING CO.
1753 No. Western Ave., Chicago 47, Ill.

CIRCLE 538 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 μ a 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 msec 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

Weights 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

AIRPAX

... for proven performance and reliability

The illustrations show only a few of the components produced by Airpax, undisputed leader in the manufacture of precision choppers. Other

products are equally noted for excellence of design and performance reliability. Chopper types, both standard and custom with mounting and header variants, number well over 250.

Pulse, audio and power transformers . . . custom designed or standard types . . . are an important part of Airpax production. Our transformer engineering staff will design transformers meeting your most exacting specifications or requirements.

Airpax maintains a Western Sales-Engineering office to expedite service to the ever expanding electronic industry on the West Coast. The office, located at 2550 East Foothill Blvd., Pasadena, is staffed with graduate engineers competent to assist in the solution of complex problems. Teletype facilities to Airpax plants ensure rapid communication and speedy delivery of your requirements.

CIRCUIT BREAKER SERIES 500



2300-1 LOW NOISE CHOPPER



6025 TRANSISTOR CHOPPER

PREAC MAGNETIC AMPLIFIERS



CUSTOM MAGNETIC AMPLIFIERS

ELECTRONIC TACHOMETERS SERIES 7000



VISIT THE AIRPAX DISPLAY
WESCON
BOOTHS 521-523



AM31

CAMBRIDGE, MARYLAND FORT LAUDERDALE, FLORIDA

CIRCLE 551 ON READER-SERVICE CARD



"Frisbee, management expects big things from you . . .

— so get on the phone to Microwave Associates and learn what ferrites can do for us!"

If you are working with ferrite devices consider these facts:

Microwave Associates currently has a complete line of over 40 ferrite devices, from S-Band to V-Band, fully developed and available for fast delivery . . . including circulators, hi-power isolators, and custom-matched duplexer packages.

Microwave Associates tests every one of these ferrite items at full-rated power before shipment. Our engineering department is particularly capable of designing for you an overall duplexing package which will not only perform optimum switching functions, but will also guarantee you consistently excellent receiver protection.

There is a booklet, of course . . . 59F with detailed specifications. Send for your copy.

If you're working with ferrite devices you should be working with us.



MICROWAVE ASSOCIATES, INC.
BURLINGTON, MASSACHUSETTS BROWNING 2-3000

Reprints of this picture and caption free on request
CIRCLE 552 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., Heipot 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



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STAINLESS STEEL

300 & 400 Series

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- Bolts
- Cap Screws
- Cap, Socket Head
- Cotter Pins
- Dowel Pins
- Hinges
- Nuts
- Machine Screws
- Set Socket
- Sheet Metal Screws
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CIRCLE 556 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959

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 2007-2008

CIRCLE 560 ON READER-SERVICE CARD

MOBILE-IZE YOUR ELECTRONIC EQUIPMENT



INSTRUMENT CARRIER MODEL MC-1

Decks with black ribbed rubber.

PRICE ONLY \$74.00 (standard)

With Formica Top and rubber lower deck add \$5.75 (optional)
Both decks Formica add \$9.00 (optional)

f. o. b. Glendale, Calif.

TECHNIBILT CORPORATION WESCON
905 AIR WAY, GLENDALE 1, CALIFORNIA Booth 409

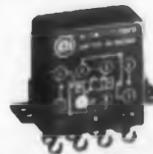
CIRCLE 561 ON READER-SERVICE CARD



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 —



Series 32

which, when operated in this power-pinching way, could be just what you've been looking for.

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.

*Sigma Series 6, 7, 32, 61, 72 & 73

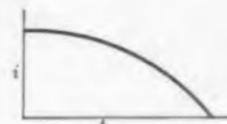


Fig. 1

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.

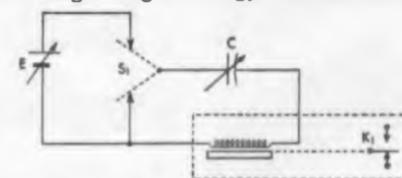


Fig. 2

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 "PulsePacket", handsomely bound in a manilla envelope.



At WESCON —
Booths 1901 & 1903

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CIRCLE 563 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

NEW! THE MERCURY "10" SERIES TRIODE CAVITIES



10% tuning range

Fully standardized line for design and production . . . Frequency range from 225mc to top existing tube limits

DELIVERY—30 DAYS OR LESS!

Only JVM offers these outstanding engineering advancements—low cost standardized production—off-the-shelf availability—design flexibility and uniform performance.

Miniaturized MERCURY "10" cavities are precision engineered for restricted tuning range, minimum weight, frequency stability and temperature compensation. The "10" series includes 720 different cavities designed for maximum power and or voltage ratings of a variety of tubes.

Call or write for engineering drawings and specifications.

J-V-M MICROWAVE CO.

9302 W. 47th Street Brookfield, Illinois HUnter 5-2000
TWX Brookfield, Ill. 2796

See J-V-M Triode Cavities at Wescon Booth 3714

CIRCLE 567 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959

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 μ f to 2000 μ f 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

Ratios from 3:1 to 2700:1

Whether you require a Universal, Induction or Shaded Pole Gear Motor or individual Gear Reduction Units, Howard can fill your mechanical and electrical requirements from a complete line of standard models that assures you of minimum cost and delay. One of the many Howard models is shown below. Check your specs first with Howard or write for our free complete catalog.

MODEL 3000—2 Pole Shaded Pole with Gear Unit

DIAMETER: 3 $\frac{1}{16}$ "

LENGTH: 3 $\frac{3}{8}$ " to 4 $\frac{1}{2}$ "

MAX. CONT. TORQUE*: 1 RPM (at 1 $\frac{1}{2}$ " stacking length) 45 in. lbs.

MAX. INTER. TORQUE*: 1 RPM (at 1 $\frac{1}{2}$ " stacking length) 70 in. lbs.

BEARINGS: Porous bronze sleeve type with oil reservoir.

*With external fan. Torques at other speeds from 1 to 400 RPM also available.

There's a
HOWARD
fractional h.p.
gear motor



for every
application!

POWERED BY

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1725 State St., Racine, Wisconsin

Divisions: Electric Motor Corp., Cyclohm Motor Corp., Racine Electric Prods., Layd Scruggs Co

CIRCLE 571 ON READER-SERVICE CARD

Don't get lost in a maze of wires!



Cut cost of assembly by as much
as 65%, with printed circuits on
TAYLOR copper-clad laminates



Conventional circuitry is a maze of wire and spaghetti. It is costly to assemble and unpredictable in performance. A printed circuit on TAYLOR rolled copper-clad laminate is a strong prefabricated part of known reliability. This quality is largely due to the new finish on the copper. Both solder and ink go on uniformly. The handling of one part alone can cut assembly costs as much as 65%.

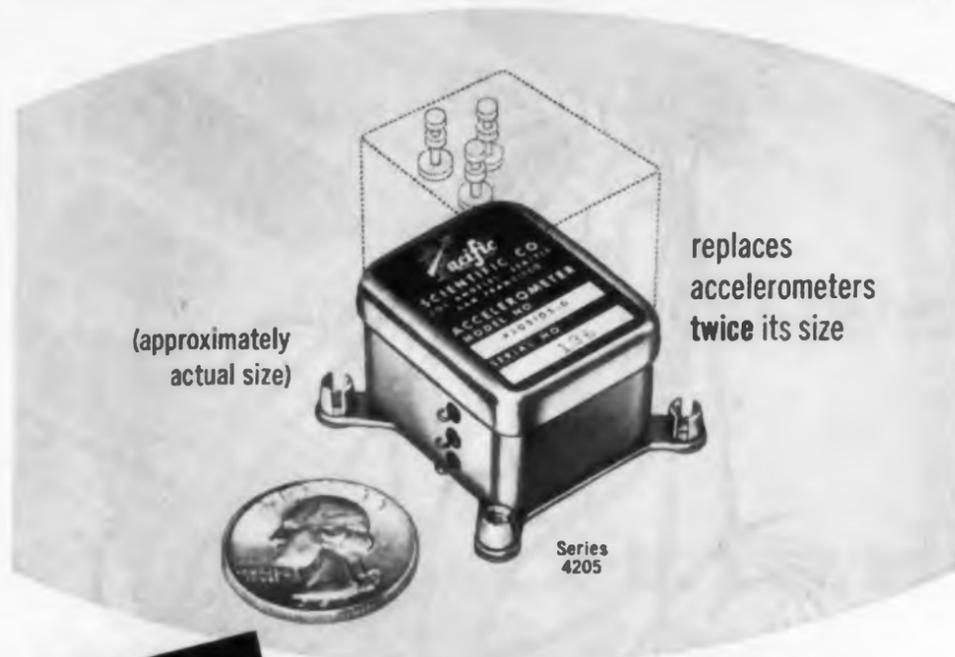
And there is an important passalong benefit: field repairs, when necessary, can be made easier and more economically. Write TAYLOR FIBRE Co., Norristown 48, Pa., for complete details.

Taylor

LAMINATED PLASTICS VULCANIZED FIBRE

CIRCLE 572 ON READER-SERVICE CARD

LATEST ADDITION TO THE PACIFIC FAMILY OF ACCELEROMETERS ...



new!

smallest on the market!

Pacific's
inexpensive

POTENTIOMETER-TYPE MODEL 4205

ACCELEROMETER

Replacing another accelerometer twice its size in an air to air missile, this tiny new addition to Pacific's family of accelerometers delivers 2% accuracy over a -10 to +30G range, and has the smallest envelope on the market - measuring only 1.1"W x 1.5"L x .8"D! Designed as an inexpensive instrument for telemetering and control it features silicon fluid damping for unsurpassed shock and vibration immunity.

Each of Pacific's basic models illustrated is representative of a series of similar units that vary only in output characteristics. They are fully tooled, tested and approved production models that can meet most acceleration measurement requirements.

In the design and production of accelerometers and other electro-mechanical components - Pacific's creative ability, engineering skills, experience and production facilities, can save you money - and time!



Creative Manufacturing
and Development
in Airborne Controls

TRADE MARK



For complete information on Pacific's standard accelerometers - or on specific models designed to your own requirements, write today!

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Canada - Garrett Mfg. Corp.

CIRCLE 573 ON READER-SERVICE CARD



Series 4202

Unique Torsion Bar Suspension and restraining system provides very low hysteresis with exceptionally rugged, long life. Automatic caging mechanism. Single or dual potentiometer pick-off and/or switches provide versatility. Available in a wide variety of G ranges.



Series 4201

Lightweight, Miniature - combines wide flexibility of design and performance characteristics with a proven, high production instrument. Potentiometer pick-off . . . wide selection of G ranges with an operating range of 0-±1G to 0-±50G.



Series 4206

For Increased Accuracy to 1% or less under rugged environmental conditions. Originally designed for use in an anti-missile missile, this unit features temperature compensated damping mechanism using silicon fluid.

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

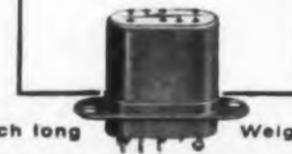
Select-A-Pak allows prospective users of epoxy adhesives to evaluate a range of resins and hardeners. The kit includes two clear resins and one filled resin, two one-component systems (liquid and thixotropic non-flow paste), one Hysol epoxi-patch kit, five hardeners, and instructions.

Houghton Laboratories, Dept. ED, Olean, N.Y.
Booth 1206

CIRCLE 576 ON READER-SERVICE CARD

small...but **mighty**

COMAR'S SUB-MINIATURE TYPE SM



Less than an inch long Weighs less than 1/2 oz.

big relay performance in crystal can size

A high precision, efficient sub-miniature relay. Constructed to withstand severe vibration, heavy shock and temperature extremes. For control systems, missiles, computers, aircraft and similar applications requiring miniature size and dependable performance.

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CHICAGO 18, ILLINOIS

RELAY • SOLENOID • SWITCHES • HERMETIC • FAULT

CIRCLE 577 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959

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

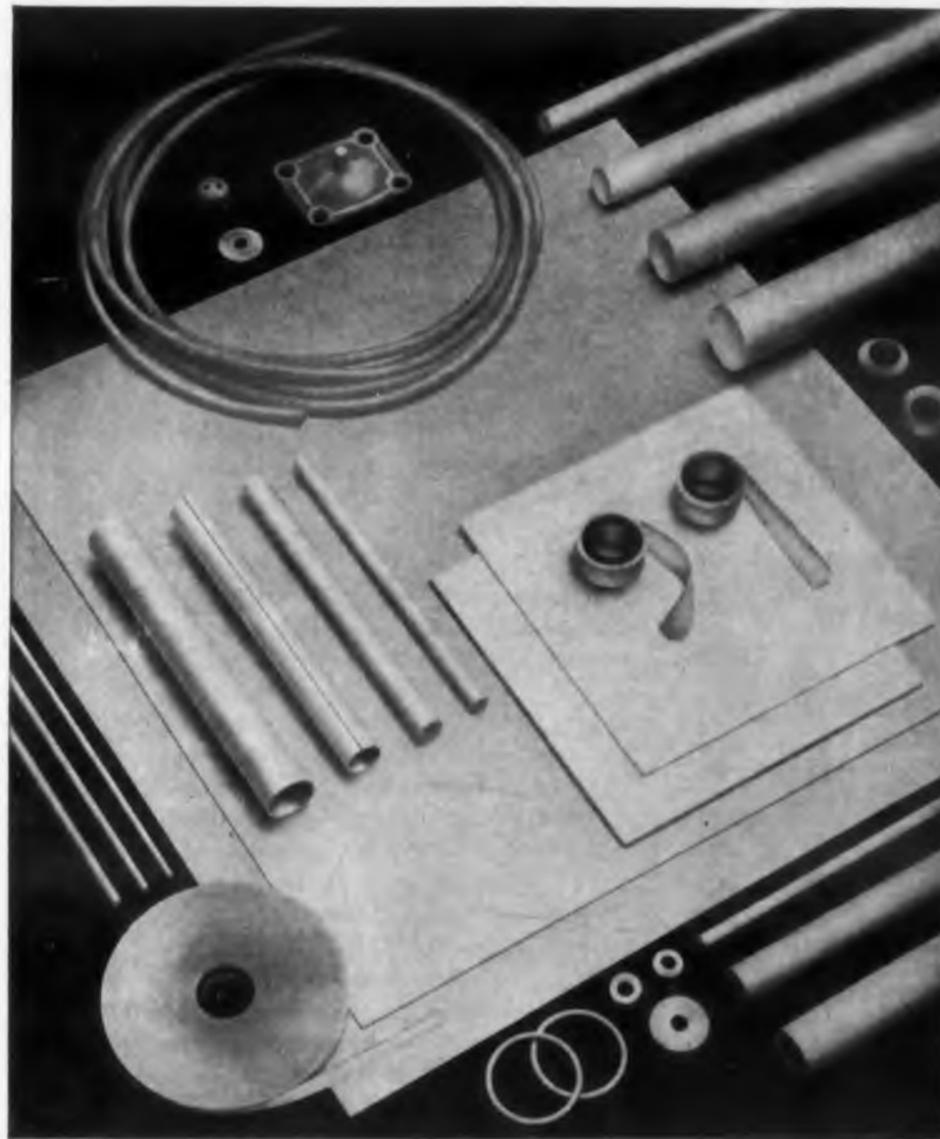
For control panels

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

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Whether your design calls for "Teflon" in sheet, rod, tube or tape form . . . or a specially fabricated "Teflon" part extruded, molded or machined to your specifications . . . R/M has the experience and facilities to meet your needs. And R/M sales engineers are always available to help solve any

problems you may have concerning this remarkable substance . . . its properties, application or manufacture. Make R/M your headquarters for all your "Teflon" needs. For friendly, competent assistance, contact your nearest R/M district office. Or write Plastic Products Division, Manheim, Pa. for literature.

*A Du Pont trademark



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PLASTIC PRODUCTS DIVISION FACTORIES: MANHEIM, PA.; PARAMOUNT, CALIF.

Contact your nearest R/M district office listed below for more information or write to Plastic Products Division, Raybestos-Manhattan, Inc., Manheim, Pa.

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RAYBESTOS-MANHATTAN, INC., Engineered Plastics • Asbestos Textiles • Mechanical Packings • Industrial Rubber Sintered Metal Products • Rubber Covered Equipment • Abrasive and Diamond Wheels • Brake Linings • Brake Blocks • Clutch Facings • Laundry Pads and Covers • Industrial Adhesives • Bowling Balls

CIRCLE 582 ON READER-SERVICE CARD

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TOROIDAL COIL WINDING MACHINES

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OF
PERFORMANCE, ECONOMY AND
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MODEL "M" SHOWN

NOW AVAILABLE

NEW MODEL 5W LOW COST LABORATORY
WINDING MACHINE

Meets 90% of all coil winding requirements

WRITE FOR FULL INFORMATION

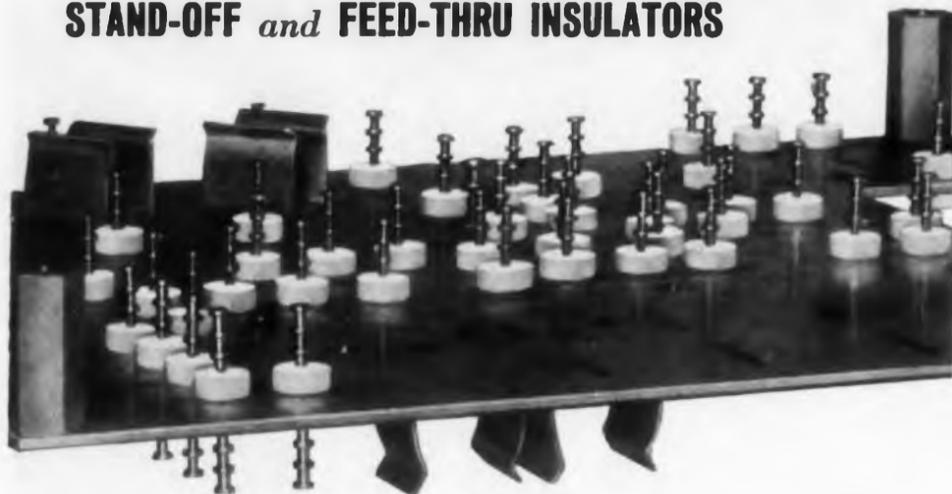
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3710 Midway Drive • San Diego, Calif.

CIRCLE 581 ON READER-SERVICE CARD

Where reliability is critical...

Chemelec*

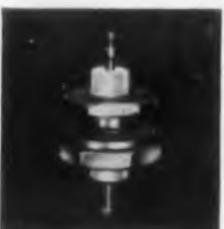
STAND-OFF and FEED-THRU INSULATORS



Compression-Mounted Type



Metal-Base Type



Patented Metal-Base Type

Simple to install, resistant to heat and breakage, and—above all—reliable under any conditions, Chemelec Stand-Off and Feed-Thru Insulators are the obvious choice in missile guidance, fire control, tracking, and radar systems . . . nearly all critical electronic circuits. DuPont TEFLON†—unmatched for electronic applications—is used as the insulator body. TEFLON has exceptional dielectric properties, is chemically inert, resists heat to extreme temperatures, won't break under severest shock or vibration. And, Chemelec Compression-Mounted Stand-Off and Feed-Thru Insulators are designed for easy installation. You simply press them into pre-drilled holes; they become self-fastening, requiring no additional hardware for adjustment. Available in compression-mounted, metal-base, miniature and sub-miniature types . . . standard R.M.A. colors with a wide range of sizes and terminal designs.

For further information, write for Catalog EC-358. Fluorocarbon Products, Inc., division of United States Gasket Co., Camden 1, New Jersey.

Chemelec* CONNECTORS

—Teflon Insulated for Outstanding High Frequency Service



*Registered Trademark †DuPont Trademark

Chemelec TEFLON-insulated male and female connectors are used mainly as break-away connectors . . . plug-in crystal diodes, plug-in coils and forms, test probes. Once compressed into chassis holes, the connectors need no further adjustment or hardware. Chemelec Connectors have all the fine TEFLON characteristics, and are available in the .040, .050, and .064 pin size. Female connectors are also available in the .080 size.

Fluorocarbon Products Inc.

CIRCLE 583 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 am-

plifier 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 $\pm 0.1\%$

This line of precision capacitors has a tolerance of $\pm 0.1\%$ and a long term operating stability of $\pm 0.05\%$. 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

 CONDUIT LOCKNUTS — Up to 6"	 SPRING-NUTS Preassembled Nut & Spring Lock Washer	 FINISHED NUTS Heavy • Regular Jam
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 MACHINE-SCREW NUTS Standard & Small Pattern—Single & Double Chamfer	 CAP NUTS	 STOP-NUTS Standard & Reversible One-Piece—Re-usable
Available in Stainless Steel, Silicon Bronze, Brass, Aluminum and Steel		
JACOBSON NUT MFG. CORP. Kenilworth, New Jersey		

CIRCLE 587 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



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One of the Prime Suppliers to the Foremost Original Equipment Manufacturers

Finest Quality Hermetically Sealed Crystals

Ovens with Hermetically Sealed Thermostats

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MAGNETIC TAPE & DRUM HEADS

quality control from prototype to production



The Magnetic Head Division of General Transistor Western Corporation designs and produces premium quality magnetic heads to your specifications . . . at lowest cost. Special quality control checks insure an extremely narrow channel to channel and head to head uniformity; all metal construction plus precision lapped gaps and mounting surfaces account for their excellent reputation in the computer and missile field. Write or call now for complete design portfolio.



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CIRCLE 592 ON READER-SERVICE CARD

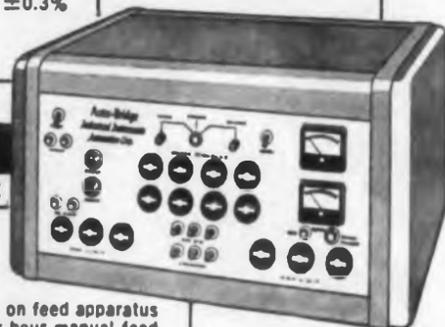
NEW! AUTOMATIC SEMI-AUTOMATIC MANUAL PRODUCTION TEST EQUIPMENT



THREE NEW INSTRUMENTS in matching enclosures for testing at the three most commonly used frequencies...DC, 1 KC and 1 MC. Available in three versions, automatic, semi-automatic and inexpensive manual units with no operator decision required.

AB-3-5 1 KC LIMIT BRIDGE

	RANGE	ACCURACY	PROD. RATE
Capacity	100 uuf to 15 uf lower at reduced accuracy.	$\pm 0.3\%$	Depending on feed apparatus -1500 per hour manual feed to more than 5000 per hour with automatic feed.
Resistance	10 ohms to 5 megohms, higher at reduced accuracy.	$\pm 0.3\%$	
Impedance	10 ohms to 5 megohms, higher at reduced accuracy.	$\pm 0.3\%$	

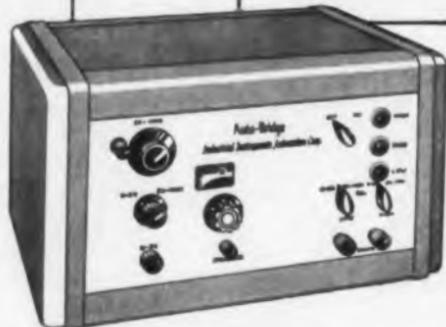


MODEL AB-4-4 DC LIMIT BRIDGE

	RANGE	ACCURACY	PROD. RATE
Resistance	10 ohms to 100 ohms.	$\pm 0.3\%$	Depending on feed apparatus -1500 per hour manual feed to more than 5000 per hour with automatic feed.
	100 ohms to 5 megohms.	$\pm 0.1\%$	
	5 megohms to 10 megohms.	$\pm 0.2\%$	

AB-5-1 1 MC LIMIT BRIDGE

	RANGE	ACCURACY	PROD. RATE
Capacity	0-1000 uuf in two ranges. (+ tolerance 0-100% - tolerance 0-25%)	$\pm \frac{1}{2}\%$ from 0-500 mmf $\pm 1\%$ to 1000 mmf	Depending on feed apparatus -1500 per hour manual feed to more than 5000 per hour with automatic feed.



*Can also be used for continuous measurement

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CIRCLE 593 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 $\pm 2\%$ 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

AT LAST!

PRECISION CUTTING TOOLS

DESIGNED FOR PROFESSIONALS

Get rid of clumsy, dangerous razor blades and jack-knives. Here are your kind of tools for all cutting, slicing, trimming and slitting jobs.

x-acto® PRECISION KNIVES

A wide range of surgically-sharp, instantly interchangeable blades to fit light, medium and heavy-duty handles.



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LIMITED OFFER!

Safety Guard Knife with blade. Sleeve completely covers blade when not in use. Special \$1.00 postpaid



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CIRCLE 597 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959

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 $\pm 0.5\%$.

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



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Electro-Pulse, Inc.

MILLIMICROSECOND

CURRENT PULSE GENERATORS

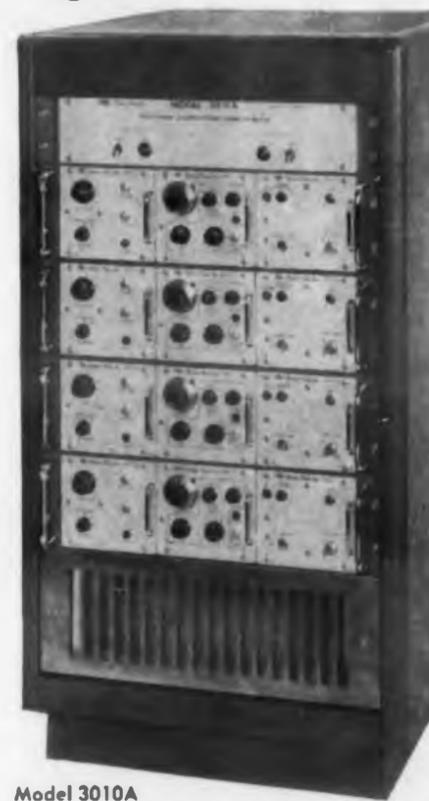
...3000 SERIES

for Magnetic Core and Logic Test

- High Source Impedance
- 50 ma to 2.5 amp Stabilized Output
- Rise Times to 35 millimicroseconds
- Useable to 3 megacycles

Available in 2 or 4 channel configuration, the 3000 Series is specifically designed for wide application in the design and test of current pulse driven devices, with particular consideration given to the requirements of ferrite and thin film memory and switch cores.

The equipment produces variable width, amplitude, and rise time outputs from external triggers, or may be operated as an amplifier with output widths controlled by input signal durations. Typical signal sources are ordinary pulse generators, programmed digital trigger generators, gate generators, and transistor logic.



Model 3010A
FOUR CHANNEL GENERATOR

Write for complete data—our Bulletin 3000/ED

Also available with multichannel programmed 10 bit trigger generator —
— Request Bulletin 5100B/ED

PLUG-IN MODULAR CONSTRUCTION
provides unparalleled flexibility
of application and ease of maintenance.



Electro-Pulse offers a COMPLETE LINE of pulse generating and coding equipment:

- ✓ General Purpose Pulse Generators
- ✓ Word Generators
- ✓ Time Delay Generators
- ✓ Gate Generators
- ✓ Code Group Generators
- ✓ Pulse Train Generators
- ✓ Time Mark Generators
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Model 4560A
10 MC DUAL PULSE GENERATOR

Representatives in Major Cities

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DOW**MAGNESIUM PRODUCTS**

400-TON PRESS draws end pieces of magnesium transmitter housing for missile ground support electronic system. Heated dies make possible one step draws.

The electronic transmitter housing shown in various stages of production on this page is a good example of the type of work carried on at Dow's Bay City Fabrication plant. It is a large and complex assembly which is produced in quantity, involves many different operations, and must conform to extremely high quality standards.

Large or small jobs. The Bay City plant is a large, well equipped magnesium production facility set up to handle large or small jobs, and plenty of both. Its activities encompass every phase of fabrication — deep drawing, bending, spinning, stamping, piercing, machining, arc and spot welding, assembling, chemical treating and painting. The facilities are government certified.

Engineering and quality control. Dow engineers working closely with the customer are frequently able to suggest design modifications which cut costs and/or meet application requirements better. A quality control team using modern methods and equipment assures that high standards of craftsmanship are rigidly maintained.

Many "firsts". The Bay City Fabrication plant has pioneered many developments in the production of magnesium parts and products. They were first to hot draw the lightest structural metal, and first to spot weld and automatically weld it. They have also been a leader in the production use of chemical treatments and finishes for magnesium.

Whatever your requirements, if they involve magnesium fabricated parts or assemblies, it will pay you to make Dow your supplier.



WRITE TODAY for this illustrated brochure discussing Dow fabrication services. THE DOW CHEMICAL COMPANY, Midland, Michigan, Magnesium Product Sales Department 1312BC8-5.

ARE YOU UTILIZING DOW'S EXTENSIVE MAGNESIUM FABRICATION FACILITIES?

Dow, primary producer of magnesium and its alloys, offers capacity and outstanding capabilities of its Bay City Fabrication plant.



"WRAPPER", or shell of housing is roll formed of magnesium sheet.



AUTOMATIC ARC WELDER, using tungsten-inert gas process, joins end to wrapper.



ASSEMBLY involves attachment of doors, hardware, other components using riveting, bolting, welding.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

CIRCLE 605 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 C 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 ($\pm 10\%$) or 6.3 v ac, 400 cps, 55 ma ($\pm 10\%$).

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 μ v 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 $5 \times 2 \times 10^{-6}$ in./in./F, and capacitance of one pin to ground is 2 μ f. 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.

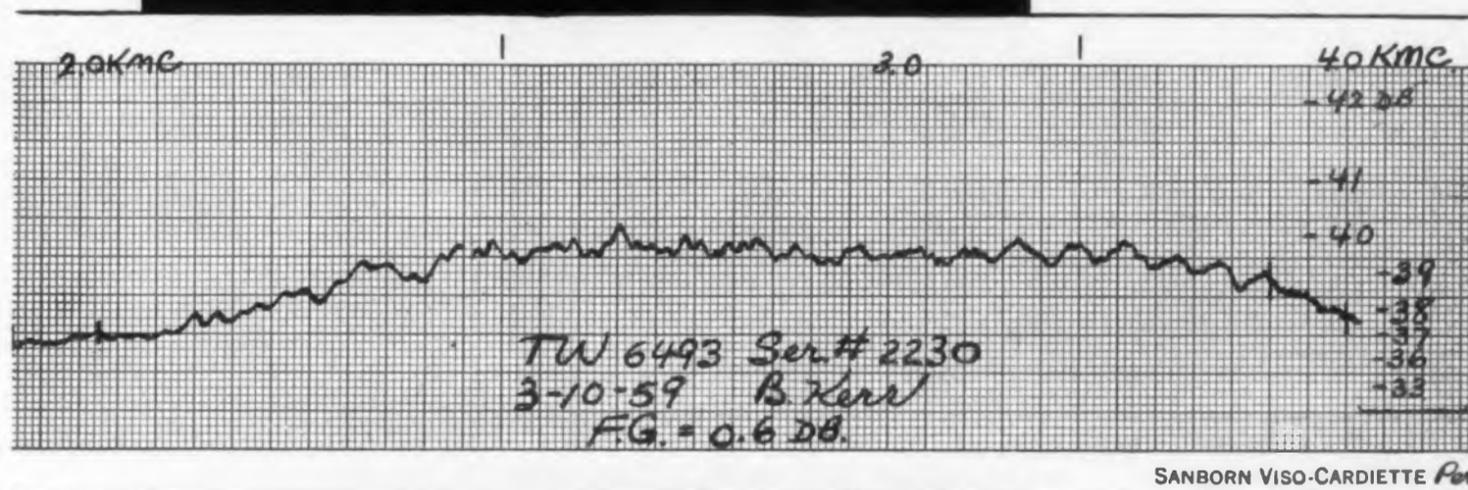
Booth 1304-1305

CIRCLE 621 ON READER-SERVICE CARD

Microwave Component News

from SYLVANIA

Now available—a wide range of traveling wave tubes



ONLY SYLVANIA CAN OFFER YOU

AVAILABILITY—now in production, 16 types of traveling wave tubes covering the microwave spectrum from 1 to 11 kmc, and milliwatts to kilowatts. Backward wave oscillators are also available. Modifications and new designs for your special requirements are part of Sylvania's service.

HIGHEST GAIN—Sylvania's traveling wave tubes deliver 2 to 5 times the gain of competitive types. For example, TW-4002 delivers a minimum gain of 37 db over its full 2 to 4 kmc band.

GUARANTEED UNIFORMITY—Sylvania guarantees gain variations one-half those of other tubes; i.e. 2 to 3 db narrower limits. Other test limits are correspondingly more rigid.

PROVEN RUGGED DEPENDABILITY—Sylvania traveling wave tubes have proved their performance by meeting tough military standards and by being specified and used in modern supersonic aircraft.

For more information
write your nearest Sylvania tube sales office or
Sylvania Electric Products Inc.,
Special Tube Operations,
500 Evelyn Ave., Mountain View, Calif.

SYLVANIA
Subsidiary of
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CIRCLE 609 ON READER-SERVICE CARD

Actual strip chart recording of test on a production tube shows the uniform gain characteristics of this Sylvania tube over the 2.0 KMC to 4.0 KMC spectrum



McLEAN FANS COOL CURTISS-WRIGHT SIMULATOR

McLean Filter Box Propeller Fans are shown being used to cool computer racks installed in an electronic Flight Simulator built by the Electronics Division of Curtiss-Wright Corporation. Similar installations of McLean Fans are included in various models of electronic Flight Simulators, for commercial and military aircraft, built by the Curtiss-Wright Division to train aircraft crews. The Fans have a wide range of CFM's and are ideal for trailers, vans, mobile or stationary generating systems, etc. Write for data sheet.



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- Specification Sheet on Reversible Fans

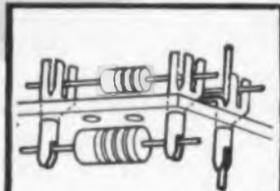
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World Leader in Packaged Cooling
 Princeton, New Jersey — WALnut 4-4440
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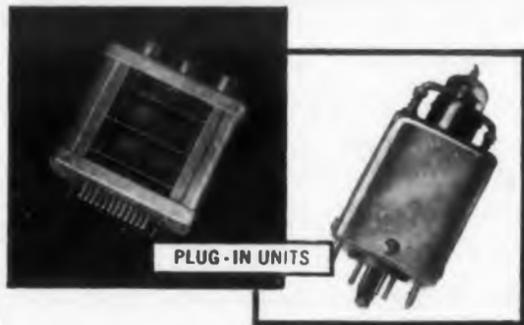
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NEW PRODUCTS AT WESCON

Silicon Capacitors

Have 0.5, 1.0 μfd 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 μfd at -4 v, and a maximum working voltage of 10 v; SCH-52 and SCH-52-A have a capacitance of 1.0 μfd 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

Electrical Engineers OPPORTUNITIES AT UNIVAC[®]

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For the development of special communications devices. Electrical Engineering degree with a minimum of five years' experience in one or more of the following fields: high frequency transmission, network theory, military airborne electronic equipment.

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To plan and implement rigid military quality control and reliability requirements for the manufacture of data processing equipment. Openings available at several levels. Three or more years' related experience on electronic equipment.

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For preparation of maintenance and operation manuals for electronic computers and special input-output equipment. Engineering or Science degree with two or more years of actual writing experience on manuals for electronic equipment.

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For maintenance of missile guidance computers and other military data processing systems. Several months' computer training provided prior to field assignment in continental U.S. Engineering or Science degree, or equivalent in electronics maintenance.

STANDARDS & SPECIFICATIONS ENGINEERS

For preparation of engineering standards and component specifications for electronic equipment. Engineering or Science degree with experience in military specifications for electronic equipment or specialized electronic components on either commercial or military equipment.

These openings are for our St. Paul Laboratories and offer excellent potential for professional growth as well as company career opportunities.

Salaries commensurate with experience; liberal employee benefits; company-paid relocation expenses.

For immediate consideration, send inquiries and resume of education and experience to:

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 2750 West Seventh Street, St. Paul 16, Minn.



CIRCLE 921 ON CAREER INQUIRY FORM, PAGE 77

ELECTRONIC DESIGN • August 5, 1959

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 wire-wound 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

Where only the **best** is good enough
... you'll see



electronic instruments

In basic electronic instruments for lab or test work, *less* than the best may be a dangerously bad bargain. Unexpected limitations — of reliability, range, precision — can throw out weeks of work on today's jobs, and can make tomorrow's tougher jobs untouchable. The *best* instrument of its type is probably a bit more expensive, but it's worth buying . . . because you can believe in it today, and will rely on it tomorrow. An example is the Krohn-Hite Model 440-A wide range push-button oscillator illustrated here.

Exactly because K-H instruments *are* good enough even for tomorrow's most critical work, they are increasingly chosen today where true reliability and precision are needed.

Oscillators — .001 cps to 520 kc, dial or push-button tuning, less than 0.1% distortion, sine wave and square wave outputs.

Power Supplies — zero to 600 volts dc, zero current to 1 ampere, regulation .001%, ripple less than 100 μ v, internal impedance 0.1 ohm to 100 kc.

Power Amplifiers — 10 to 50 watts, dc to 1 mc, transformer or direct coupled, 0.005% distortion.

Tunable Electronic Filters — variable from .01 cps to 200 kc, band pass, band rejection and servo types.

Write for your free copy of the new Krohn-Hite Catalog



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Krohn-Hite CORPORATION

580 Massachusetts Avenue,
Cambridge 39, Mass.

CIRCLE 629 ON READER-SERVICE CARD

A capacitor "FORM-FACTOR" that permits TIGHT CIRCUITRY DESIGN

Electron Products' metallized paper capacitors feature small size, and equally as important . . . the "form-factor." Series M-150 and W-150 are available FROM STOCK in round, rectangular and wafer configurations to suit your requirements for miniaturized packaging. These series have self-healing characteristics for utmost in reliability. Also available in hermetically sealed rectangular or round tubes for extreme environmental conditions.

SPECIFICATIONS:

Operating temperatures: -55°C to $+125^{\circ}\text{C}$ or higher on special order.

Voltages Available: 100, 200, 300, 400 and 600 volts.

Values: from .001 mfd to any value specified. Standard values available from stock

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CIRCLE 628 ON READER-SERVICE CARD



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avoid unnecessary delays GT DELIVERS SILICON TRANSISTORS IN 24 TO 48 HOURS!

No need to get hung up with delays or hooked by unkept promises! GENERAL TRANSISTOR delivers sample quantities of GT Silicon Transistors in 24 to 48 hours... production quantities in 2 to 4 weeks!

These are not mere claims, but firm promises on which you can base your design and production schedules.

Quality? Yes — plenty of weight here without waiting. General Transistor is today one of the largest suppliers of highly dependable devices, delivering quality in quantity.

For full information — and fast delivery — call your local General Transistor representative, or contact us directly. Write for Silicon Brochure S-100.

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GENERAL TRANSISTOR CORPORATION

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Phone: Hickory 1-1000



A Few of the GT Alloyed Junction Silicon Transistors Now Available

- HIGH SPEED SWITCHING
- MEDIUM SPEED SWITCHING
- HIGH VOLTAGE
- HIGH SPEED LINEAR AMPLIFIER
- MEDIUM SPEED LINEAR AMPLIFIER

	2N1219	2N1220	2N1221	2N1222	2N1223
V_{cbo}	30 v	30 v	30 v	30 v	40 v
V_{ceo}	25 v	25 v	25 v	25 v	40 v
V_{cso}	20 v	20 v	10 v	10 v	10 v
I_{co}	.1 μ a max.				
h_{fe}	18 min.	9 min.	—	—	—
$f_{ab}(mc)$	5 min.	2 min.	5 min.	2 min.	2 typ.
h_{ie}	—	—	18 min.	9 min.	6 min.

FOR IMMEDIATE DELIVERY FROM STOCK, CONTACT YOUR NEAREST AUTHORIZED GENERAL TRANSISTOR DISTRIBUTOR OR GENERAL TRANSISTOR DISTRIBUTING CORP., 91-27 138TH PLACE, JAMAICA 35, NEW YORK. FOR EXPORT: GENERAL TRANSISTOR INTERNATIONAL CORP., 91-27 138TH PLACE, JAMAICA 35, NEW YORK. PRECISION MAGNETIC RECORDING HEADS AVAILABLE FROM GENERAL TRANSISTOR WESTERN CORP., 8110 VENICE BLVD., LOS ANGELES, CALIF.

CIRCLE 630 ON READER-SERVICE CARD

NEW PRODUCTS AT WESCON

Wire Stripper

Has seven-stop gage

Strip-Er-Clip 760 will strip and clip all wire from 14 to 26 gage. A seven-stop gage adjusts instantly to the correct wire size to prevent damage. Made of heat-treated steel, it has a heavy insulated grip and streamlined jaws for use in 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 for rapid frequency response testing of rate gyros and angular accelerometers. Frequency coverage is 0.1 to 150 cps; it takes loads in excess of 100 lb (with decreased performance). If the associated dc servo power amplifier is used, natural frequency will exceed 150 cps.

Micro Gee Products, Inc., Dept. ED, Box 1008, 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 technique 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

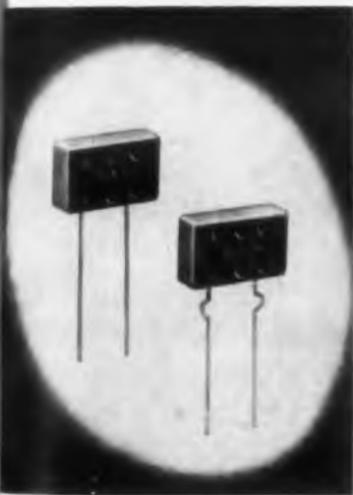


Transistorized portable oscilloscope type 321 will operate up to 3 hr on ten high current, size D flashlight cells or up to 6 hr on rechargeable cells. It will also operate on 11 to 35 v dc, and on 110 to 125 or 220 to 250 v, 50 to 800 cps. Vertical passband is dc to 5 mc; rise time, 0.07 μ sec; and reflection factor, 10 mv per division. Sweep range is 0.5 μ sec 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 μ mf. 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



Engineered by Tinnerman ...

SPEED CLIP[®] lets MUFFIN-FAN[®] user change direction of airflow quickly...and saves 25% in mounting cost!

Some users set the Muffin-Fan, made by Rotron Manufacturing Company, to blow a cooling north-to-south breeze through their electronic or electrical equipment. Others want a south-to-north breeze. Both are readily pleased... the ingenious Tinnerman SPEED CLIP that holds the fan in its frame permits quick snap-out and snap-in to reverse the direction of airflow.

Rotron is pleased, too... the specially-designed SPEED CLIP assures positive, safe attachment of fan to frame. Eliminates possible housing breakage. Provides a unique sales advantage. AND cuts 25% off the cost of the mounting.

This exclusive SPEED CLIP is one more example of the way Tinnerman SPEED NUT Engineering Service takes a customer's idea or problem at the design stage and develops an efficient part to meet the need. And usually with worth-while reductions in parts cost.

You, too, can use this service to gain all sorts of product-design and cost-cutting benefits. Call in your nearby Tinnerman sales representative to discuss SPEED NUT Brand Fasteners in your product or idea. He's listed in most "Yellow Pages" directories under "Fasteners." Or write to:

TINNERMAN PRODUCTS, INC.
Dept. 12 • P. O. Box 6688 • Cleveland 1, Ohio



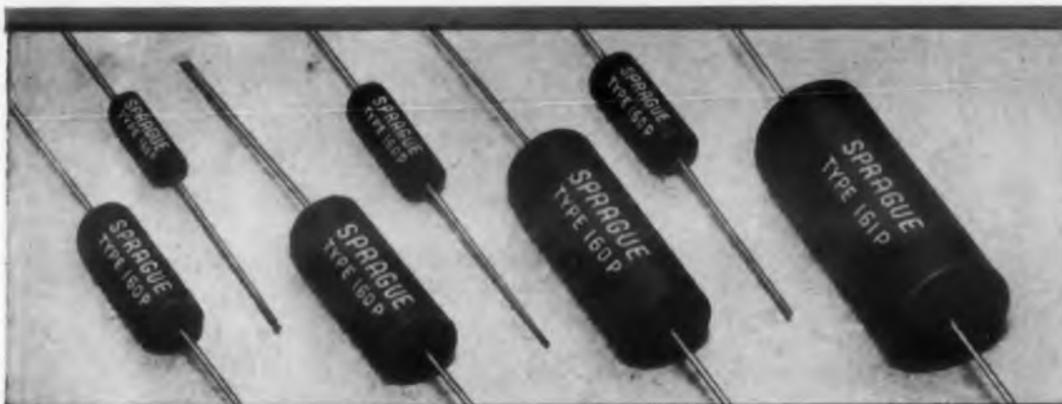
CANADA: Dominion Fasteners Ltd. Hamilton, Ontario. GREAT BRITAIN: Simmonds Aerossories Ltd., Treforest, Wales. FRANCE: Simmonds S.A., 3 rue Salomon de Rothschild, Sarrebourg (Moselle). GERMANY: Mecano Dandy GmbH, Bielefeld.

CIRCLE 637 ON READER-SERVICE CARD

DIFILM[®] DUAL DIELECTRIC

gives new BLACK BEAUTY[®] series of small, low-cost capacitors outstanding performance characteristics

- withstand 105C operation with no voltage derating
- moderate capacitance change with temperature
- excellent retrace under temperature cycling
- superior long-term capacitance stability
- very high insulation resistance



NEW!... DIFILM Type 160P fully-molded case and Type 161P pre-molded case capacitors in 5/16" to 1" diameters for general commercial and entertainment electronics.



NEW!... DIFILM Type 162P slotted-base multi-purpose molded case capacitors for auto radios and other severe vibration applications. Slot prevents collection of moisture around leads when capacitor is end-mounted against chassis.



• New DIFILM Black Beauty Capacitors represent a basic advance in paper tubular capacitor design. DIFILM Capacitors combine the proven long life of paper capacitors with the effective moisture protection of plastic capacitors... by using a *dual dielectric of both cellulose and polyester film that's superior to all others for small, yet low cost, capacitors.*

• Just check the characteristics listed above. This overall performance is fully protected by HCX[®], an

exclusive Sprague hydrocarbon material which impregnates the windings, filling all voids and pinholes before it polymerizes. The result is a solid rock-hard capacitor section, further protected by an outer molding of humidity-resistant phenolic. *These capacitors are designed for operating temperatures ranging up to 105°C (221°F)... at high humidity levels... without voltage derating!*

For complete specifications on DIFILM Black Beauty Capacitors, write for Bulletin 2025 to Technical Literature Section, Sprague Electric Company, 347 Marshall Street, North Adams, Massachusetts.

SPRAGUE COMPONENTS:

CAPACITORS • RESISTORS • MAGNETIC COMPONENTS • TRANSISTORS • INTERFERENCE FILTERS • PULSE NETWORKS
• HIGH TEMPERATURE MAGNET WIRE • CERAMIC-BASE PRINTED NETWORKS • PACKAGED COMPONENT ASSEMBLIES

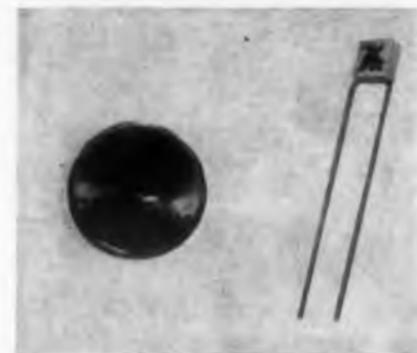
CIRCLE 638 ON READER-SERVICE CARD

SPRAGUE[®]
THE MARK OF RELIABILITY

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 μ f and 1200 to 10,000 μ f. 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 $\pm 15\%$ 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 $\pm 20\%$ 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 magnetrons 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 μ sec, rise time is 0.15 μ sec. 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

ELECTRONIC DESIGN • August 5, 1959

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



FRESH APPROACHES to help you meet exceptional requirements in precision motor parts, complete units, and assemblies

These examples are typical of the precision rotating components available from Wright Machinery Company Division of Sperry Rand Corporation. They are illustrative of the fresh approaches used by Wright

Machinery in meeting exceptional requirements. For complete information on these specific items, fill in the coupon. Or, tell us your particular problem and we will study your needs and make recommendations.

WRIGHT MACHINERY COMPANY

DIVISION OF SPERRY RAND CORPORATION • DURHAM, N. C.

(ED)

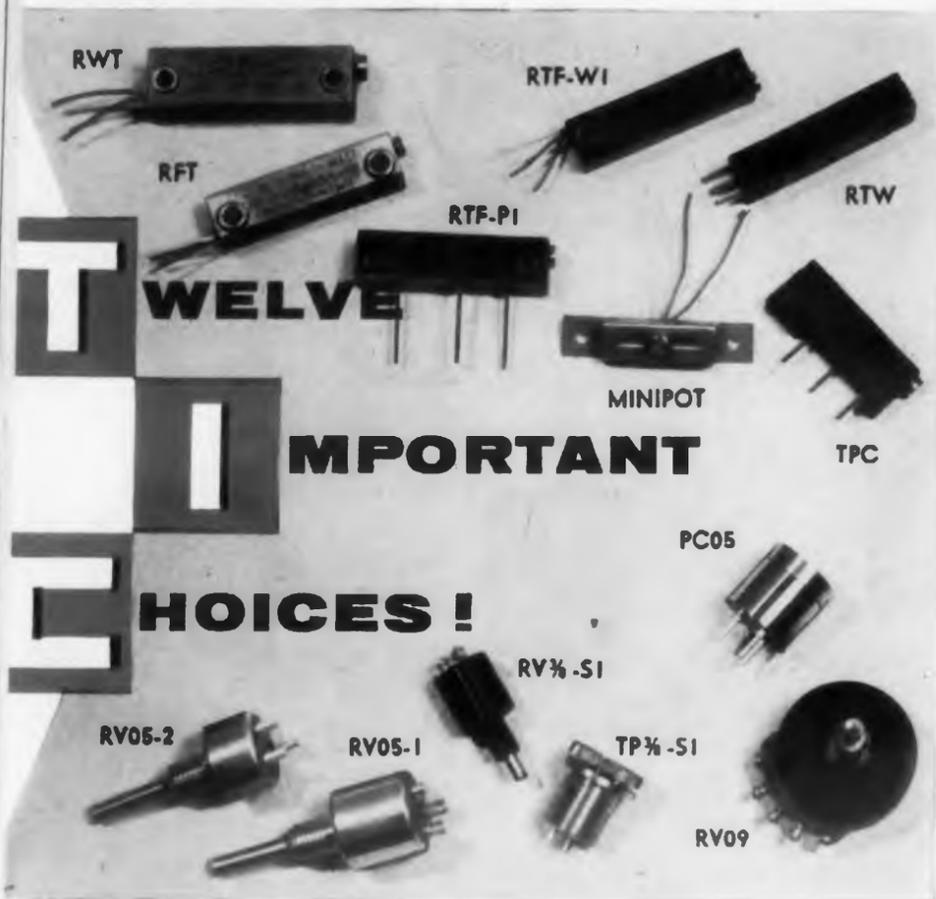


Gentlemen: Please send me data on the following: _____

Name & Title _____

Company & Address _____

CIRCLE 643 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

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.

Subsidiaries:

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

ELECTRONIC DESIGN • August 5, 1959

SILICONE INSULATED TUBE CAP CONNECTORS



This is a new series of Tube Cap Connectors using special silicone components for high reliability applications. They provide the highest degree of resistance to temperature extremes and are virtually unaffected by ozone and corona. The excellent dielectric characteristics make them ideal for high voltage. Skirts and sealed-in leads guard against flashover at high altitudes. Additional features include anti-corona cup and long-life spring contacts.

Clip this out — keep handy for part numbers and specs on connectors below for either 1/4" or 3/8" top caps. Prefix 90 for 1/4"; 91 for 3/8". Lead wire 18" long from center of cap or length to your specs.

90 or 91SCCSL beryllium copper contact, cadmium plated nests in anti-corona cup. Silicone rubber insulation throughout.

90 or 91SCCRSL beryllium copper contact, cadmium plated nests in anti-corona cup. Silicone rubber insulation throughout. Takes up to one watt resistor — specify value and tolerance.

90 or 91SCCDSL beryllium copper contact, cadmium plated nests in anti-corona cup. Skirt clings to tube — guards against flash-over. Silicone rubber insulation throughout.

90 or 91SCCDL beryllium copper contact, cadmium plated enclosed in anti-corona cup. Skirt clings to tube — helps suppress corona—guards against arc-over. Takes up to one watt resistor. Specify value and tolerance.

90 or 91CCSTLRL beryllium copper contact, cadmium plated nests in anti-corona cup. Glass-filled silicone insulation on cap; silicone rubber on lead. Long skirt for arc-over. Takes up to 2 watt resistor. Specify value and tolerance.

Besides new silicone types — Alden provides a complete series of connectors for 1/4", 3/8" and 1/2" cap in your choice of phenolic, mica, polyethylene, nylon and Kel-F. Complete hi-voltage cable assemblies are available using Alden hi-voltage disconnects and tube cap connectors.

TELL US ABOUT YOUR CONNECTING PROBLEM. FOR PROMPT RECOMMENDATIONS — WRITE OR PHONE JACK POLLARD NOW.

ALDEN PRODUCTS CO.

3139 North Main Street, Brockton 64, Mass.

CIRCLE 648 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959



Pulse Generators

Have rise times to
35 μ sec

Available in two or four channel configuration, series 3000 current pulse generators are for use in the design and testing of current pulse driven devices. Their output rise time is variable to 35 μ sec with peak amplitudes of 50 ma to 2.5 amp and high source impedance. The instruments produce variable width, amplitude, and rise time outputs from external triggers at rates to 3 mc, or they may be operated as amplifiers with output widths controlled by input signal durations. Typical signal sources are ordinary pulse generators, programmed digital trigger generators, gate generators, and transistor logic devices.

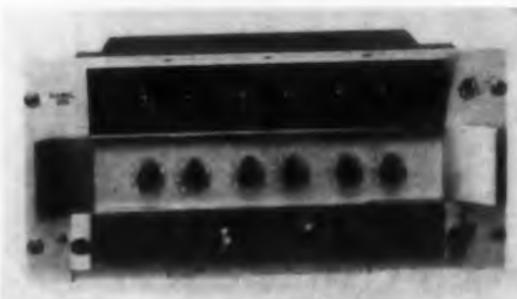
Electro-Pulse, Inc., Dept. ED, 11861 Teale St., Culver City, Calif.

Booth 1911-1913

CIRCLE 649 ON READER-SERVICE CARD

Timing Generator and Search Unit

For multichannel magnetic tape systems



Digital timing generator, model 270, is an all solid-state device that generates a precise timing reference during data reduction periods. This generator, together with magnetic tape search unit model 202, is used with multichannel magnetic tape systems. It generates, displays, and records a precise digital record of elapsed time. The search unit provides for the automatic location and controlled playback of sequences selected on the basis of the previous recorded time indices.

Hermes Electronics Co., Dept. ED, 75 Cambridge Parkway, Cambridge 42, Mass.

Booth 2821-2823

CIRCLE 650 ON READER-SERVICE CARD

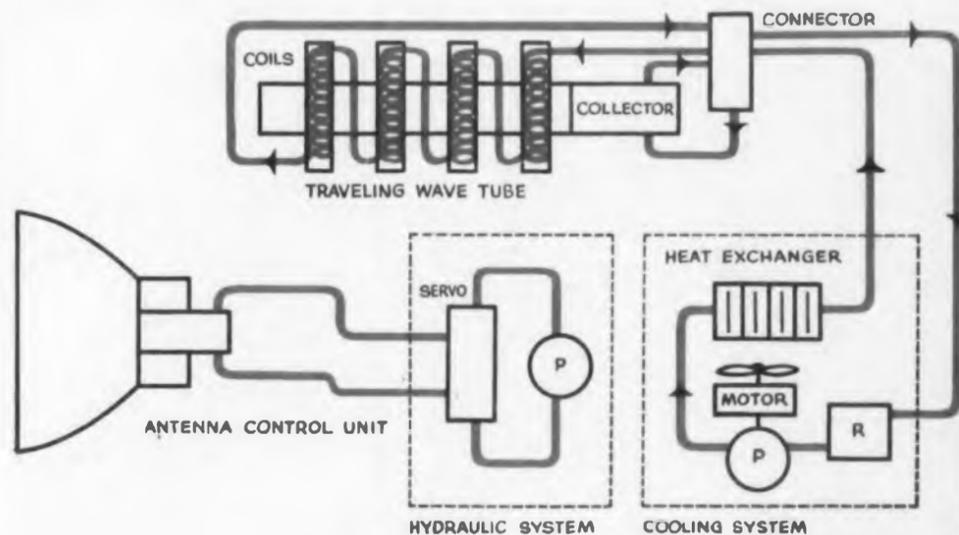
Design Tips . . . on liquid cooling with Coolanol 45



PROBLEM: Cool traveling wave tube and supply hydraulic power for antenna control unit.

SOLUTION: Use one fluid, Coolanol 45, as coolant for tube and hydraulic fluid for power transmission.

EXAMPLE:



The schematic diagram shows how you can standardize, miniaturize, and simplify your design problem in one step with Coolanol 45. Coolanol 45 gives you efficient heat transfer for accurate temperature control . . . dielectric properties for safe operation . . . dependable power transmission . . . all of these over the remarkable temperature range of -65° to 400° F!

SEND FOR NEW DESIGN BOOKLET

"Design Tips on Liquid Cooling with Coolanol 45" discusses static and dynamic cooling methods, how to apply the package concept to cooling design, how to simplify and standardize cooling and hydraulic units. It gives you a step-by-step solution to a typical cooling problem to show you how to apply principles of heat transfer in actual practice. For your copy of this new booklet, circle the reader-service number . . . or write direct:



Coolanol: Monsanto T. M., Reg. U. S. Pat. Off.

MONSANTO CHEMICAL COMPANY, Organic Chemicals Division
Aviation Fluids Department, St. Louis 66, Missouri

When you need a synthetic fluid, come to Monsanto—creator of fluids for the future

CIRCLE 651 ON READER-SERVICE CARD



Hold your frequency under fire (and ice)!

New linear permalloy core keeps filters frequency-stable over a wide range of temperature conditions—at half the cost

Designers of audio filter networks, faced with the high price of components and the need for frequency stability over a wide swing in ambient temperatures, can now benefit from a most significant development—the linear molybdenum permalloy powder core.

The linear cores we've developed are used with polystyrene capacitors. This combination costs as little as half the price of temperature-stabilized moly-permalloy cores and the silvered mica capacitors with which they must be used.

What's more, frequency stability is increased! For temperatures ranging from -55°C to $+85^{\circ}\text{C}$ we have observed frequency stability variations as low as 0.05%. This is consider-

ably less frequency shift than normally expected with temperature-stabilized combinations.

We guarantee the temperature coefficient of these linear cores within a very narrow range! Information regarding sizes, prices and performance behavior awaits your request. Popular sizes, in 125 permeability only, available immediately from stock. *Magnetics, Inc., Dept. ED-74, Butler, Pa.*

MAGNETICS inc.

SEE US AT WESCON!

CIRCLE 652 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 $+200^{\circ}\text{C}$.

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

ELECTRONIC DESIGN • August 5, 1959

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 thyatron 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

CLEVITE

DIFFUSED SILICON RECTIFIERS

TECHNICAL DATA:

Diode Type	Maximum DC Inverse Operating Voltage (volts)	Maximum Average Forward Current @ 25°C (ma)	Maximum Forward Voltage Drop @ 25°C (volts @ ma)
1N645	225	400	1.0 @ 400
1N647	400	400	1.0 @ 400
1N649	600	400	1.0 @ 400
1N677	100	400	1.0 @ 400
1N681	300	200	1.0 @ 200
1N683	400	200	1.0 @ 200
1N685	500	200	1.0 @ 200
1N687	600	200	1.0 @ 200

Clevite offers silicon rectifiers designed for maximum reliability in the severest military and commercial applications.

Check these features:

- HIGH DISSIPATION — 600 mw
- SUBMINIATURE GLASS PACKAGE
- HIGH VOLTAGE — up to 600 volts
- HERMETICALLY SEALED
- HIGH TEMPERATURE OPERATION — up to 150 ma at 150°C

For details, write for Bulletin B217A-3

A DIVISION OF

CLEVITE

CLEVITE

TRANSISTOR PRODUCTS

241 CRESCENT ST., WALTHAM 54, MASS.
Twinbrook 4-9330

Now—the
TERMINAL BLOCK
 with...

99%+

RELIABILITY

What makes a good terminal block?
 Two things. One is quick connection.
 The other is absolute dependability.
 You get both in a Twin Lock Terminal Block.

Plug in the terminal lug and the
 connection is made and locked. One
 twist of the set screw and it's double
 locked. Fast? It's done in seconds.
 Strong? It takes a hundred pounds
 of force to pull a lug out of its socket.
 Positive? It has the least resistance
 of any mechanical connection.

Write for complete engineering data.



1024 West Wilcrest Blvd. Inglewood, California
 Telephone: Oregon 8-4773 • TWX INGL 8194
 Coliseum Tower, 10 Columbus Circle New York 19, N.Y.
 Telephone: Circle 5-2170 • TWX NY 11867

CIRCLE 658 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 $\pm 10\%$ below 100 K and $\pm 20\%$ above; in tapered units, it is $\pm 20\%$ 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 $\pm 5\%$ 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

ELECTRONIC DESIGN • August 5, 1959

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 bridge P
 Booth 28

ELECTR

LOW COST SNAP-IN

neon indicator lights

CUSTOM ENGINEERED



These are the smallest, low-cost complete assemblies on the market. The neon-filled lamps provide soft, steady illumination that is completely free from glare. With the bulb in series with a resistor for 115-230v. applications, neither transformers nor series hook-ups are necessary. Long, trouble-free operating life has been proved in thousands of the most demanding applications.

Specially designed lenses can be supplied to customers' specifications with lettering, trademarks or other symbols molded, stamped or printed on plastic or glass of virtually any color

or configuration. Complete assemblies can be supplied with leads, lead terminals, quick disconnects, switches etc., attached.

With an experienced staff of design engineers plus complete production facilities, Ucinite is capable of supplying practically any requirement for connectors, switches and other small metal and metal-and-plastics assemblies . . . including stamped electrical circuits on flat or molded boards or housings.

Call your nearest Ucinite or United-Carr representative for full information or write directly to us.



Manufactured by

The UCINITE COMPANY

Division of United-Carr Fastener Corporation, Newtonville, Mass.



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

air-marine

motors, inc.

Cooling Electronic "Hot Spots"

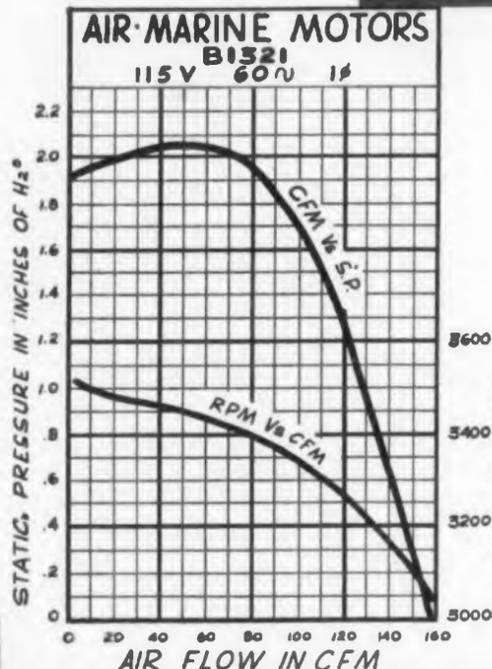
AIR • MARINE INVERTED TYPE BLOWERS DELIVER HIGH VOLUME AGAINST HIGH BACK PRESSURE

The AIR • MARINE inverted type centrifugal blower is especially designed for those applications where space is at a premium. By locating the motor inside the squirrel cage, space is saved and the motor is constantly cooled. Compliance with applicable MIL specifications make this blower ideally suited for critical applications.

Characteristics—115 or 208v
—50/60 \sim —1 or 3 ϕ —158
CFM at 0" SP at 3200 RPM



Model B 1321



For further information on the complete line of Air • Marine blowers, motors, and fans, contact our sales dept. at either

air • marine motors, inc.

369 Bayview Avenue
Amityville, L. I., N. Y.

air • marine motors, inc.

2221 Barry Avenue
Los Angeles, California



See us at the Wescon Show Booth 607 & 609

CIRCLE 663 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



Model 791D

\$920

DEVIATION MEASURED

10cps to 125kc

New FM Deviation Meter has carrier frequency range 4—1024Mc; crystal controlled LO enables measurement down to 10cps deviation. Used with a 'scope, it measures peak deviation of complex wave-forms. Very easy to operate, Model 791D speeds deviation measurements.

Carrier Freq. Range: 4—1024Mc, xtal locked
Mod. Freq. Range: 25cps to 35kc
Deviation Ranges: 0.5, 25, 75, 125kc.
Accuracy: 3%, Xtal standardized
Distortion: Less than 0.2
21 tubes: 6AK5, 6C4, 6B2, 5651, 6CD6G, 5Z4G, 5647, 6AS6

WESCON
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314-316



MARCONI
INSTRUMENTS



111 CEDAR LANE • ENGLEWOOD, NEW JERSEY

CIRCLE 667 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 5, 1959

Phase Shifter

May be used as secondary standard



From a 400 cps $\pm 5\%$ 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

Let KNAPIC
grow your
SILICON
CRYSTALS
for you!

kep 

Crystals are gas or vacuum grown by a modified Czochralski technique.



SILICON AND GERMANIUM MONOCRYSTALS

For Semiconductor,
Solar Cell and
Infrared Devices

Major manufacturers of semiconductor devices have found that Knapic Electro-Physics, Inc. can provide production quantities of highest quality silicon and germanium monocrystals far quicker, more economically, and to much tighter specifications than they can produce themselves. Knapic Electro-Physics has specialized in the custom growing of silicon and germanium monocrystals. We have extensive experience in the growing of new materials to specification. Why not let us grow your crystals too?

Knapic monocrystalline silicon and germanium is available in evaluation and production quantities in all five of the following general grade categories—Zener, solar cell, transistor, diode and rectifier, and high voltage rectifier.

SPECIFICATIONS—Check These Advantages

- Extremely low dislocation densities.
- Tight horizontal and vertical resistivity tolerances. Resistivities available in controlled ranges .005 to 1000 ohm cm., N and P type.
- Diameters from .10" to 2". Wt. to 250 grams per crystal. Individual crystal lengths to 10".
- Low Oxygen content 1×10^{17} per cc., 1×10^{16} for special Knapic small diameter material.
- Doping subject to customer specification, usually boron for P type, phosphorus for N type.
- Lifetimes: 1 to 15 ohm cm.—over 50 microseconds; 15 to 100 ohm cm.—over 100 microseconds; 100 to 1000 ohm cm.—over 300 microseconds. Special Knapic small diameter material over 1000 microseconds.

Specification Sheets Available

Infrared Domes and Lenses

**LARGE DIAMETER
SILICON LENSES
AND CUT DOMES
FOR INFRARED USE.**

Individual silicon ingots for lens use and hollow cut domes to 8" diameter are now available in production and evaluation quantities. Diameters up to 19" will be available in the near future. Transmission characteristics—minimum 52%, coated 97% in ranges between 1 to 15 microns.

Quotations will be prepared on request for production orders, for semiconductor materials not falling within the listed categories, or for those requiring additional experimental work.



Dislocation density, Knapic silicon monocrystals. Crystal diameter 1/10" to 3/8"—None; 3/8" to 3/4"—less than 10 per sq. cm.; 3/4" to 1-1/4"—less than 100 per sq. cm.; 1-1/2" to 2" less than 1000 per sq. cm.



Knapic Electro-Physics, Inc.

936-938 Industrial Avenue, Palo Alto, California Phone: DAvenport 1-5544

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of the new
Westinghouse
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POWER

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Available in 2 and 5 ampere collector ratings in production quantities now. For complete specifications and details, contact your local Westinghouse representative.

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Westinghouse Electric Corporation, Semiconductor Department Youngwood, Pa.

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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 $1 \times 1 \times 1\frac{1}{8}$ 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 impedance 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 $3 \times 2\frac{7}{8} \times 1$ 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. Suitable for 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 μ sec 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 μ sec rise time and calibrated sweeps from 1 to 100 μ sec 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 $\pm 125^{\circ}\text{C}$ 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

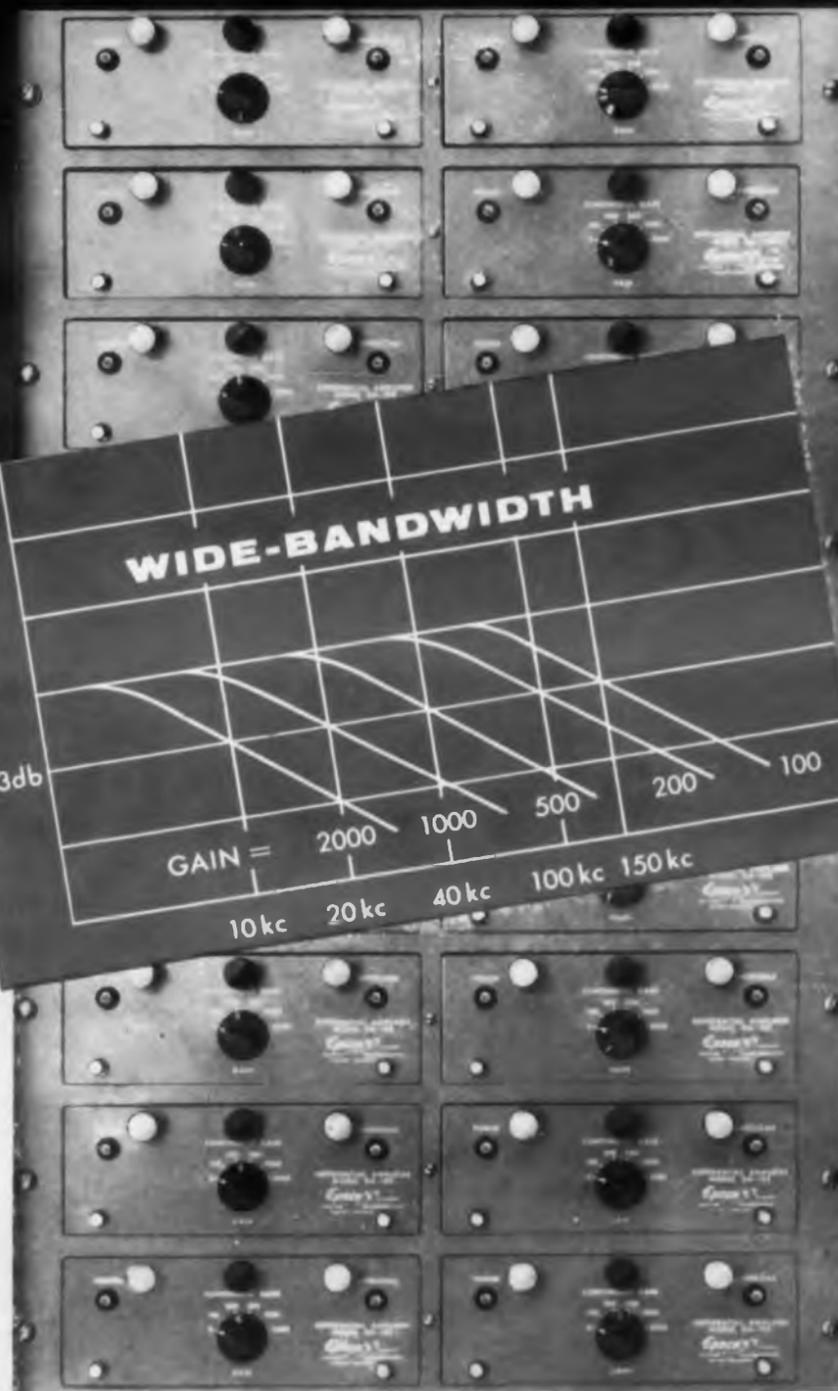
CIRCLE 675 ON READER-SERVICE CARD

Wide Bandwidth

with True Differential Input

► Only Epsco
Instrumentation
Amplifiers give you
all these features...

- WIDE BANDWIDTH . . . dc to 150 kc at gain of 100
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- HIGH GAIN . . . selectable gains of 100, 200, 500, 1000, 2000
- HIGH STABILITY . . . drift less than $2\mu\text{v}$ per day; less than $5\mu\text{v}$ long term cumulative drift
- LOW NOISE . . . less than $3\mu\text{v}$ rms to 50 cps
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- 100,000 OHM INPUT IMPEDANCE
- FAST RISE TIME . . . 2.3 μ sec. for full scale step input at gain of 100
- WIDE DYNAMIC RANGE . . . unsaturating at twice nominal output
- NO ADJUSTMENTS OR CALIBRATIONS
- NO BATTERIES



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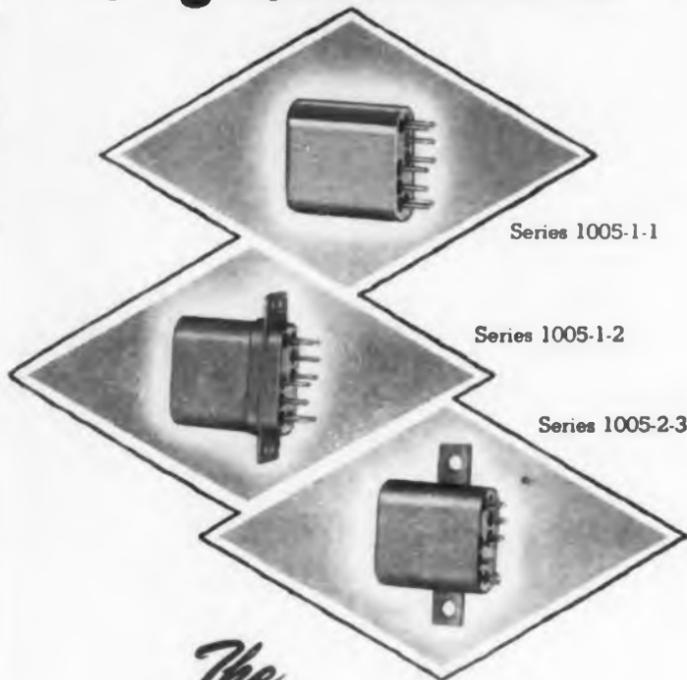
Available rack-mounted or in portable units. Write for Bulletin 105801 for complete technical information and options available.

Epsco 
First in data control

Epsco, Inc., Instruments & Equipment Division, 275 Massachusetts Ave., Cambridge, Massachusetts
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GUARDIAN
Series 1005 RELAY
micro-miniature

Ideal for Industrial and Military Applications



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Series 1005—Available with 5 AMPERE contacts for 50,000 operations (min.) at 125° C., or 100,000 operations (min.) at 25° C., upon specification. Standard rating is 3 amperes at 125° C. non-inductive, 28 volts D.C. Applicable to MIL-R-25018 and MIL-R-5757-C specifications.

Fluxless Sealing—A Guardian first! Eliminates cost of flux materials and the time required to apply it. Coil lead splices are the only internal connections using solder. Guardian's new exclusive fluxless solder sealing, in addition to use of non-gaseous materials, makes this relay adaptable to low energy level switching.

Tested and Proved—Series 1005 operates on currents as low as 10 microamps at switching voltages of 30 millivolts with a minimum life expectancy of 1,000,000 operations.

We Invite Your Inquiry.

Visit Guardian's Booth No. 3632 at 1959 WESCON SHOW

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CIRCLE 677 ON READER-SERVICE CARD

232

NEW PRODUCTS AT WESCON

Molded Composition Potentiometers

Rated at 2 w



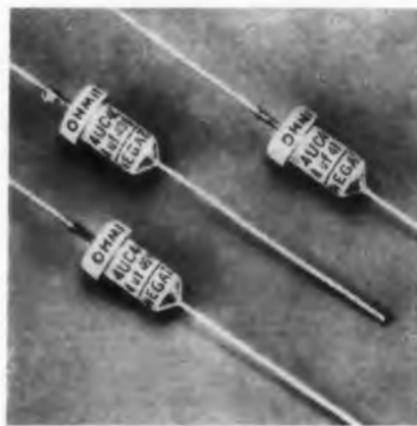
Designed to operate in extreme environments, these 2 w, molded composition-element potentiometers are suited for test equipment, military gear, computers, servo systems, and industrial metering. They are made according to MIL-R-94, Style RV4 and have one-piece wiper assembly construction, stainless steel 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 $\pm 10\%$ for values to 1 meg and $\pm 20\%$ 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

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CIRCLE 949 ON CAREER INQUIRY FORM, PAGE 77

SEALED subminiature **SWITCH**
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resists **CORROSIVE**
ATMOSPHERES

LIFE-TESTED in a wide variety of highly corrosive atmospheres, the UNIMAX Type SS has proved that its construction effectively seals out fumes and gases, to assure dependable operation even after long exposures.



- Mounting and outline dimensions meet MS-25085-1.
- Available with auxiliary actuators.
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- Groups of these Type SS sealed switches combined with special actuating devices can be furnished to your requirements.

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CIRCLE 681 ON READER-SERVICE CARD
ELECTRONIC DESIGN • August 5, 1959

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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

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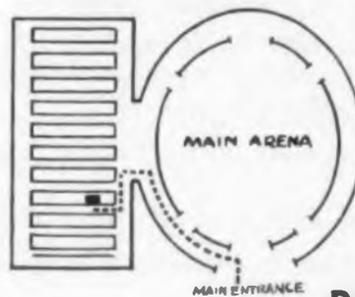
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New transformer line tailored to latest transistor designs

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All Ace RFI* shielded enclosures are designed to ensure permanent, fully effective r-f protection. Attenuation is better than 100 db at all frequencies from 15 kc to over 1000 mc. This exceeds the attenuation requirements of MIL-E-4957A (ASG). Modular construction permits quick and easy assembly.

Find out how Ace enclosures can help solve your next shielding problem. Write for literature on Ace's complete line of shielded enclosures and engineering services.



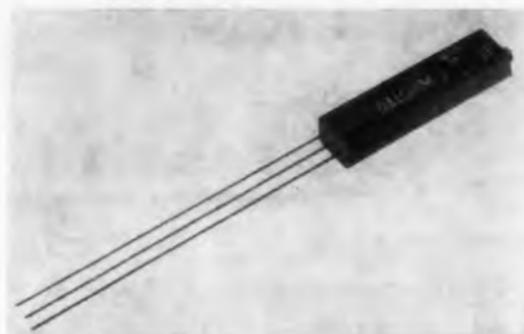
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NEW PRODUCTS AT WESCON

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 $\pm 3\%$ on all values. Standard tolerance is $\pm 5\%$ and special tolerances to $\pm 1\%$ 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

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ELECTRONIC DESIGN • August 5, 1959

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

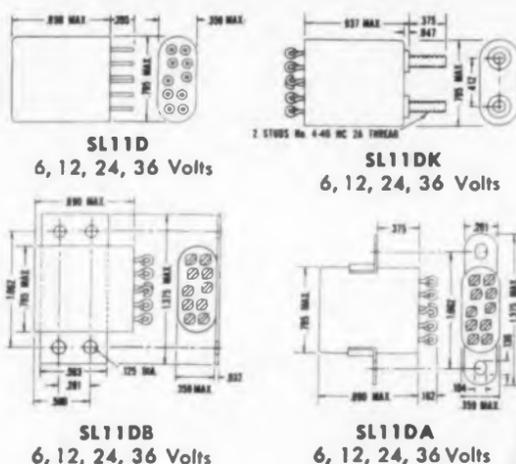
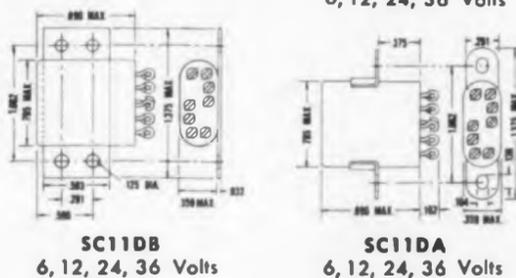
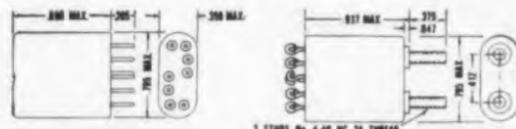
Model A902 centrifuge tests aircraft and missile components under positive and negative g-effects and high ramp functions. It has two outboard rotating tables mounted on the boom. One table is spun by an independent power source (0 to 1800 rpm) to produce a sinusoidal g field. It may be spatially-oriented while the boom is rotating. The opposite table is actuated electro-pneumatically. It is used to generate a high acceleration ramp function.

Cenisco, 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



SC

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SL

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32 STANDARD P & B CRYSTAL CASE RELAYS

Prototype or small-production-run quantities of P&B's micro-miniature relays are now available from your local electronic parts distributor. Choose from 2 types, 4 mountings, 4 coil voltages—32 models in all.

P&B's dual coil, permanent magnet, crystal case relays remain operative under 100g shock, 30g to 2000 cps vibration. Modern White Room production facilities assure

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The SC conforms to standard dimensions and circuitry, and can replace ordinary relays of the same size.

The SL, a latching relay, utilizes the dual-coil, permanent magnet principle to provide a highly efficient, tenacious latch, assuring high contact pressure.

Order today from your local electronics parts distributor.

SC and SL SPECIFICATIONS:

Shock: 100g for 11 millise.

Vibration: 30g from 55 to 2000 cps
.195" max. excursions from 10 to 55 cps

Ambient Temperature Range:
-65°C. to +125°C.

Contact Arrangement: dpdt

Contact Load: 2 amps at 30 vdc
1 amp at 115 vac, 60 cycle

Sensitivity:

SL—230 milliwatts at 25°C. with
630 ohm coil

SC—260 milliwatts at 25°C. with
550 ohm coil



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**SEALED
 ELAPSED TIME
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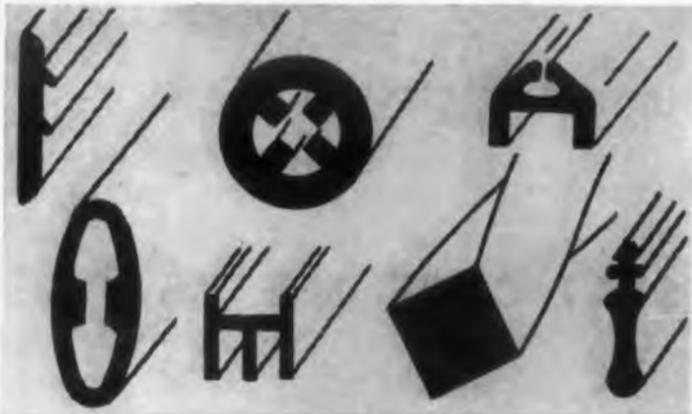
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NEW PRODUCTS AT WESCON

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 auto-transformer.

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

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 THE METER OF PRECISION

custom
 produced
 to

equipment manufacturers' specifications



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A wide selection of stock **PACE** meters is also conveniently available at leading electronic parts distributors for your laboratory models and prototypes.

► Illustrated: Model 45-P clear plastic 4½" meter, one of a family of acrylic-cased instruments, directly interchangeable with standard phenolic-cased units of similar size. **PACE** also offers a wide range of phenolic-cased meters in 2½" to 7" sizes.

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ELECTRONIC DESIGN • August 5, 1959

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Induction

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HARDENING
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ANNEALING
MELTING
BRAZING



LEPEL Electronic Tube
GENERATORS—1 KW; 2½ KW;
5 KW; 10 KW; 20 KW; 30 KW; 50 KW;
75 KW; 100 KW.

LEPEL Spark Gap Converters
2 KW; 4 KW; 7½ KW; 15 KW; 30 KW.

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HI-POWER EFFICIENCY



RIGHT ANGLE ADAPTER, 350-5000 MCS.



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COAX SLOTTED LINE, 1500-5000 MCS.



LT TO "N" TYPE TRANSITION, 350-5000 MCS.

These operational configurations comprise a representative
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all military and industrial specifications.



TAMAR ELECTRONICS, INC.

2339 COTNER AVENUE • LOS ANGELES 64, CALIFORNIA

CIRCLE 703 ON READER-SERVICE CARD

Microminiature Relay

Has 250 mw operating power



Series KXI microminiature relays have dptd
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 ampli-
fiers. A spring-loaded, momentary-on position
in the dc on-off switch allows generation of posi-
tive 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

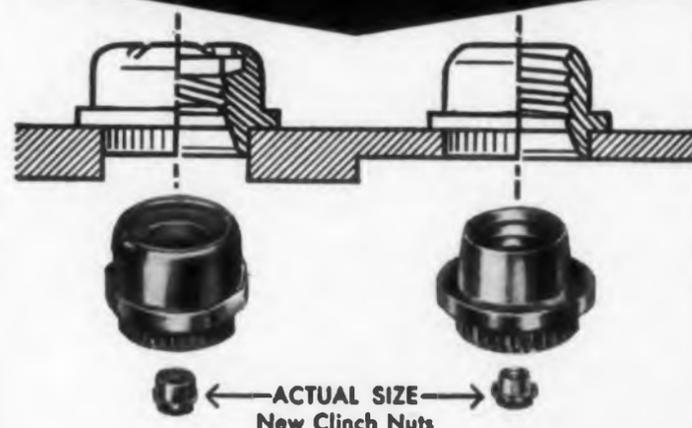
Uses no magnetic focusing fields

Model HA-27 traveling wave tube amplifier has
a frequency range of 1.0 to 2.0 kmc. It is electro-
statically 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 ampli-
tude 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

New ESNA miniatures flush mount in thin stock



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miniature clinch nuts may be just what you're looking for! They
are easily flush mounted in sheet as thin as .030".

Type NCFM clinch nut for temperatures up to 350°F, has
special nylon locking insert which will not gall screws or create
the cadmium flaking so damaging to electrical circuitry. Type
LHCFM is an all-metal nut with an elliptical crown locking
device capable of withstanding up to 550°F.

Detailed dimensional drawings on these two new miniature
nuts, plus full data covering necessary installation tools are now
available. Write Elastic Stop Nut Corporation of America, Dept.
S8-857, 2330 Vauxhall Road, Union, N. J.



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OF AMERICA**

CIRCLE 707 ON READER-SERVICE CARD

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 - Effects of rare metals in soldering
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CIRCLE 708 ON READER-SERVICE CARD

Commander of a SAC B-52 is shown adjusting controls of the Sperry A-14 Automatic Flight Control System. Teamed with Sperry's advanced K-bombing-navigation-system, this electronic co-pilot provides precision control on long flights to target, assists in instrument landings and automatic programmed control on target runs.



servo assist for sperry's electronic co-pilot

When the commander of a B-52 gives his Strato-fortress the order to execute this or that maneuver, the control system of his "electronic co-pilot" automatically applies just the right force on the control surfaces to obtain the desired maneuver under the prevailing flight conditions. That's automatic flight control at its finest!

Daystrom Transicoil helps provide the calculated muscle for this flight system in the form of servo controlled pitch, roll, and yaw follow up; coordination integrator; and pitch integrator.

Only the highest level of accuracy, performance, and reliability will do . . . for you, for us.

The engineering and manufacturing assistance you need to turn modern system requirements into optimized working sub-systems and assemblies is the very basis of our business. Contact us direct or through our local representative. Check into our 24 Hour Service on servo motors and generators. Daystrom Transicoil, Division of Daystrom, Inc., Worcester, Montgomery County, Pennsylvania. (Phone: JUNO 4-2421)



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Kerite reports: "Tough tapes of MYLAR® help keep costs down, improve cable design"

"We have to use highest-quality materials to maintain the performance people expect from Kerite cables. Tapes of 'Mylar' polyester film help us insure top performance. What's more, 'Mylar' actually costs us less per foot of cable than other tape materials, because it is so tough we can use it in thinner gauges. This helps us offset rising costs in many other cable materials.

"'Mylar' helps by improving production efficiency, too. Its high tensile strength drastically cuts machine downtime due to tape breaks. And our customers benefit from improved perform-

ance... 'Mylar' makes cable cleaner and easier to strip, provides greater crush resistance, assures longer life."

The control cable shown is only one of a variety of cables made with "Mylar" at the Kerite Company. Kerite, America's oldest cable producer, was a pioneer in the cable field and is still pioneering new concepts in cable design and construction.

Manufacturers of all types of electrical products are replacing conventional materials with thin, tough "Mylar". You, too, can improve performance, cut costs by capitalizing on the unique

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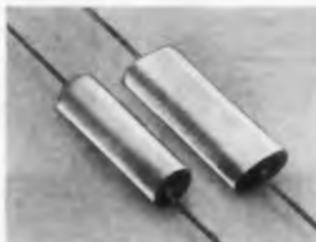
**"Mylar" is Du Pont's trademark for its brand of polyester film.

**Per ASTM D-149.

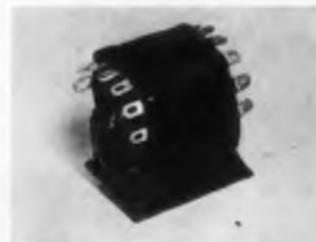
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AC



NEW!

hp 403A Transistor ac Voltmeter—1 cps to 1 MC

Battery-operated, weighing less than 5 pounds and small enough to hold in your hand—this new transistor ac voltmeter measures 100 μ v to 300 v (max. full scale sensitivity 1 mv) over frequencies 1 cps to 1 MC! Twelve voltage ranges; also reads direct in db from -12 to +2 db. 400 hour battery life equals 6 months of average use; battery voltage may be checked by front panel switch. Noise less than 50 μ v. Completely isolated from power line or ground interference. Average reading meter minimizes turnover and waveform errors. Accuracy \pm 3% to 500 KC, \pm 5% to 1 MC. Input impedance 2 megohms; generous 600 v overload capacity on higher ranges, 25 v maximum on lower ranges. \$250.00.

All of these widely useful -hp- instruments are available in rack-mounted
-hp- voltmeter accessories—voltage dividers, coaxial connectors, voltage

DC



NEW!

hp 405AR Digital Voltmeter Automatic range, polarity

Here's true "touch-and-read" measuring simplicity. Automatic range, polarity selection; covers 0.001 v to 1,000 v. (Accuracy \pm 0.2% of reading \pm 1 count). New, unique circuitry provides a stability of readings virtually eliminating fatiguing jitter in the last digit. Floating input, multi-electronic code output for use with digital recorders. Uses electronic computing circuits to insure low maintenance, trouble-free operation. Just 7" high! \$825.00.

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hp 400L
Log VTVM—10 cps to 4 MC

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hp 400H
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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 μ 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 μ 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.

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hp 412A Precision
Volt-Ohm-Ammeter

At last a true, precision multi-purpose instrument. Measures dc voltage 100 μ v to 1,000 v (max. full scale sensitivity 1 mv), 1% accuracy full scale. Measure currents 1 μ a to 1 amp with $\pm 2\%$ 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 μ v to 1 v in 11 ranges, or currents of 10 μ ma to 3 ma in 18 step, 1-3-10 sequence. Accuracy $\pm 3\%$ on all ranges. Drift less than 2 μ v under all conditions; very much less under lab conditions. Input impedance 1 megohm $\pm 3\%$ on all ranges. Also usable as 100 db amplifier with up to 1 v output from signals as small as 10 μ v. \$500.00.



NEW!
hp 428A
Clip-On Milliammeter

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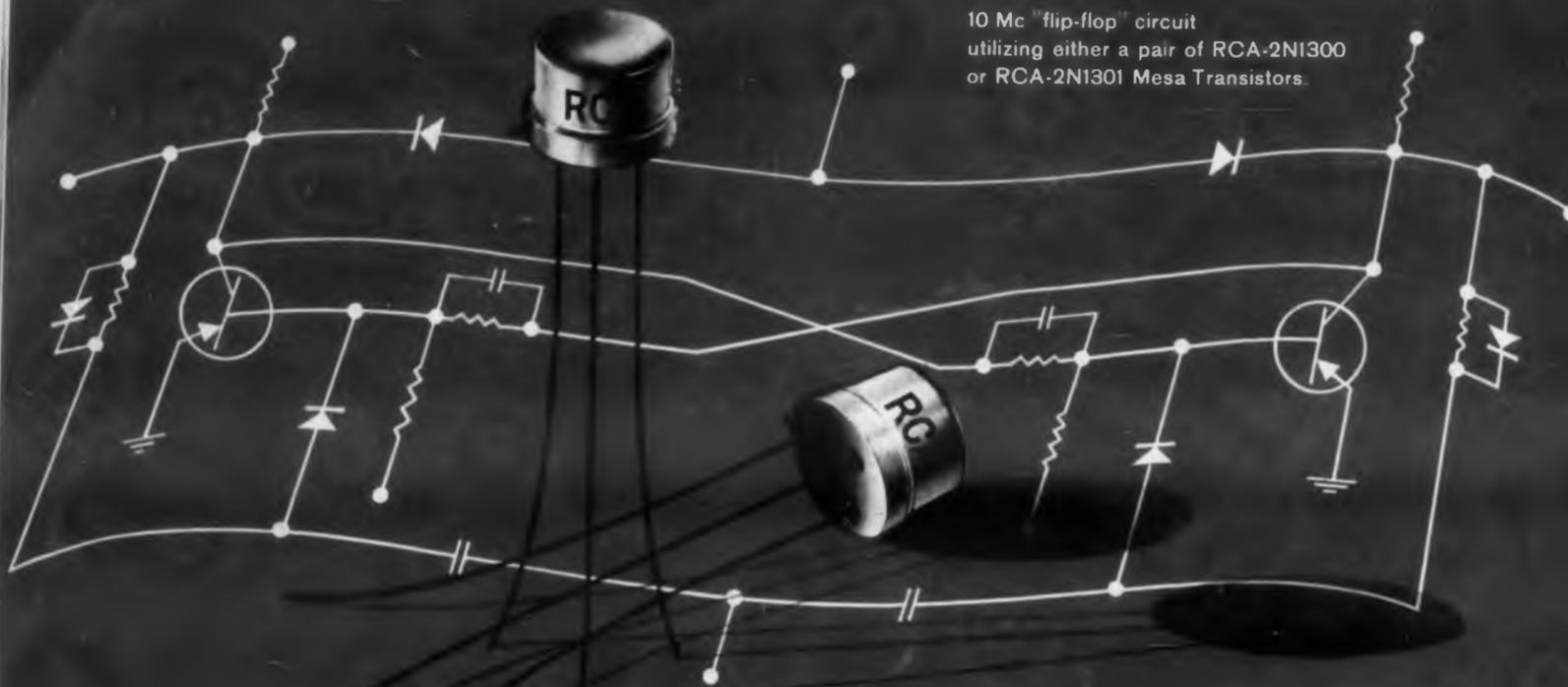
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10 Mc "flip-flop" circuit
utilizing either a pair of RCA-2N1300
or RCA-2N1301 Mesa Transistors.



RCA-2N1300 and 2N1301

LOW-COST MESA COMPUTER TRANSISTORS

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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!

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- 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 ^a 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 ^b 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

^aMaximum collector-to-emitter
voltage rating = -12 volts

^bFor collector ma = -10 and
collector-to-emitter volts = -3.

RCA Field Offices

EAST: 744 Broad St., Newark 2, N. J.
HUMboldt 5-3900

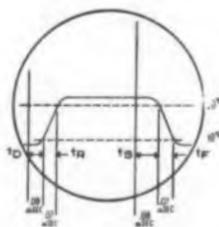
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