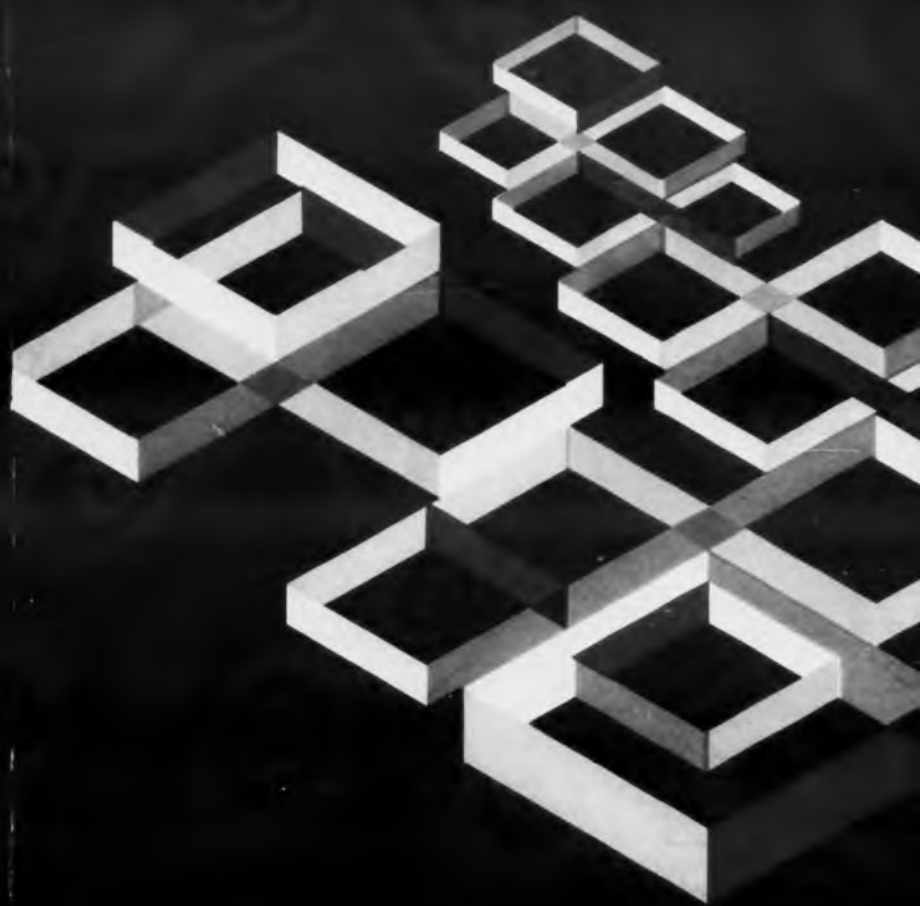


ELECT
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R O N I C
E S I G N

OCTOBER 1981

*to meet today's
demands—*

*a
staff report
p 34*



**NOW!
30 DAY
DELIVERY**

SIZE 8 & 10 INTEGRAL GEARHEAD MOTORS

3 Times Torque Load Capacity*
of comparable size 8 gearheads

*Will sustain 20 in-oz torque load for 1,000 hours operation and 100 in-oz momentary overload at the maximum ratios.

CPPC one-piece gearhead housing eliminates separate gear plates and fastening posts, improves and maintains accuracy through exact alignment of gear clusters, assures smoother operation and more expedient inspection and servicing.



Gearhead and motor are selectable, individual parts enclosed in the same common motor housing.



Clifton Precision, pioneers in postless gearhead construction, introduces the finest in gearhead design—cage type, one piece gearhead housing machined from a single block of metal. In these units exact duplication of gear centers is accomplished through simultaneous boring of permanently integrated bearing plates (patent pending). Positive and permanent alignment of gear clusters composed of AGMA precision Classes II and III hardened-steel gears integral with shafts journaled at both ends in ABEC class 5 bearings, minimize deflection and backlash, maximize torque load capacity, insure smoother operation and continued reliability of performance beyond normal endurance life requirements. Cage type construction facilitates inspection and lubrication while gearhead is mounted simply by removing motor. CPCC motors will stand greater heat than ever before due to the use of new materials. See box at lower right.

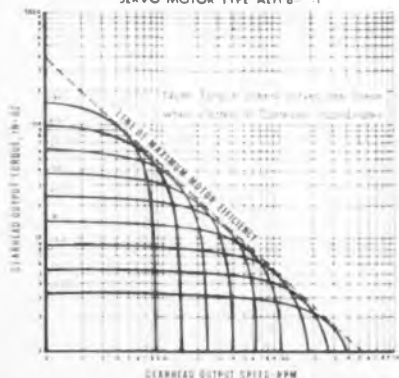
Write for our free pamphlet which gives detailed specifications of our entire gearhead motor and motor-tachometer line, sizes 8, 10 and 11.

STANDARD TYPES		No. of Clusters	Dir. of Rotation
Size 8	Size 10		
12.00	19.98	2 (3 pass)	reverse
20.63	32.19	3 (4 pass)	direct
34.26	58.28	3 (4 pass)	direct
56.44	93.89	4 (5 pass)	reverse
97.07	169.97	4 (5 pass)	reverse
165.58	273.84	5 (6 pass)	direct
275.02	495.74	5 (6 pass)	direct
469.19	796.70	6 (7 pass)	reverse
779.22	1445.92	6 (7 pass)	reverse

Note: 1 Any ratio ($\pm 3\%$) is available within the limits of the ratio range at additional cost and may require longer delivery time.
2 Max. backlash = 30 minutes at 2 in-oz reverse gauge load in above units. Inquire if special tolerance is required.

PERFORMANCE CHARACTERISTICS

SIZE 8 INTEGRAL GEARHEAD MOTOR
SERVO MOTOR TYPE ALH B-1



MOTORS

The following CPCC standard motors, electrical characteristics of which can be found in the current CPCC Rotary Components catalog, are offered with our gearheads

SIZE 8

ACH .8 1 AMH 8 3
ACH 8 4 ALC 8 1
AMH 8 1 ALC 8 4

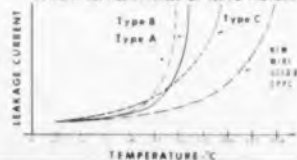
SIZE 10

ACH 10 1 ALH 10 1
ACH 10 4 ALH 10 5

CURRENT LEAKAGE

VARIAION WITH TEMPERATURE OF LEAKAGE CURRENT BETWEEN PHASES OF SERVO MOTORS

Superiority of insulation in CPCC motors is illustrated by actual comparative curves shown at the right.



CLIFTON PRECISION PRODUCTS CO., INC.
CLIFTON HEIGHTS, PENNSYLVANIA



CIRCLE 1 ON READER-SERVICE CARD



COVER: The staff report on "interim" packaging in this issue suggested to ELECTRONIC DESIGN's art director a symbolic treatment of modular packaging, depicting the interconnection of the modules in a system.

Sidelights On This Issue

The American Rocket Society's show, "Space Flight Report to the Nation," (see p 8) sent imaginations soaring, as befitted its spectacular subject matter. ELECTRONIC DESIGN's chief news editor, Robert C. Haavind, staggering back under a load of abstracts, brochures and press kits, could find only one word to describe the show: massive.

A sobering aspect of the exhibit, Haavind thought, was the frank admission in meeting after meeting that the frontiers of space still are largely uncharted, as are the means of reaching them. This considerable reliance on theories and untested concepts poses an enormous challenge for the men who must choose from among a multitude of theoretical designs the space systems that will work. Such decisions will require men of penetrating technical foresight and strong background. It also raises the specter of politics and company power plays swaying decisions in the wrong directions.

Haavind found electric engines for space repulsion dominating the major exhibits.

The show had a strong intramural flavor. Exhibitors tried hard to impress one another and, from the traffic flow, it would appear that many companies were using the show to chart new team efforts.



Bierman Moves Up

Howard Bierman, associate editor of **ELECTRONIC DESIGN**, will assume the duties of managing editor. He will succeed James A. Lippke, who has entered the consulting field. One of Mr. Lippke's first assignments will be a training program for new **ELECTRONIC DESIGN** technical editors.

Mr. Bierman has been with the magazine for three years. He is a graduate of City College of New York (B.E.E.). He worked for three years at ITT research laboratories and nine years in the radio-TV design field.

Mr. Bierman has written several books on radio-TV design and is the contributor of technical articles to several encyclopedias.

No Room

In preparing the **ELECTRONIC DESIGN** staff report on "interim" packaging, technical editor Robert Cushman ran into something of a packaging problem himself. So generous was the response to his call for editorial ideas and material, the staff report alone could have filled this issue.

Nothing's lost, however. Articles that were crowded out of the staff report will appear in future issues.



Editor Cushman

CIRCLE 2 ON READER-SERVICE CARD

THERE'S A NEW LOOK



TO TUBE RELIABILITY AND LONG LIFE

Raytheon Reliability-Controlled Tubes are certified to have an average life span of more than 10,000 hours when used under approved conditions — with full credit for failure within 1,000 hours — at no increase in price!

Through the use of special design and manufacturing techniques, Raytheon now brings

you a line of Reliability-Controlled Tubes to meet your most critical needs for long life and reliability. Each Reliability-Controlled type is monitored by tests far more severe than those normally encountered in service and is backed up by an unprecedented 10,000 Hour Life Certificate.

Applicable to shipments of 100 tubes or more from factory or Raytheon Distributor stock, Raytheon's 10,000 Hour Life Certificate assures you of:

- 1 Full credit for any and all tube failures which occur during the first 1,000 hours of service.
- 2 Proportional credit on the shipment lot to the extent that failures prevent that shipment lot from achieving an average life of 10,000 hours.

Eight Reliability-Controlled types are now available — 6AH6WA, 6AN5WA, 5670, 5654/6AK5W, 5755, 6414, 0A2WA, 5651WA — more types in development. Each data sheet contains a section devoted to operating conditions and ratings recommended to achieve the

long and reliable service built into these tubes. Full technical data and complete details on the new Raytheon 10,000 Hour Life Certificate are available from Raytheon Company, Industrial Components Division, Newton 58, Massachusetts.

RAYTHEON COMPANY

INDUSTRIAL COMPONENTS DIVISION

RAYTHEON

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TOROIDS

Custom-engineered to Exacting Specifications.

- Frequency range: 20 cycles—100 kc
- Power level: Up to 150 watts
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- Size range: Approximately 1/4 to 4" O.D.
- DC current range: Depends on the size, frequency and power level

MICROTRAN Quality and Reliability Guaranteed!



MICRO MINIATURE TRANSISTOR TRANSFORMER

Molded (M) 1/4" x 1/4" x 1/4"
Hermetic (H) 1/4" x 1/4" x 1/4", wt. 3/4 oz
Open Frame (F) 1/4" x 1/4" x 1/4", wt. 4 oz.

Part Number	Application	Primary Impedance	Secondary Impedance
MMT1*	Line to Base	600	600
MMT4*	P.P. Coll. to P.P. Base	50,000 C.T.	600 C.T.
MMT7*	Coll. to P.P. Base	25,000	1,200 C.T.
MMT8*	P.P. Coll. to P.P. Base	50,000 C.T.	1,200 C.T.
MMT9*	Line to P.P. Base	600 C.T.	1,200 C.T.
MMT11*	P.P. Coll. to P.P. Base or Line	4,000 C.T.	600 C.T.
MMT17*	P.P. Coll. to P.P. Base	10,000 C.T.	200 C.T.
MMT18*	P.P. Coll. to P.P. Base	25,000 C.T.	1,200 C.T.
MMT19*	Coll. to P.P. Base	2,500	2,500 C.T.
MMT26*	Line to Base	600 C.T.	600 C.T.

*Add either M, H, or FB to Part No. to designate construction. See catalog for detailed information.



TRANSISTOR TRANSFORMER SELECTION KIT

Save valuable time in optimizing circuitry
Set of 9 transformers covers impedance range of 150 through 200,000 OHMS. Matches most new transistor impedance ratings.
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PENNSYLVANIA, NORRISTOWN & PHILA.
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WASHINGTON, SEATTLE—F. B. Connelley
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Atlas Wholesale Radio Inc.



ULTRA MINIATURE TRANSISTOR TRANSFORMER

Open-frame (F)* Wt. .08 oz. size 1/4" x 1/4" x 1/4"
Molded (M)* Wt. .14 oz. size 1/2" x 1/2" dia.
Nylon Bobbin, Nickel-Alloy Core. Levels to .5m.

Part Number	Application	Primary Impedance (D.C.)	Secondary Impedance
UM28*(-)	Choke	10 hy (0 dc)	
UM29*(-)	Interstage	600 C.T.	600 C.T.
UM30*(-)	Choke	1.5 hy (0 dc)	
UM31*(-)	Interstage	10,000 C.T.	1,200 C.T.
UM32*(-)	Output	1,500 C.T.	600
UM33*(-)	Output	1,000 C.T.	600
UM34*(-)	Driver	10,000 C.T.	600 C.T.

*Add either F or M to part number to designate construction. See catalog for detailed information.



VERI-MINIATURE TRANSISTOR TRANSFORMER

Open Frame (FB)* Wt. 2 oz. size 1/2" x 1/2" x 1/2" high
Molded (M)* Wt. 1/2 oz. size 1/2" x 1/2" x 1/2" high

Part Number	Application	Primary Impedance	Secondary Impedance
VM1*	Input	200	600 (1.5 ma.)
VM2*	Interstage	200	600 (1.0 ma.)
VM3*	Interstage	200	600 (1 ma.)
VM4*	Input	200,000	1,200 (.72 ma.)
VM5*	Interstage	50,000	600 (1.0 ma.)
VM6*	Interstage	100,000	1,200 C.T. (.72 ma.)
VM8*	Output	1,250 (2.0 ma.)	34
VM10*	Interstage	2,500 (1.5 ma.)	2,500 C.T.
VM11*	Choke	20 hy. (0 ma.)	12 hy. (.5 ma.)
VM13*	Interstage	20,000	1,000 C.T. (.75 ma.)

*Add either M, or FB to part number to designate construction. See catalog. 4 color coded leads, resin impregnated.

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145 E. MINEOLA AVE., VALLEY STREAM, N. Y.

CIRCLE 3 ON READER-SERVICE CARD

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New Products 60

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A progress report on plasma amplifiers and a guide to application of socketless microwave tubes are featured in this edition of MicroWaves

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These essentially circuitless devices appear quite promising in broadband receiver applications

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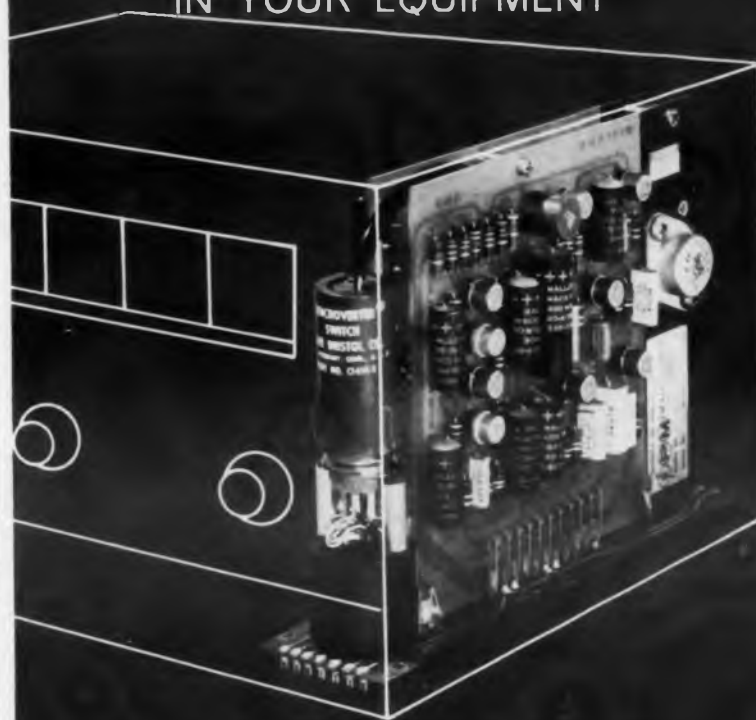
The editors of ELECTRONIC DESIGN huddled over a 1962 calendar (and sandwiches) last week and came up with a promising line-up of 16 staff and feature reports for next year. The schedule will be as follows:

Design '62, Jan. 4; microminiaturization, Feb. 15; IRE planning issue, March 1; IRE show issue (two volumes), March 15; IRE report, March 29; microwave antennas, April 12; production, April 26; diodes, May 24; transducers, June 21; transistors, July 5; WESCON planning issue, Aug. 2; WESCON show issue, Aug. 16; WESCON report, Aug. 30; radio frequency interference, Sept. 27; analog computers, Oct. 11; and reliability, Nov. 8.



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Model 3102 Features Chopper Stabilization,
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Here is the highly compact, precision PM 3100 Series wideband DC amplifier supplied to meet your specific OEM needs. Order it the way you want it . . . then simply add feedback and bolt it down. With the Model 3102 — lowest cost DC amplifier in its performance class — you get specs like these: 1 $\mu\text{v}/^\circ\text{C}$ drift (better, if desired) . . . 50 megs single-ended input impedance, 10K differential . . . gains of 10 to 1,000 or more . . . 0.01% gain stability . . . DC to 35KC bandwidth . . . 60 milliohms output impedance . . . output capability of ± 15 volts DC at 100 ma. Buy it in or out of a can, with or without a power supply. Use it as a standard amplifier or operationally for integrating, summing, etc. Contact PM for detailed performance specifications.



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CIRCLE 4 ON READER-SERVICE CARD

Advanced Systems Focus on Electro-Optics

National Electronics Conference Hears of Laser-Ranging Device, Light-Modulation Scheme and EL-PC Cell Commutator

Alan Corneretto
News Editor

THE expanding technology of electro-optics was much in evidence at the giant National Electronics Conference, held earlier this month in Chicago. Among the papers delivered on this speciality were three pointing up the progress in harnessing optical effects for advanced systems and devices. These papers described:

- A means of continuously modulating an optical ruby maser's output at up to 160 mc with potassium dihydrogen phosphate (KDP) crystals. This technique would be applied to an optical-communications system.
- An optical ranging scheme accurate to 50 ft at 15,000 ft. This system, too, is based on an optical ruby maser.
- An 8-channel commutator equivalent to a cascaded T-network switching circuit, but consisting of interconnected electroluminescent - photoconductive (EL-PC) cells, and reportedly having a usable bandwidth of 2 mc and a switching time of about 250 msec.

Among the products displayed at the con-

ference were an X-band magnetron, said to have operated at 400 C for more than 400 hrs, and a sleep-inducing apparatus that operates by pulsing square waves from a patient's eyeballs to the back of his head.

Gordon Jacobs, a system designer at General Electric Co., Syracuse, N. Y., reported building a light-modulation system using KDP crystals that modulate both the coherent output of a pulsed ruby laser and the incoherent emission of a mercury-arc lamp. The GE system was reported to do this continuously and over wider than usual bandwidths. In the past, maximum light-modulation bandwidth possible with KDP crystals, because of charging-current and heating limitations, was on the order of 1 mc, Mr. Jacobs said.

Like other Pockels-effect modulators, described by Bell Laboratories, Harvard, and Sperry Gyroscope (see p 28), the GE unit consists of a crystal in a re-entrant-cavity oscillator. Polarized light passing through the crystal is speeded or retarded in phase by longitudinal application of a modulating voltage to the crystal.

The power required to drive a KDP crystal reactive load is theoretically dependent

only on bandwidth and is independent of the center frequency of the rf carrier involved. As a result, the usual video frequency and high-capacity video transformer were discarded in favor of an rf carrier and low-capacity rf transformer. By using an rf carrier for the wideband signal, rather than modulating directly at a video frequency, broadband performance is achieved and driving power for modulation is reduced. To permit continuous modulation at the frequencies involved, large electrodes capable of carrying high-charging currents are bonded directly to the crystal.

GE reports getting usable bandwidths of 5 mc modulated at up to 160 mc. Modulation power required was about 20 w per mc of bandwidth with the optimum reached at a modulation frequency of 50 mc. Normally, modulating at video frequency requires about 240 w per mc of bandwidth.

A mercury-arc light communication system has been operated over a 1,000-ft link between two buildings at GE using a telescope receiver and a photomultiplier tube in an RC circuit as a demodulator. Up to modulation frequencies of about 100 mc, the signal-to-noise was said to be good, but it deteriorated above 100 mc. Using a mercury-arc-light source, a signal-to-noise ratio of 20 db was obtained easily.

The work at GE is part of the development of optical-communication systems based on continuous-wave optical masers and phase modulation, rather than on absorption modulation of their light. The company hopes for eventual modulation bandwidths of 500 to 1,000 mc.

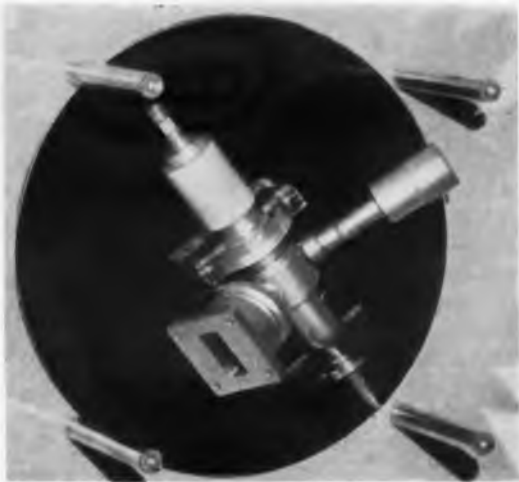
Pulsed-Laser Ranging Device Under Development for Military

TRG, Inc., Syosset, L. I., N. Y., has developed a ranging system in which pulses from an optical ruby maser bounce off a target and, received by a photomultiplier-



Optical-frequency transmitter (left) contains a ruby-laser light source and a light modulator consisting of a KDP crystal in a cavity oscillator. Modulating carriers of up to 160 mc have been applied to information carriers of 5-mc bandwidth at the frequency of red light. With a mercury-arc lamp source and a photo-multiplier-tube detector, communications over 1,000 ft have been achieved. Receiver is shown at right.





Developmental magnetron, shown without magnet, is one of two that operated more than 400 hrs at 400 C, delivering 235 kw peak output power at X-band. Tube will be tested later at 650 C to determine whether magnetron operation without cooling is possible. Ceramic insulator covers cathode assembly; output flange is in the foreground.

tube detector, yield range data accurate to ± 50 ft. at 15,000 ft. As described by Lawrence Goldmuntz of TRG, the short-duty cycle—a high-intensity pulse system—is able to provide range accuracy because of the short, rapid-rise-time pulses available from the laser. Accuracy also is assured by a quasi-correlation technique used in the receiver. The problem of back scatter was said to have been surmounted by a narrow-bandwidth optical system.

Mr. Goldmuntz reported that in operation a small portion of the admitted light from the laser is scattered into a photo cell, the output of which triggers a horizontal A-scope trace. After triggering, the sweep travels for a preset time corresponding to the maximum target range. On reaching the preset range deflection, the spot returns to the origin and awaits triggering by the next admitted pulse.

The echo pips are applied as Z-axis modulation. They cause the trace to brighten slightly. Because of the character of the admitted waveform and because the intervals between pulses usually are shorter than the range, many nonsynchronized echos in addition to the true-range echo generally return during one A-scope sweep.

The true-range echo becomes discernible above the statistical background of nonsynchronized echos and other signals by virtue of many sweeps during one pump light flash and the persistence of the scope screen.

(continued on p 6)

ELECTRONIC DESIGN • October 25, 1961



This unique "extra"
fifth digit...

...provides 100%
over-ranging...ten times
greater resolution at decade
voltage points where other 4-digit
voltmeters change ranges and lose
one full digit of resolution.

The KIN TEL Model 501B 4-digit, over-ranging digital voltmeter measures DC from ± 0.0001 to ± 1000.0 volts to an accuracy within 0.01% of reading ± 1 digit. An extra fifth digit in the left decade indicates "0" or "1" to provide ten times greater resolution at decade (1, 10, 100) voltage points than standard 4-digit voltmeters. Ranging and polarity indication are entirely automatic. The measured voltage, decimal point and polarity symbol are displayed on an in-line readout in a single plane—no superimposed outlines of "off" digits.

An adjustable sensitivity control permits decreasing sensitivity to allow measurement of noisy signals. Ten-line, parallel input printers can be driven directly, and converters are available for driving other types of printers, typewriters, and card or tape punches. The input impedance is 10 megohms at null on any range, and an input filter attenuates power-frequency ripple by 60 db. Stepping switches are DC-driven (as in telephone service) at 20 steps per second, are guaranteed to give at least two years of trouble-free service without maintenance.

The 501B is one of a complete line of KIN TEL digital instruments. Others include AC converters, AC and DC preamplifiers, ratiometers, comparators, and multi-channel input scanners.

IMPORTANT SPECIFICATIONS

Display... Six decades display 5 digits (Left digit "0" or "1" only), decimal point, polarity symbol. Ranging and polarity indication are automatic. Projection system readout employs bayonet-base lamps with 3000-hour minimum life rating. Readout contains no electronic circuitry and can be remotely mounted.

Automatic Ranges... ± 0.0001 to ± 1000.0 volts DC in four ranges: 0.0001 to 1.9999; 02.000 to 19.999; 020.00 to 199.99; 0200.0 to 1000.0

Accuracy... 0.01% ± 1 digit (of reading).

Input Impedance... 10 megohms on all ranges at null.

Reference Voltage... Chopper-stabilized supply, continually and automatically referenced to standard cell.

Stepping-Switch Drive... DC voltage within stepping-switch manufacturers rating applied by transistor drive circuit at rate of approximately 20 steps per second.

Controls... Three: on-off; sensitivity; and mode of operation (standby, normal, print auto, print remote).

Printer Drive... Built-in for parallel input printers. Automatic or remote.

Dimensions and Net Weights... Control unit: 45 lbs, 5 1/4" H x 19" W x 16" D.
Readout: 10 lbs, 3 1/2" H x 19" W x 9" D.

Price: \$2995

KIN TEL manufactures electronic instruments for measurement and control, and closed circuit TV. Representatives in all major cities. Write for detailed literature or demonstration.

5725 Kearny Villa Road, San Diego 11, California. Phone: BRowing 7-6700

CIRCLE 5 ON READER-SERVICE CARD

COHU
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KIN TEL DIVISION

FOR THE FIRST TIME: A FAST-RESPONSE TUBELESS AC LINE REGULATOR—1KVA ...BY PERKIN



Model MTLR1000

(only 5¼" high)

New Perkin Model MTLR1000 combines reliable magnetic amplifier circuitry with a transistorized pre-amplifier that cuts response time to as low as .05 second! You get safe, continuous AC power, precisely controlled by a silicon zener diode reference circuit. Remote sensing and automatically resetting thermal devices for overload protection make this new AC line regulator ideal for remote locations. All static components for added reliability. Now, after years of research, these features are available in one unit for the first time—yours from Perkin.

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SPECIFICATIONS

AC Input: 95-135v, 60 cps $\pm 10\%$,
1 phase

AC Output: 110-120v

Regulation Accuracy: $\pm 0.2\%$ for
line changes from 105-
125v ($\pm 0.5\%$ from 95-
135v) and load changes
from no load to full load.

Response Time: 0.05-0.1 seconds
for line or load
changes.

Total Harmonic Distortion: 3% max.
Power Factor Range: 0.7 lagging to
.9 leading.

Load Range: 0-8.5a

Dimensions: 17" W x 16½" D x
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NEWS

Electro-Optics . . .

(continued from p 5)

TRG expects to improve performance of its system by using a double flashing technique in which the ruby would be pumped to threshold with one discharge through the pumping lamp and pumped above threshold by another discharge. This would provide single pulses of controlled spacing. An amplifier for creation of short, intense pulses is also under study as a means of improving system performance. Gains of a factor of two in a 2-in. ruby rod and gains of a factor of 12 in an 8-in. rod were reported by TRG. A third technique being investigated is optical heterodyning in the echo receiver to reduce back-scatter effects. Such a receiver would replace the present narrow-band optical receiver. Much of TRG's work in this area is supported by the Advanced Research Projects Agency of the Dept. of Defense. The company reports it has the contract to develop a practical ground-to-ground ranging system for such targets as tanks.

Solid-State 8-Channel EL-PC Commutator Tested

A net of photoconductive cells actuated by electroluminescent lamps and forming an 8-channel commutator has been built and tested at GE's Electronic Laboratory, Syracuse, N. Y. Among the advantages cited for the device by GE's R. D. Stewart, who described it in a paper at the conference, are: electrical isolation between signal and control sources; ease of matching EL-activating lamps to PC cells (yielding a calculated volume of 0.01 cu in. per EL-PC pair); power gain of more than 40 db; and noise level low enough to permit detection of signals in the low microvolt region.

The commutator built at GE uses Ohmic-contact cadmium-sulfide PC cells and orange EL cells. They are arranged in a network equivalent to a cascaded T-net of electro-mechanical switches. A usable bandwidth of about 2 mc was measured; the device switched in from 100 to 500 msec.

GE expects that EL-PC commutators, despite inherent limitations of low speed and low frequency response, will prove useful where reliability, small size and low-voltage operation are required. The company plans to fabricate deposited-thin-film versions of the commutator.

The EL-PC work reported on by Mr. Stewart is related to GE's neuron simulation project (*ED*, Sept. 13, p 41). T. E. Bray, told the conference that the first EL-PC neural element is being tested. It has achieved the transfer functions set for it by the Air Force. In its finished form, the 20-input, all-analog device consists of more than 40 multipliers and 20 analog memory elements. It occupies 2.5 cu. in. and consumes 0.5 w.

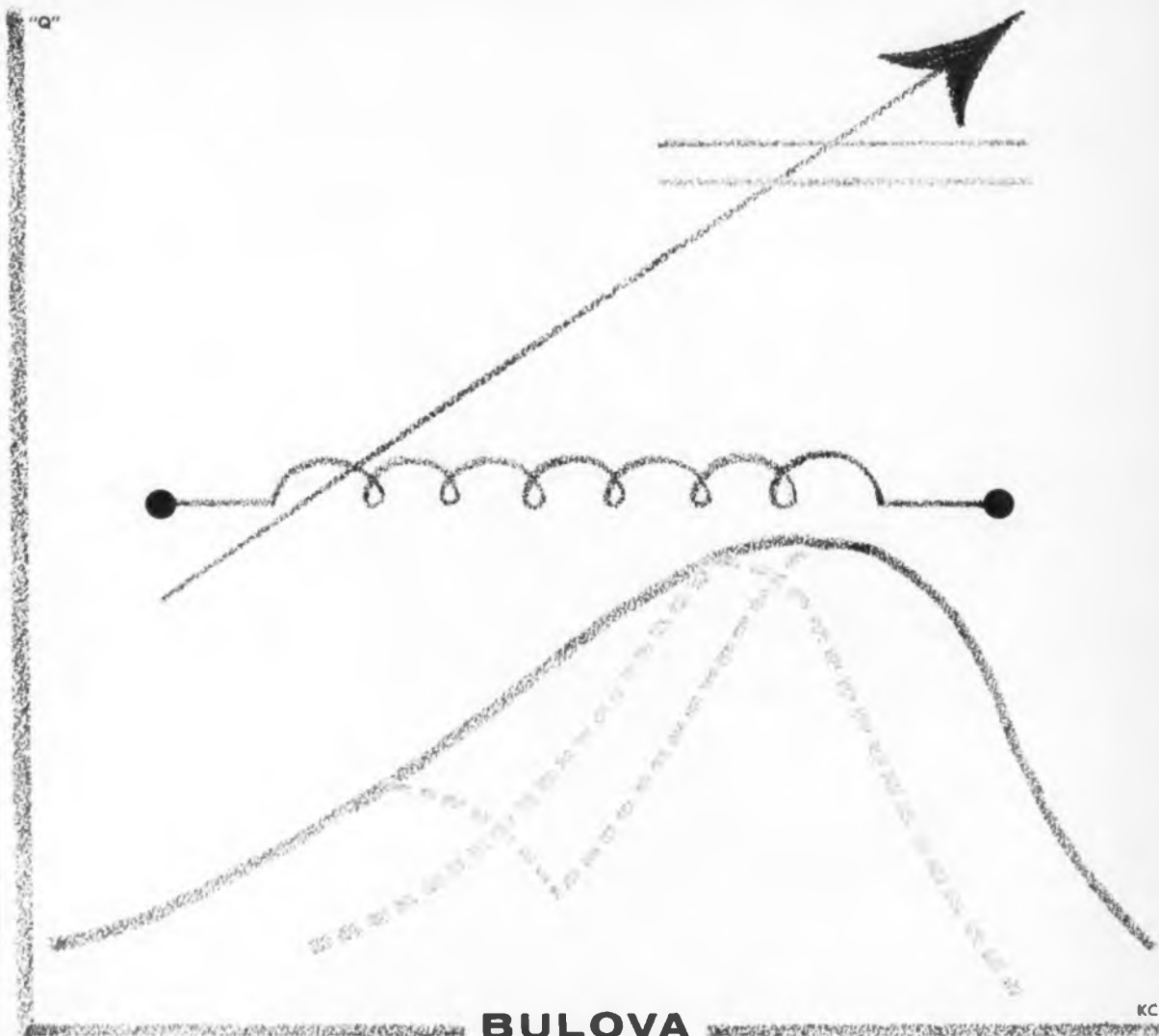
Displays Include Sleep-Inducer, High-Temperature Magnetron

A relaxing, or sleep-inducing device called Electroson was displayed at the Chicago show by Electronic Polyphase Ionic Corp., Chicago. It operates by emitting current from a headband so that square-wave pulses travel from electrodes over the eyeballs to the back of the patient's head. Sleep is induced in periods ranging from seconds to several minutes, the company reported.

Related to similar devices in use in the Soviet Union and Japan, the unit is basically a multivibrator pulse generator. Its frequency is regulated by changing the time constants of both arms of the multivibrator. Partial wave shaping and major frequency control is achieved by altering the RC time constants in one arm of the multivibrator. A limiter and feedback wave shaper are included to shape peaks. Maximum voltage output is 25 v at 5,000-ohm load; about one ma of current is used and frequency range is from 0.5 to 150 cps.

The patient receives the current through a two-part electrode, one part of which is stainless steel, the other a glass container filled with saline solution. The solution wets a cotton wick that touches both the metal electrode and the patient. Price of the unit was said to be about \$350.

Raytheon Corp., Burlington, Mass., displayed a developmental X-band magnetron, said to have operated for more than 400 hrs at 400 C. The tube was designed to work in airborne equipment without blowers, ducting or cooling. The tube is basically a 6-frequency 6249 magnetron. It produces a minimum peak power of 235 kw in the 8,500-to-9,600-mc band, according to the company. High-temperature operation was achieved without any major design innovation, although special material containing a minimum of residual gas is used, Raytheon said. Gold soldering also is employed. The tube is being developed under an Air Force contract, which calls for additional life tests at 650 C. These tests are to begin shortly, the company reported. ■ ■



BULOVA HIGH FREQUENCY INDUCTANCE SUBSTITUTION BOX

Whatever the "variation" you need, the new Bulova inductance substitution box provides the precise measure with three decades of inductance ranging from 0.1 to 111 millihenries.

The Bulova SB-100 uses gold contact subminiature switches to permit low stray capacity and excellent low level contact. Maximum distributed capacity of any selected inductance is less than 20 picofarads, and the maximum useful frequency is in excess of 2 mc. The fully encapsulated coils allow the unit to be used in environmental chambers with a minute inductance change, (approx. + 100 ppm/°C).



The use of direct current up to 50 milliamperes without appreciable change in inductance is permitted. The accuracy of the instrument is $\pm 1\%$ true inductance at 1 volt and $25 \pm 10^\circ\text{C}$. Its zero setting residual inductance is 0.5 microhenry.

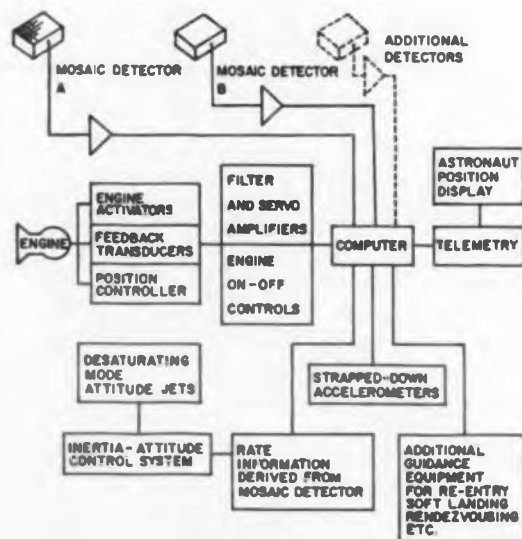
This new high frequency inductance substitution box is only one of many recent advances made by Bulova Electronics. For information on these specific units, or on how Bulova experience in mastering component and system reliability can help you, write Department

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CIRCLE 8 ON READER-SERVICE CARD

Space Report: Soaring Ideas—Down-to-Earth Problems

Guidance, Power-Supply and Propulsion Concepts Presented At Rocket Society's Show Point Up Challenge to Designers



Proposed mosaic approach to space guidance would replace conventional inertial-type systems using periodic celestial references. Two mosaic detectors, placed at different points on a vehicle, would be sufficient to establish a fix.

Robert C. Haavind
Chief News Editor

THE NEED for design ingenuity in the space age was well illustrated by the great variety of problems and solutions discussed in myriad sessions and informal discussions during the Space Flight Report to the Nation. The exposition, sponsored by the American Rocket Society, was held from Oct. 9 to 15.

Key electronic areas covered in exhibits that filled New York's Coliseum, included:

- Ideas for space-guidance systems.
- Progress on power-system designs for space.
- Numerous approaches to electrical propulsion for space.

One suggestion for space navigation was based on a mosaic optical system modeled after the structure of the eye. This approach, according to Eugene F. Lally of Jet Propulsion Laboratory, would eliminate the need for inertial systems or position information sent from the ground.

The achievement of such a mosaic setup, in which a computer system would match incoming signals from the mosaic with stored data to make position determinations, awaits the development of suitable microminiature

circuitry, Mr. Lally said. Rather than gimballing the mosaic detectors to the spacecraft, several detector mosaics could be placed around the vehicle.

Stars, Planets Would Help Fix Positions In Space

Fixes would be taken by reference to stars and a planet. A scan sequence for establishing both a star and a planet on one mosaic would require attitude control of the vehicle during the acquisition phase. Mr. Lally suggested that added analog information might be obtained in the star-identification process by using detectors that establish the temperature characteristics of the star.

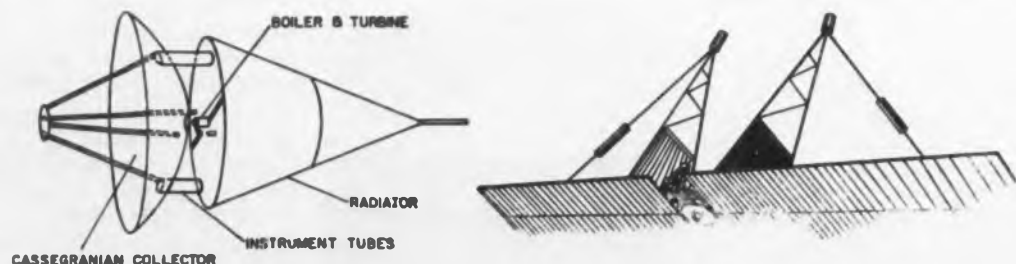
Although a single detector could not perform this, a combination of red-sensitive and blue-sensitive detectors could be used to obtain ratios that would aid in recognition.

Some alternate analog approaches to this type of mosaic system were suggested by Mr. Lally. These were the use of photoconductive detectors scanned by an optical beam; image conversion through use of cooled ionic crystals, which change infrared to visible light; or the illumination of semiconductor junctions. With the latter approach, he suggested that the use of the lateral photoeffect to determine star displacements from the center of the junction area would give a more accurate fix than would be possible with the total junction areas as the revolving element in the mosaic.

These analog methods eventually should give way to pure digital techniques, Mr. Lally predicted, so that smaller and smaller elements could be used. This would simplify the processing involved.

Many Approaches Taken In Space Power Conversion

Reviews of progress in energy sources for space indicated that a wide choice will be



Two solar-conversion approaches to supplying power to a vehicle approaching the sun are illustrated in these artist's concepts. Solar turbogenerator, left, would be slightly heavier and would have the disadvantage of possible low reliability because of moving parts. Solar thermoelectric converter, right, would require considerable structural weight to position the large collecting panels.

Binary Computer Is Desk-Size



This desk-size binary computer, shown at the American Rocket Society's space exhibit, has a high-speed magnetic-core memory with 512 15-bit words of random access storage. The memory system has a read-restore cycle period of 8 μ sec, and add time of 24 μ sec. The console has all arithmetic and control registers on its panel, permitting operator intervention. All logical circuitry and test points are accessible to the operator. Developed by Univac, St. Paul, Minn., the system uses solid-state parallel-logic circuitry with 630 logical elements. The computer costs \$34,500.

available to the system designer. A variety of design configurations for magneto-hydrodynamic, thermionic, thermoelectric, electrochemical, nuclear and solar conversion power sources for space flight was discussed at several sessions.

Two possible solar-converter designs for a probe toward the sun were discussed in a paper by B. E. Thompson, J. H. Guill and H. Radd of General Dynamics/Astronautics, San Diego. One of the suggested systems was a solar-powered 30-kw turbogenerator. The disadvantages of this system include its weight and the low reliability of the rotating machinery involved. An alternative, according to the authors, is a solar thermoelectric converter made by the General Atomic Div. of General Dynamics. This approach would make use of collector panels with a total area of 1,900 sq ft.

Electric engines captured major attention during the meeting. More activity in this area was urged by Capt. Richard J. Hayes and Ernst Stulinger of the National Aeronautics and Space Administration and Myron A. Hoffman of the Massachusetts Institute of Technology. The speakers cautioned that overemphasis on lunar probes might hamper progress in work on longer space missions.

Ion and arc jet-type engines are nearing the flight-test phase, and numerous electromagnetic engines are under development (ED, Oct. 11, p 8), the speakers noted. The program is making progress despite lack of funds, the speakers said. ■ ■

CIRCLE 9 ON READER-SERVICE CARD ▶

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120 V (BV_{CBO})

0.5 V(SAT)

150 mc. f_T

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CORE DRIVER
LINE DRIVER**



2N2087: ABSOLUTE MAXIMUM RATINGS
Storage Temperature -65 to +300°C.
 BV_{CER} ($R \approx 10 \Omega$) 80 volts
 BV_{CBO} 120 volts
 BV_{CEO} 5 volts
Collector Current I_C 500 ma
Total Device Dissipation (case 25°C.) ... 2 watts
Total Device Dissipation (case 100°C.) ... 1 watt
Total Device Dissipation (free air 25°C.) ... 0.6 watt

ELECTRICAL CHARACTERISTICS (@ 25°C.)

Characteristics	Conditions	Min.	Max.	
h_{FE}	$V_{CE} = 1V.$ $I_C = 150 \text{ ma.}$	40	120	
V_{CE}	$I_C = 150 \text{ ma.}$ $I_B = 15 \text{ ma.}$		1.2	volts
$V_{CE}(SAT)$	$I_C = 150 \text{ ma.}$ $I_B = 15 \text{ ma.}$		0.5	volts
f_T	$I_C = 50 \text{ ma.}$ $V_{CE} = 10V.$	150		mc
C_{ob}	$V_{CE} = 10V.$ $I_C = 0 \text{ ma.}$		12	pf
I_{CBO}	$V_C = 60V.$ $T = 25^\circ C.$		2	μA
I_{CEO}	$V_C = 60V.$ $T = 125^\circ C.$		150	μA
BV_{CER}	$R \approx 10 \Omega$ $I_C = 20 \text{ ma.}$ pulsed	80		volts
t_r			85	nsec
t_f			100	nsec
t_r			55	nsec

Both types 2N2087 and 2N2086 are immediately available from your Philco Industrial Semiconductor Distributor.

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The 2N2087 combines 120 BV_{CBO} , 40 h_{FE} min., 0.5 V. max. $V_{CE}(SAT)$, 150 mc min. f_T , 12 pf max. C_{ob} , and 100 nsec max. t_r .

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These new Philco epitaxial silicon mesa transistors deliver optimum drive for computer memory planes, serve as medium power switches in airborne control systems, and are ideally suited to a wide variety of other applications such as small power supplies, servo amplifiers, and automation controls. For complete information, write Dept. ED102561.



10 nsec t_s max.

with 2N783



0.19 Volts V_{CE} (sat) max.

with 2N784



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SYLVANIA SILICON

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SYLVANIA 2N783... world's fastest MPN silicon switching transistor

t_{on}	$I_{B(1)} = 3 \text{ mA}, I_{B(2)} = 1 \text{ mA}$ $V_{CC} = 3 \text{ V}, R_L = 270 \text{ Ohms}$	18 nsec
t_s	$I_{B(1)} = 10 \text{ mA}, I_{B(2)} = 10 \text{ mA}$ $V_{CC} = 10 \text{ V}, I_C = 10 \text{ mA}, R_L = 1000 \text{ Ohms}$	10 nsec
t_{off}	$I_{B(1)} = 3 \text{ mA}, I_{B(2)} = 1 \text{ mA}$ $V_{CC} = 3 \text{ V}, R_L = 270 \text{ Ohms}$	30 nsec

SYLVANIA 2N784... an optimum combination of high speed switching and low V_{CE} (sat)
 $I_C = 10 \text{ mA}, I_B = 1 \text{ mA}$

0.19 V

For speed, meet the fastest silicon switch on record—try Sylvania 2N783. Utilizing the proven mesa structure and advanced techniques for epitaxial growth, Sylvania 2N783 provides exceptionally fast turn-on, turn-off, and storage times. Sylvania 2N784 is a remarkable combination of ultra-fast switching speed and unusually low saturation voltage.

Packaged in TO-18, both types possess high reliability and the excellent power dissipation capabilities typical of the mesa structure. They exhibit high electrical uniformity, characteristic of highly automated Sylvania batch-mesa manufacturing techniques.

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ABSOLUTE MAXIMUM RATINGS (AT 25°C)

	2N783	2N784	UNIT
Collector to Base Voltage	40	30	V
Collector to Emitter Voltage	20	15	V
Emitter to Base Voltage	5	5	V
Collector Current	200	200	mA
Collector Current (free air)	300	300	mW
Power Dissipation (case at 25°C)	1	1	W
Storage Temperature	-65 to +300	-65 to +300	°C
Junction Temperature	+175	+175	°C

ELECTRICAL CHARACTERISTICS (AT 25°C)

Symbol	Conditions	2N783		2N784		UNIT
		Min.	Max.	Min.	Max.	
BV_{CBO}	$I_C = 100 \mu\text{A}, I_E = 0$	40	-	30	-	V
BV_{EBO}	$I_C = 100 \mu\text{A}, I_C = 0$	5	-	5	-	V
BV_{CES}	$I_C = 0.1 \text{ mA}, V_{BE} = 0, R_{BE} = 10 \text{ ohms}$	20	-	15	-	V
I_{CBO}	$V_{CB} = 25 \text{ V}$	-	250	-	250	μA
I_{CE0}	$V_{CB} = 25 \text{ V}, T = 150^\circ\text{C}$	-	30	-	30	μA
h_{FE}	$I_C = 10 \text{ mA}, V_{CE} = 1 \text{ V}$	20	80	25	-	-
V_{BE}	$I_C = 10 \text{ mA}, I_B = 1 \text{ mA}$	0.7	0.9	0.7	0.9	V
V_{CES}	$I_C = 10 \text{ mA}, I_B = 1 \text{ mA}$	-	25	-	19	V
C_{ob}	$V_{CB} = 10 \text{ V}, I_C = 0, F = 1 \text{ MC}$	-	3.5	-	3.5	μf
h_{re}	$V_{CE} = 10 \text{ V}, I_C = 10 \text{ mA}, F = 100 \text{ MC}$	2.0	-	2.0	-	-
t_{on}	$I_{B(1)} = 3 \text{ mA}, I_{B(2)} = 1 \text{ mA}$ $V_{CC} = 3 \text{ V}, R_L = 270 \Omega$	-	18	-	20	nsec
t_s	$I_{B(1)} = 10 \text{ mA}, I_{B(2)} = 10 \text{ mA}$ $V_{CC} = 10 \text{ V}, I_C = 10 \text{ mA}, R_L = 1000 \Omega$	-	10	-	15	nsec
t_{off}	$I_{B(1)} = 3 \text{ mA}, I_{B(2)} = 1 \text{ mA}$ $V_{CC} = 3 \text{ V}, R_L = 270 \Omega$	-	30	-	40	nsec

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CIRCLE 10 ON READER-SERVICE CARD

NEWS

SIGNIFICANT BITS

Important Industry News Written
For Fast Scanning by Engineers

A video system, designed to operate 250 miles above the earth, will be used to observe the placing into test trajectory of an Echo A-12 test payload. Information transmitted to earth by the TV system, developed by Siegler Corp.'s Hallamore Div., Anaheim, Calif., will be recorded on film and magnetic tape. Tests of the 30-in. prototype of the Echo A-12 TV viewer were made by Siegler last May for the National Aeronautics and Space Administration, using an 800-million candle-power searchlight to view the inflation of the Echo balloon.

0001

Optical-maser technology has taken some important steps forward with three developments at Bell Telephone Laboratories. These are:

- A 10-kmc light modulator using the electro-optic effect in potassium dihydrogen phosphate (to be described by Dr. I. P. Kaminow at the Northeast Electronics Research & Engineering Meeting in Boston, Nov. 14-16).
- Attainment of higher peak emission for given pumping power by substituting mirrors for the silvered ends of a ruby rod and putting a chopper in front of one mirror to hold back the output while the population of upper energy states becomes greater than previously achieved.
- Discovery of a new maser material—neodymium in calcium tungstate—with the emission line in the photographable portion of the infrared (10,600 Å). The resulting optical maser operates with input power of 5 joules at room temperature.

0010

A digital-data recording system has been designed for the University of Michigan to automate microscope readings. The device will be used with a projection microscope to digitize and record X and Y coordinates of selected points. Light-wave interferometers (Moire fringe) attached to the measuring stages of the microscope will produce output signals to two bi-directional transistor-

ized counters. The system will store counter data upon command and, when storage is complete, will automatically initiate recording through an IBM summary card punch. Datex Corp., Monrovia, Calif., is the designer.

0011

Nonmagnetic sealed silver-cadmium cells, designed to eliminate the weight and space limitations of nickel-cadmium batteries, are undergoing operational tests in the Explorer XII satellite. The silver-cadmium cells are said to provide three times as much power as lead-acid or nickel-cadmium batteries, yet take up only a third as much space. The cells are made under the name of Silcad by Yardney Electric Corp., New York City.

0100

Trailer vans loaded with atomic-test equipment have been dispatched by the Defense Department to 46 locations across the country in the Project Vela Uniform program for reliable detection of secret underground shots.

Baby Computer Perfected



No bigger than a loaf of bread, this working computer is said to perform 33,000 mathematical calculations per sec. The model is composed of 5,500 currently available electronic components and weighs 12 lb. Burroughs Corp., Detroit, which developed the machine, utilized the macro-module system of packaging. Shown is the finned heat exchanger, which is the central element in a "log", or row of triangular chips. The chips contain circuitry and plug into a folding printed-circuit card.

ELECTRONIC DESIGN • October 25, 1961

New from Sprague!



TO-9
CASE

*The Most Widely-Used Logic Transistor,
Type 2N1499A, Now Has a Smaller Brother...*

TYPE 2N979



TO-18
CASE

LOW-COST LOGIC TRANSISTOR

Here is a new Sprague Transistor that is smaller in size, yet identical in performance with the well-known 2N1499A Logic Transistor.

Designed for use in saturated switching circuits, this low-cost, hermetically-sealed MADT® Transistor is capable of switching at frequencies in excess of 10 megacycles.

In addition to computer applications, this rugged transistor is ideally suited for data processing and instrumentation equipment.

There are two major reasons why The Sprague 2N979, as with the 2N1499A, is earning a high level of acceptance:

1. DEPENDABLE PERFORMANCE — Specifically designed with parameters intended for logic

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circuits, these transistors consistently show low storage time, low saturation voltage, high beta, high switching speed. Their cases are cold welded to insure reliability.

2. ATTRACTIVE PRICE — Available in production quantities, these transistors are first-run devices, *not* "fall-outs". They are produced on FAST (Fast Automatic Semiconductor Transfer) lines with direct in-line process feedback, especially programmed to insure high production yields.

Here are some key parameters:

I_{CBO} 1 μ a typ.
 BV_{CBO} 20V min.
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 f_T 100 mc min.

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CIRCLE 11 ON READER-SERVICE CARD

AXIMAX MINIATURE 400CPS FANS

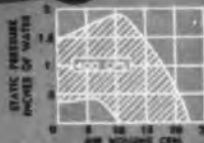
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12 to 23 CFM
11,400 to
22,500 RPM

1 13/32"
4 OZS.



- Extremely compact and lightweight—1 13/32" x 1 1/4", 4 ozs.
- 115 or 200 VAC, 1 ϕ or 3 ϕ , 400 cps.
- Airflow reversible.
- Built to Military Specifications.



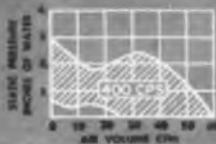
AXIMAX 2

24 to 60 CFM
8,000 to
20,000 RPM

1 13/32"
4 1/2 OZS.



- Size: 2" x 1 1/2". Weight: 4 1/2 ozs.
- 115 or 200 VAC, 320 through 1600 cps, 1 ϕ or 3 ϕ
- High altitude (Altivar) \otimes and high density designs available.
- Airflow reversible.
- Built to Military Specifications.



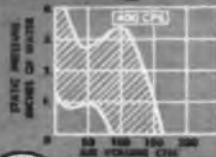
AXIMAX 3

70 to 165 CFM
9,000 to
22,000 RPM

2 3/16"
14 OZS.



- Size: 3 1/4" x 2 3/8". Weight: 14 ozs.
- 115 or 200 VAC, 400 and other cps, 1 ϕ or 3 ϕ .
- High altitude (Altivar) \otimes and high density designs available.
- Airflow reversible.
- Built to Military Specifications.



Appropriate cam-locking mounting clamps are available from Rotron for servo-mount Aximax fans.



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NEWS

Kilomegabit Data Link In Design Stage

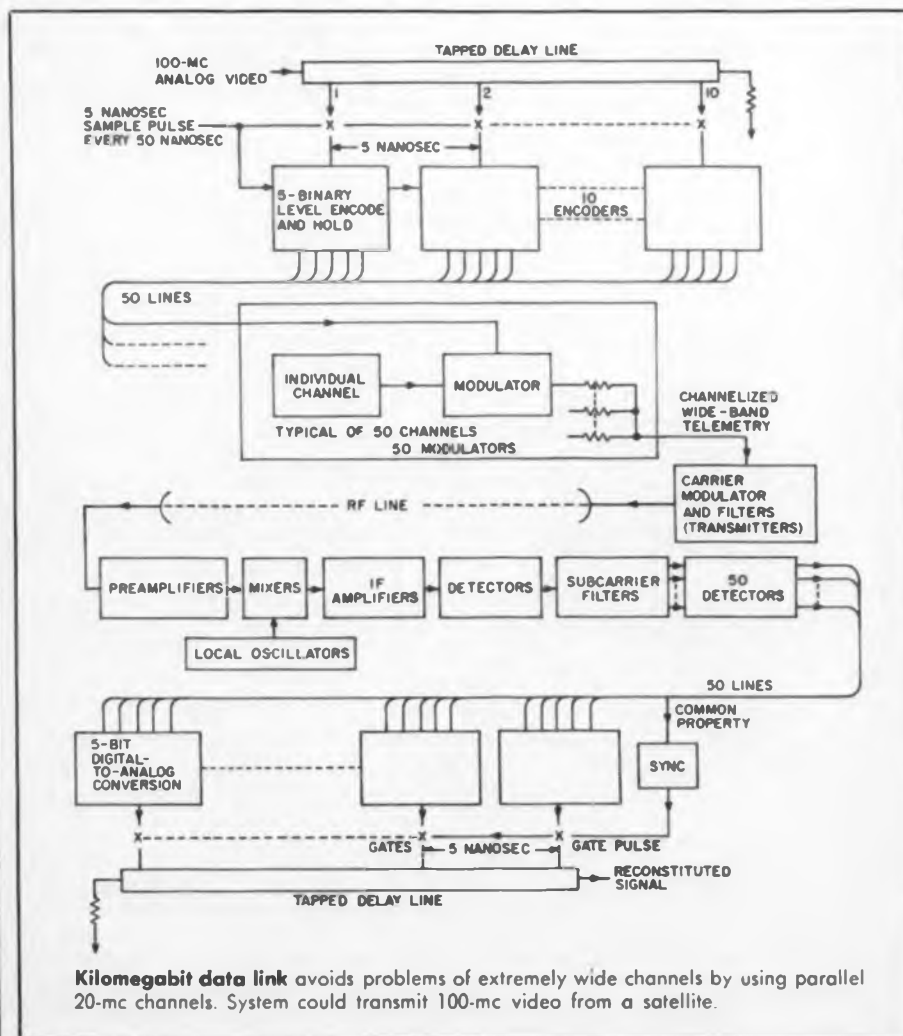
*System for Transmitting 100-mc Analog Data Digitally
Would Use 50 Parallel 20-mc Channels in 10-Gc Region*

A DATA-encoding and transmitting system said to handle 10⁶ bits of information per sec has been designed at Airborne Instruments Laboratory, Deer Park, N. Y.

The project was begun in anticipation of requirements for passing 100-mc-wide analog information through hostile conditions, according to David Cohen, an Airborne Instruments consultant engineer on the study. Such a need would arise in transmitting analog television sig-

nals from satellites and space probes to ground terminals over great distances during short acquisition intervals and in the face of jamming or other interference.

As planned by Airborne Instruments, the kilomegabit data rate would be achieved by storing a long-time sample of analog signals, simultaneously sampling them in time, and converting each sample into digital form by parallel circuitry. Digital signals would be frequency-multi-



Kilomegabit data link avoids problems of extremely wide channels by using parallel 20-mc channels. System could transmit 100-mc video from a satellite.

plexed into 50 separate channels, where each bit would modulate a separate channel of either a single or several rf carriers.

At the receiving end, each bit would be detected and demodulated in a separate channel and the signals would be relocked. Shaped and relocked signals would be reconverted to analog levels and the waveform would be reconstituted by delay-line decoders.

The main problems of implementation are expected to be sampling and digitizing at high speeds. Sample pulses are 5 nsec long. Airborne Instruments is studying thin-film matrices and tunnel-diode networks as means of achieving the high switching speeds.

For transmitting 100-mc video data the encoding system would work as follows:

The 100-mc signal is propagated along a tapped delay line, which stores the tapped portions of the signal in hold circuits for 50 nsec. New information propagated along the line drives digital encoders that convert each analog samples to 5-bit units.

Switching must be very fast because the taps can be only 5 nsec long and must be viewed by the encoder's gate system once every 50 nsec. No more than 5 nsec can be used during line sampling before the bandwidth and independence of the samples are lost. For the delay line, the company is considering a lumped-constant device similar to those used in oscilloscopes.

During transmission, the outputs of flip-flops will key separate subcarriers or separate transmitters. The maximum half-period of these flip-flops is 50 nsec. A bandwidth of about 20 mc is required for each component bit. Because no single transmitter in the 10-Gc range capable of generating the required power was found by Airborne Instruments, the company's designers chose parallel operation.

Modulation Is Flexible, Despite Limit on Indices

Use of 50 independent channels of 20 mc avoids problems of tight control of dispersion between the lowest and highest frequency. Many types of modulation are possible, including phase-shift keying, frequency-shift keying and standard amplitude modulation, according to Mr. Cohen. However, because spectrum usage would be great, modulation indices greater than one cannot be used.

The company reports that the basic consideration preventing modulation on a single kilomegacycle channel is that the wavelength of the modulation envelope would be



When you've got to attach a connector contact to the end of a coaxial wire, a single precise stroke of a crimping tool (one that crimps braid and inner conductor to the contact simultaneously) is the fastest way, the lowest-installed-cost way, the way that cuts human error in half . . . THE AMP WAY.

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COAXICON is a one-piece contact. It can be attached, simultaneously, with a single crimping tool stroke, to the braid and inner conductor of 37 sizes of RG/U coaxial

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COAXICON connectors will match cable impedances in the 50-100 ohm range, at frequencies as high as 150 megacycles. Impedance mis-match, incidentally, is only 1.06 to 1.09, even at 500 megacycles.

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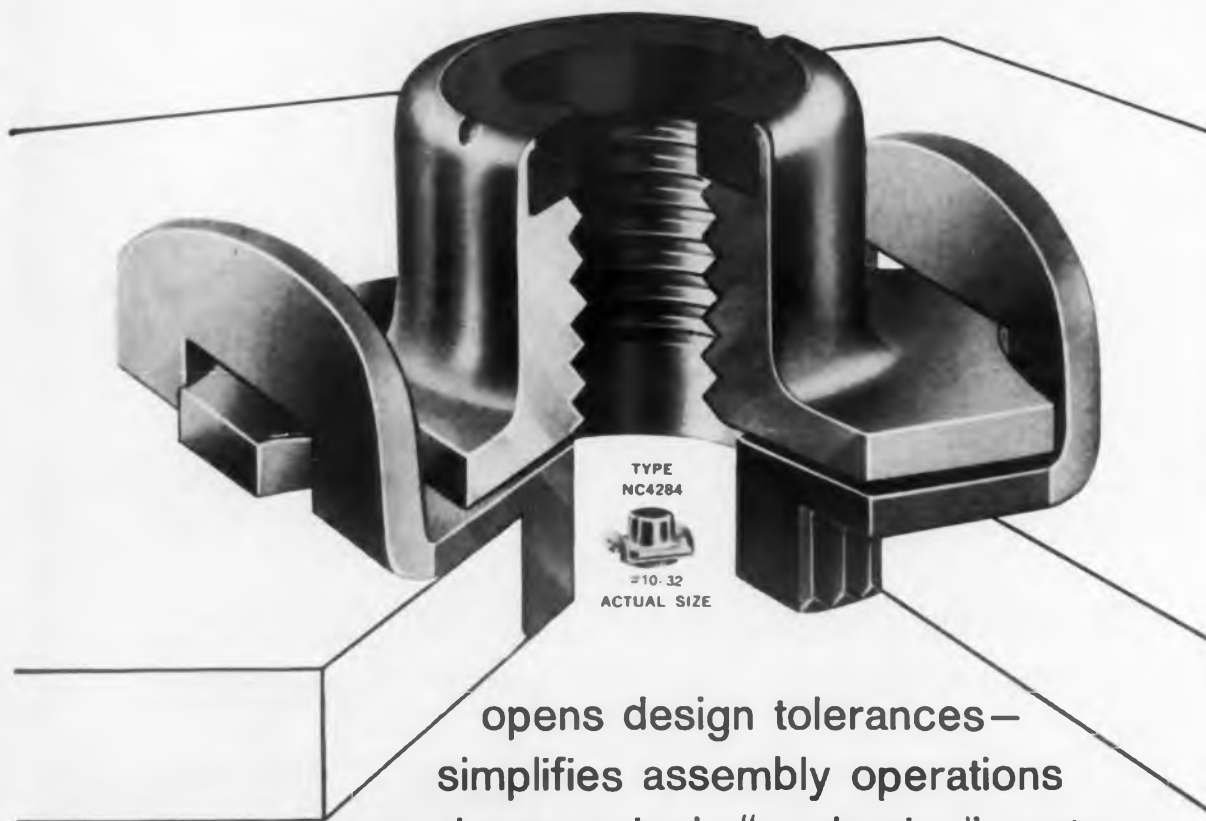
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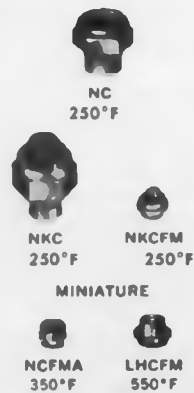
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NEW MINIATURIZED FLOATING CLINCH NUT



opens design tolerances—
simplifies assembly operations
and cuts avionic "packaging" costs.

Standard ESNA Non-floating Clinch Nut Types



Here at last is a reduced-dimension clinch nut and basket assembly that provides .020" minimum radial float. Because the nut is able to compensate for minor bolt hole misalignment in the component to be attached, production line techniques can be simpler and faster.

This very lightweight type NC4284 nut offers the electromechanical engineer new design opportunities in the assembly of electronic chassis, panels, cover plates and many other "packaging" applications. Due to its very narrow basket this fastener requires less flange width for installation than any other similar-purpose press or stake-in type part.

The retaining basket has a precisely knurled shank which standard ESNA punch and dolly tools firmly embed into aluminum or mild steel sheets, for maximum security against twist-out or push-out forces. The new fastener is easily installed in a drilled or punched hole using a regular drill or arbor press.

ESNA's exclusive red nylon locking insert gives this nut a consistent locking torque through more than 50 on/off cycles. It guarantees reliable fastener performance for assemblies that demand frequent disassembly for maintenance or inspection needs. Yet the smooth grip of the nylon collar will not flake cadmium plating from the bolts. The special formula nylon accepts temperature environments from -65°F. to 350°F.

This new floating clinch nut is designed in carbon steel—in sizes No. 4, 6, 8, and 10. Each thread size is available in 2 shank lengths of .040" and .060" for flush installation in sheets of equivalent or greater thicknesses.

For complete specifications and installation instructions on new part NC4284 and many other lightweight avionic fasteners, write Dept. S58-1057 for a copy of the new Aerospace Catalog No. 960.

ELASTIC STOP NUT CORPORATION OF AMERICA

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CIRCLE 14 ON READER-SERVICE CARD



NEWS

1 ft in free space. Antenna, atmospheric or Doppler problems that cause path lengths of the various spectral components to vary by 1 ft would cause loss of intelligence.

With division of the signal into 50 parallel channels, path-length variations of as much as 20 ft could be tolerated. This could be done by synchronizing 25 nsec after receiving the first transition. The interrogator in the receiver could be synchrolocked to the first transition to reclock the signals, though special sync codes or channels might be required. Because of relocking of the signals, the 50-bit storage in the receiving system updates once each 50 nsec. This provides the digital-to-analog converters maximum time to settle.

Airborne Instruments expects that reconstruction of the analog waveform is simpler than the modulation process. Frequency multiplexing with independent detectors and common synchronization would be used. Each detector would decide if the transmission is a 0 or a 1 bit. The analog samples would be reconstructed in groups of 5 bits. To assemble the original 100-mc analog waveform, these samples would be parallel-gated, after stabilization, onto a delay line for parallel-to-serial conversion.

Although the number of components in the complete system would be large, the equipment could be small physically, Mr. Cohen believes. This is mainly because the repetitive nature of the circuitry lends itself to modularized microminiaturization.

None of the hardware has been built, although subsystems reportedly have been breadboarded in low-frequency versions. ■ ■

Precision Elevator Drives Used For Hard-Based Atlas

Seventy-five precision adjustable-speed elevator drives for hard-based Atlas ICBM squadrons have been delivered to the Air Force.

The special drive controls, developed by General Electric Co.'s Industry Control Dept., Salem, Va., will raise each missile from its 160-ft-deep underground storage silo to surface firing position. The control will regulate elevator speed to within 1/2 of 1 per cent under any load conditions—a 20-to-1 improvement over former controls, GE reports.

Standard Resistor Measured By More Accurate Method

The measurement of the primary standard of resistance has been improved by the National Bureau of Standards.

The new method, making use of a capacitor of very accurately known dimensions, replaces inductive techniques used in the past. The new measurement indicates that the value of the NBS unit resistance is 1.0000023 ohms with estimated error of 2.1 parts per million. The estimated error was based on uncertainty in measurements and allowances for known sources of possible systematic errors other than the speed of light, which was assumed to be 2.997925×10^{10} cm/sec.

Dimensions of a cross capacitor made of gage blocks were used to compute the resistance in electrostatic units. The value of the speed of light was used to convert this to electromagnetic units.

Shielded 3-Terminal Components Used in Frequency-Dependent Bridge

The measurements were made with a new type of frequency-dependent bridge using completely shielded three-terminal components. The computable impedance of the cross capacitor at a known frequency was compared with the standard to obtain the new value.

The new value is within a few parts per million of the value obtained from previous inductance-type methods. Aside from greater accuracy, the new technique is simpler than previous ones.

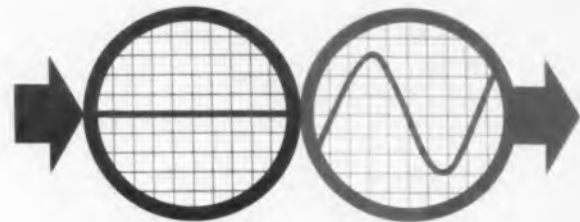
An NBS group under R. D. Cutkosky performed measurements by the new method. The computable cross capacitor was developed by D. G. Lampard and A. M. Thompson.



Frequency-dependent bridge, using completely shielded three-terminal components, is set up for making the measurement of the standard resistor by comparison with the calculated impedance of the capacitor at a known frequency.

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Regulation (load)	±1% full load to no load
Regulation (line)	±1% at full load with 28 VDC ±10% Input
Frequency Stability	±¼% from -60°C to +71°C, 28 VDC and full load
Efficiency	Approx. 80% at 100 VA output
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Eye-Catching Designs — Functional Too



1



2



3

Functionalism and esthetics have been mated to stunning effect in many electronic consumer products. This happy union was recognized in the selection of 15 U.S. industrial designs for an international exhibition in Venice, Italy. The exhibits (all photographic) will tour European capitals. The U.S. designs were chosen from nearly 300 entries submitted by members of the American Society of Industrial Designers and the Industrial Designers Institute. Some entries are shown here.

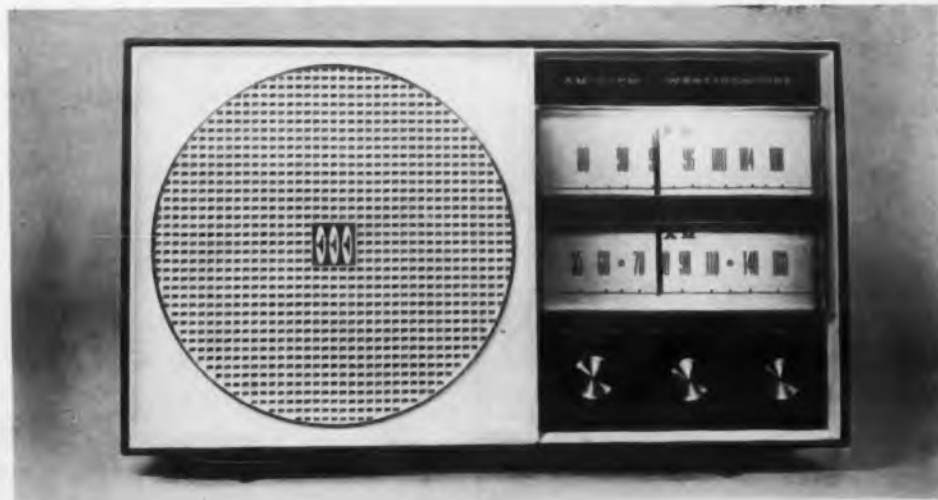
4



5



6



1. Reservation keyset for United Air Lines, designed by Laird Covey, Monroe, Conn., for Tele-register Corp., Stamford, Conn.
2. Burrows moisture recorder, designed by Latham, Tyler, Jensen, Chicago, for Burrows Equipment Co., Evanston, Ill.
3. Electromatic 570 slide projector, designed by Raymond Grosso of Harley Earl Associates, Warren, Mich., for Argus Camera Div. of Sylvania Electric Products, Inc., New York, N. Y.
4. Control panel of the Ampex FR-600 magnetic tape recorder/reproducer, designed by Frank T. Walsh and F. Arden Farey of the Instrumentation Div. of Ampex Corp., Hicksville, L. I., N. Y.
5. IBM 7302 core storage unit, designed by C. F. Graser, industrial-design manager, and staff for the Data Systems Div., International Business Machines Corp., White Plains, N. Y.
6. AM/FM radio cabinet, designed by Bronislaw Kapolski for Westinghouse Corp.'s TV-Radio Div., Metuchen, N. J.
7. Clevite Brush ED-300 educational headphones, designed by J. M. Little & Associates, Maumee, Ohio, for Clevite Corp., Bedford, Ohio.

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$\frac{1}{4}$ " multiplied by the number of capacitors used on your circuit boards is the amount of space you can save by substituting "VY" Axial-Radial Capacitors for the axial units you may now be using.* Leads are *inboard* the body in radial configuration, yet may be moved to a *straight* axial position when required. Available in four sizes, 0.5 to 5600 mmf, 300 and 500 v ratings.

*Assuming minimum allowance of $\frac{1}{8}$ " for lead bend at each end of body for axial capacitors

CONFORMS TO MIL-C-11272B

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VY vs. Axial Lead Capacitors

VY 12 Axial-Radial Capacitor



Length $\frac{3}{8}$ "
Board Space Required $\frac{3}{8}$ "

(No allowance necessary for lead bend)

VY 13 Axial Capacitor



Length $\frac{3}{8}$ "
Board Space Required $\frac{5}{8}$ "

Brand "X" Axial Capacitor



Length $\frac{11}{32}$ "
Board Space Required $\frac{19}{32}$ "

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7



High-Volume Production Of Thin-Film Devices Sought

High-volume production of thin-film devices for experimental Navy electronic systems is in the planning stage.

Under development at Federal Systems Div. of International Business Machines, Inc., Rockville, Md., the equipment will be used for missile-guidance, satellite electronics, communication devices and computing equipment, where savings in weight, space and power are vital.

The new system will be produced with technical guidance from the Naval Avionics Facility, Indianapolis (NAFI), as part of the Bureau of Naval Weapons' industrial-readiness program.

By combining advances in thin-film technology, controls, gages and monitors into an integrated design, Navy and IBM engineers are developing a precise manufacturing system for continuous vacuum deposition. Thin-film circuits on wafers would be produced continuously at the rate of over 200 sq in. of film electronics per hr, many times faster than previous laboratory methods. The flexibility of the pilot production-line design will allow the fabrication of a variety of electronic devices using combinations of resistive, capacitive, inductive, magnetic or cryogenic film components.

Deposition Takes Place In Four Vacuum Chambers

Basically, the equipment would consist of four vacuum chambers. Access to these chambers is provided by airlocks. Substrates loaded into one end will be carried by a transport mechanism from chamber to chamber. In each chamber, a stencil-like mask will be fitted automatically over the substrate. Then, sensitive controls start the vaporization of the material to be deposited, and maintain its flow at the desired rate. The thickness is automatically controlled. The substrate moves to the other chambers and the process is repeated for subsequent layers until the unit is complete.

The four chambers could be separated and operated for batch fabrication. The chemically inert high-vacuum process was chosen to assure purity, reproducibility and uniformity.

The Navy will utilize this new facility to

ELEMENTARY SIGNAL CONDITIONING

Problem: Meeting the speed and other requirements imposed by environment, temperature, power source and SCO.

Solution: A multi-stage system with inherent dampening and the use of pre-Optimatic control. This will meet present and future requirements and conditions imposed with the arrival of future "ready" amplifiers.

MECHANICAL VIBRATION ISOLATION

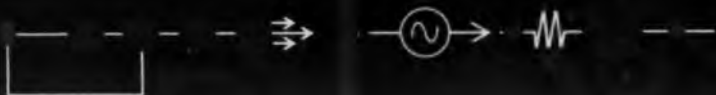
Problem: Isolating equipment at critical points in order to reduce vibration and prevent the burning of sensitive parts of the system.

Solution: A multi-stage system with inherent dampening and the use of pre-Optimatic control. This will meet present and future requirements and conditions imposed with the arrival of future "ready" amplifiers.

LINE & EQUIPMENT

Problem: Isolating equipment at critical points in order to reduce vibration and prevent the burning of sensitive parts of the system.

Solution: A multi-stage system with inherent dampening and the use of pre-Optimatic control. This will meet present and future requirements and conditions imposed with the arrival of future "ready" amplifiers.



SIX DYNAMIC ANALYSIS PROBLEMS SOLVED

T



MECHANICAL VIBRATION ISOLATION

Problem: Isolating equipment at critical points in order to reduce vibration and prevent the burning of sensitive parts of the system.

Solution: A multi-stage system with inherent dampening and the use of pre-Optimatic control. This will meet present and future requirements and conditions imposed with the arrival of future "ready" amplifiers.

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evaluate thin-film technologies on a pilot production basis before specifying their use by industry in naval weapons. Additional experimental manufacturing facilities are planned for the Navy as technologies evolve.

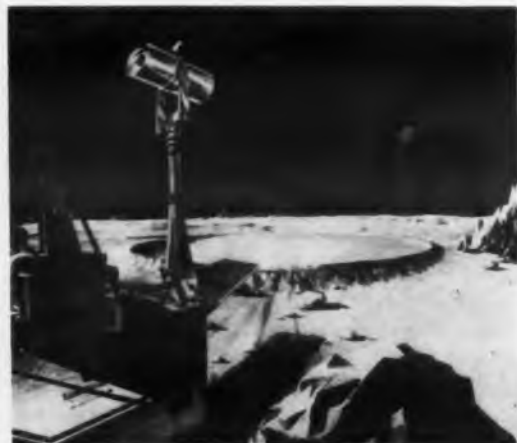
Moon-Probe Manipulator To Be Remote-Controlled

A remotely controlled manipulator, designed to operate on the surface of the moon, has been introduced into the broad program of space exploration.

The lunar manipulator, developed by General Mills, Minneapolis, Minn., will be used to investigate problems and techniques in manipulation of remote equipment on the moon. Once on the moon, the manipulator would be controlled from earth by radio signals, the company says. The first experimental manipulator is designed to handle a TV camera.

Subsequent units may perform such tasks as picking up and helping to analyze samples of the moon's crust. Future manipulators might be used for both external and internal repair of satellites, the company predicts.

As supplier of the lunar manipulator, General Mills is subcontractor to the California Institute of Technology Jet Propulsion Laboratory, prime contractor to the National Aeronautics and Space Administration.

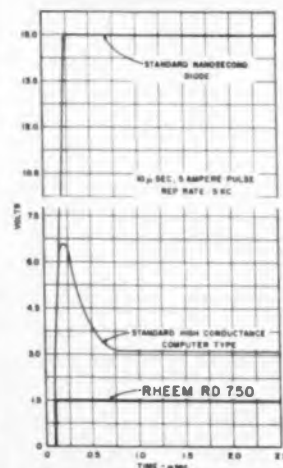


Unmanned NASA vehicle, as it might appear after a landing on the moon, is shown in artist's concept. General Mills' lunar manipulator holds TV camera high as it scans surrounding area.

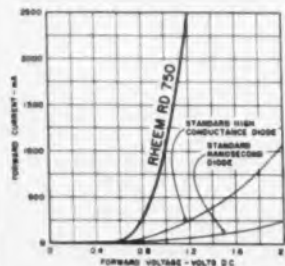


ULTRA-HIGH CONDUCTANCE NANOSECOND SILICON DIODE RD750

FIVE AMPERE PULSE SCOPE TEST. COMPARING TURN-ON TIME OF RD-750 WITH STANDARD COMPUTER DIODE AND STANDARD NANOSECOND DIODE



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Average Rectified Current	I_A	500	mA
Surge Current (1 sec.)	i_P (surge)	1500	mA
Pulse Current (10 μ sec. 5% duty cycle)	i_P (pulse)	5000	mA
Power Dissipation (Derate 5 mw/°C)	P_D	750	mW
Operating Temperature Range	T_J	-65 to +150	°C
Storage Temperature Range	T_{stg}	-65 to +175	°C

SPECIFICATIONS @ 25 °C		MIN	TYP	MAX	UNIT
Breakdown Voltage @ 100 μ A	B_V	80	100	—	V
Forward Voltage Drop @ 750 mA	V_F	—	0.9	1.0	V
Reverse Current @ V_R @ 25°C	I_R	—	0.01	0.1	μ A
Reverse Current @ V_R @ 100°C	I_R	—	2.0	10.0	μ A
Capacitance @ -9 Volts	C	—	10.0	12.0	μ fd
Forward Recovery*	V_{rr} (peak)	—	—	1.2	V
Reverse Recovery Specifications:					
$I_P = 10$ mA, ($V_R = -6$ volts, $R_L = 75$ ohms)**		—	10	15	nanosec
$I_P = 10$ mA, ($I_A = 10$ mA, $R_L = 75$ ohms)**		—	20	30	nanosec
Stored Charge (including junction capacitance)		—	20	30	picocoulomb/mA
$I_P = 200$ mA, ($V_R = -20$ V, $R_L = 200$ ohms)***		—	50	75	nanosec
$I_P = 500$ mA, ($V_R = -50$ V, $R_L = 1$ K, $C_L = 20$ μ f)***		—	200	300	nanosec

* $t_{rr} = 750$ mA, Pulse Width = 10 μ sec, Rise Time = 0.1 μ sec.
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 ***Recovery to 5 mA, measured in Rheem High Conductance Recovery Circuit.

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CIRCLE 19 ON READER-SERVICE CARD

WASHINGTON REPORT



Wilbur H. Baldinger
Washington Editor

SENATORS DENOUNCE ELECTRONIC RESEARCH WASTE

The Senate's Government Operations Reorganization Subcommittee has confirmed what many electronic researchers, designers and developers knew already: Working on federally supported programs, they have a frustrating time-and-money-wasting job trying to discover what somebody else has done or is doing.

Lack of adequate government scientific information for electronics alone is costing the taxpayers \$200,000,000 a year, or about a tenth of all federal funds spent in the field, the subcommittee concluded. Chairman Hubert H. Humphrey (D. Minn.), who also is his party's whip in the Senate, called the situation shocking.

Sen. Humphrey urged the White House to issue a "top policy mandate" for "effective and efficient information management." He said quick and decisive action was needed to stop "unwitting, needless duplication of effort" in the electronics field.

"Innumerable scientists and engineers state that it takes less time to perform research than it takes to try and find out if the research has already been performed," Sen. Humphrey complained. "The overall fact is that the federal government today has no coordinated program of science information in electronics—or, for that matter, in virtually any other scientific area."

Meanwhile, the Extent of Government Financing of private and industrial research and development was pointed up by the National Science Foundation. It reported a total outlay of about \$10.5 billion in 1960 and said \$6.1 billion—58 per cent—represented federal funds. The explosive growth of R&D was shown in a science foundation comparison of 1960 with 1953, when the outlay totaled \$3.6 billion and the federal financing share was 34 per cent.

"This largely reflects the federal government's increased utilization of industrial laboratories and facilities for the conduct of R&D projects related to national security and welfare," the report said.

WHITE HOUSE SEEKS TO ALLAY WEST FORD FEARS

President Kennedy's Science Advisory Committee says it is convinced that Project West Ford will not impair astronomical observations or prove harmful to astronauts, as the Soviet Union fears (See *ED*, Oct. 11, p 21).

Project West Ford, an Air Force communications test involving 75 lb of hair-like satellite-released dipoles, has aroused the scientific community and Russia's space administrators.

A special Science Advisory Committee panel, headed by Princeton's Dr. John W. Tukey, said: "We are convinced that this experiment will not impair our ability to study the skies—either by visible or ultraviolet light or by the reception of radio signals. We also are convinced that it will offer no additional hazard to manned space flight."

The President's advisers ticked off these "technical facts":

- "At least 100,000 times as many dipoles would be required either to affect radio measurements by absorption or deflection of incoming signals."
- Only "a weak source of interference, localized both in space and in frequency," will be produced by "illumination of the belt by a powerful ground transmitter in the course of the experiment."
- Unaffected will be ground observations—"visual, photographic or photoelectric."
- Manned or unmanned spaceships will be safe so long as they are "adequately protected against the small particles (micrometeorites) which naturally exist around the earth." These safeguards will do for West Ford filaments, too—"no matter what orbit the spacecraft uses."

Technical Footnotes to the White House Report came from Irwin I.

Shapiro and Harrison M. Jones of the Massachusetts Institute of Technology, which has charge of the government's venture. Writing in *Science*, a publication of the American Association for the Advancement of Science, they said the copper strands will be spread in a belt 2,300 miles above the earth's surface to reflect radio waves at 8,000 mc. They concluded that the experimental lifetime of the belt will be about two years, that the dipoles will be forced by the sun's rays into the earth's atmosphere and fiery disintegration in about seven years.

'FIRE PLAN' CONTRACT JANGLES COLD-WAR NERVES

The Sparton Corp. threw some Washington newsmen into a brief tizzy with the recent announcement that its Jackson, Mich., electronics division was working on a \$14,500,000 Navy contract for sonobuoys.

In a paragraph that was blacked out (but still legible) the announcement said production of the anti-submarine devices was being rushed "under the emergency 'Fire Plan'" put into operation by the Navy.

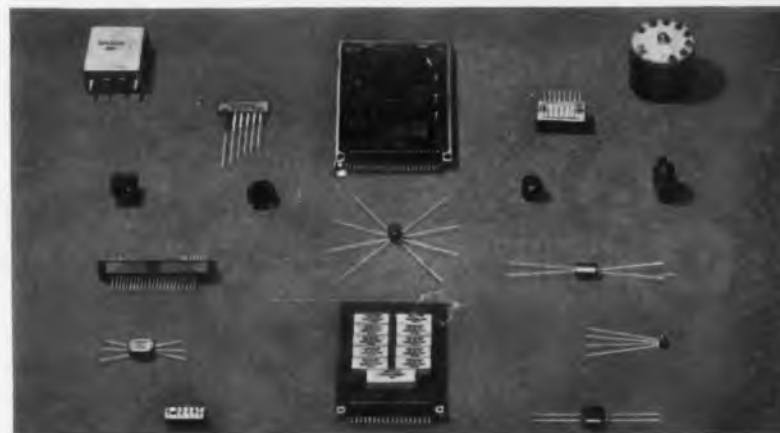
The newsmen hurriedly queried the Pentagon on this previously unreported crash-project crisis. Eventually, they got their explanation: no new emergency, no fire-when-ready orders to crews of planes that drop sonobuoys at sea; the "Fire Plan," said the Pentagon, simply was intra-office slang for work under the third 1961 supplemental appropriation by Congress for Navy contracts.

RESEARCHERS RATE TRENDS, PRIORITIES

The Defense Dept. has polled 49 electronics research leaders on the question: which trends in electronics research have the greatest significance to the military or the national economy and why? The consensus: Research in communications and command-control rates higher priority than component-reliability research. Verbatim but unsigned poll replies are detailed in a 95-page report on the project, available for \$2.25 from the Commerce Dept.'s Office of Technical Services. The title: "Important Areas of Electronic Research."

CAPITAL CAPSULES

The Logistics Management Institute is being organized by Secretary of Defense Robert S. McNamara as a nonprofit fact-finding organization to improve Pentagon procurement practices. ■ ■ ■ The Air Force has formed the Council of Air Scientists, under Dr. Leonard S. Sheingold, as the nucleus of a pool of military and civilian consultants for coordination of technical projects.



CUSTOM PACKAGING IS NO NOVELTY AT SPRAGUE'S SPECIAL PRODUCTS DIVISION

★ Sprague Electric Company's *SPECIAL PRODUCTS DIVISION* was founded originally to meet the electronic industry's needs for reliable packaged assemblies and subassemblies.

★ Sprague has developed and produced packages with countless variations in electrical characteristics and mechanical configurations, in all shapes and sizes, with and without semiconductors, as wiring boards, in encapsulated cases, in cast blocks, in hermetically-sealed packages.

★ In Sprague packaged assemblies, internal components are connected by soldering, welding, wire-wrapping, or printed wiring techniques.

★ Sprague versatility offers several basic types of construction, including molded cellular, high-density "cordwood", and molded multiple-circuit construction, permitting densities in excess of 200,000 standard components per cu. ft.

★ For application engineering assistance without obligation, write or call the Special Products Division, Sprague Electric Company, 347 Union Street, North Adams, Massachusetts.

SPRAGUE COMPONENTS

PACKAGED COMPONENT ASSEMBLIES	CAPACITORS
FUNCTIONAL DIGITAL CIRCUITS	RESISTORS
MAGNETIC COMPONENTS	TRANSISTORS
PULSE TRANSFORMERS	INTERFERENCE FILTERS
CERAMIC-BASE PRINTED NETWORKS	PIEZOELECTRIC CERAMICS
HIGH TEMPERATURE MAGNET WIRE	PULSE-FORMING NETWORKS

SPRAGUE
THE MARK OF RELIABILITY



CIRCLE 20 ON READER-SERVICE CARD

NEW TAPES TAME DESTRUCTIVE HEAD-HEAT COMPLEX

SCOTCH® BRAND Heavy Duty Instrumentation
Tapes take new speed and friction tensions in stride!



Today's trend to speed-up in the recording of instrumentation data—with tape speeds up to 120 inches per second—can mean "Slow Down, Trouble Ahead!" for tapes that can't cope. On the other hand, "SCOTCH" BRAND Heavy Duty Tapes love to live dangerously—are made for challenging environments where tape speeds are fast and getting faster, where instantaneous temperatures caused by friction between tape and head shoot up. Two new "SCOTCH" Tapes—Heavy Duty Tapes 498 and 499—are especially designed for applications where ordinary tapes soon wear out.

They live 15 lives. Actual field tests show that "SCOTCH" BRAND Heavy Duty Tapes last 15 times as long as standard tapes . . . stoutly resist high temperatures, both externally and internally generated. In instrumentation uses, where tensions caused by friction and heat make tape wear an important factor, these Heavy Duty Tapes preserve the integrity of the coating, minimize rub-off and particle redistribution that separate tape from head . . . and you from a signal.

When the heat's on for ordinary tape (above 150°F.), the binder softens and coating loosens from backing. Then the dropout count mounts. Not so with "SCOTCH" Heavy Duty Tapes! They coolly withstand the damaging effects of temperatures up to 250°F., without blocking or layer-to-layer adhesion. And excellent resolution is maintained at high and low frequencies.

High conductivity is another feature of "SCOTCH" Heavy Duty Tapes . . . nearly 1000 times that of conventional tapes! Static charges drain off without building up . . . you get a smooth, clean tape pass every time, with excellent resolution. This efficient static drain-off makes stray contaminants less likely to be attracted to the tape.

At tape-killing paces—high speeds, tensions, temperatures—we suggest you consider these heavy-duty champions of the tape world: No. 498 and (for extra recording time) No. 499. And for all your needs—in data acquisition, reduction, or control—there is a right "SCOTCH" BRAND tape for the job.

Call your 3M Representative in all major cities . . . he's a helpful guy, a convenient source of supply and information. Consult him for details or write: Magnetic Products Div., 3M Co., St. Paul, Minn.

© 1961 3M Co.

"SCOTCH" and the Plaid Design are registered trademarks of 3M Company, St. Paul 6, Minnesota. Export: 99 Park Avenue, New York, N.Y. In Canada: London, Ontario.



Magnetic Products Division



CIRCLE 21 ON READER-SERVICE CARD

NEWS

Hayden Acquires Book, Magazine Publishers

The Hayden Publishing Co., Inc., has acquired control of the Ahrens Publishing Co., New York City, a business-magazine concern specializing in the hotel and restaurant field.

The move brings Hayden, publisher of ELECTRONIC DESIGN, into the merchandizing publications field. Ahrens publishes *Hotel World-Review*, *Restaurant Management*, *Restaurant Equipment Dealer* and *Travel America Guide to Hotels and Motor Hotels*. Ahrens also has a book-publishing division.

Ahrens, together with the recently acquired John F. Rider, Publisher, Inc., will operate as a separate division of Hayden, according to a statement by Hayden's board chairman, T. Richard Gascoigne, and president, James S. Mulholland, Jr.

John F. Rider will continue as president of the technical-book publishing company he founded. Don Nichols, board chairman; Charles F. Loeffel, board vice chairman; and John C. Cadle, president, will retain their posts with Ahrens.

The acquisition of Ahrens "marks a major step in the diversification of Hayden, providing a full-fledged entry into the merchandising area of business-paper publication," Messrs. Gascoigne and Mulholland said. "We are particularly fortunate in the fact that continuity of Ahrens' management will permit the accelerated development of plans and projects already underway."

High-Temperature Glass Used to Seal Diodes

High-temperature glass sealing of silicon-diode sheets has been achieved with a technique that may provide hermetically-sealed semiconductor devices without the use of cans.

The method is adaptable to volume production and tests indicate that excellent surface protection is provided.

The glass-sealing process, developed by International Business Machines Corp.'s Components Div., Poughkeepsie, N. Y., begins with the formation of a silicon-dioxide surface on a silicon wafer, which has been conventionally masked and diffused. Then a powdered, chemically resistant glass—



Glass seals, fired at temperatures of about 845 C, are said by IBM researchers to withstand severe testing as well as or better than semiconductor seals provided by conventional transistor cans. Several hundred diodes on the silicon sheet shown here can be cut apart ultrasonically without breaking the seals over junction areas, thus promising volume production of devices using these seals.

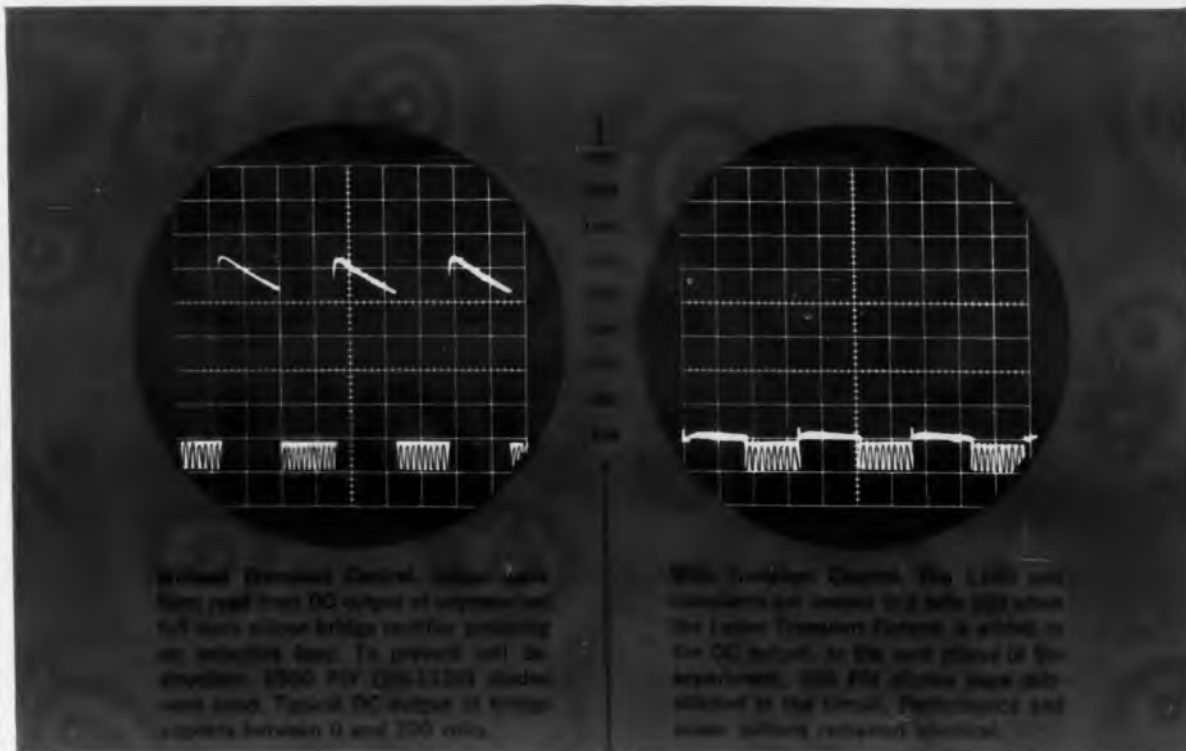
such as Pyrex, which has a coefficient of thermal expansion about equal to that of silicon—is applied to the oxidized surface. The glass then is chemically fused to the oxide surface by heating to about 845 C.

Yields of 95 to 100 per cent were achieved, according to IBM, using an oxide thickness of 5,000 Å and glass thickness of 3 microns, with firing time of 10 min.

Individual devices are cut apart with an ultrasonic cutter, and leads are attached through small holes etched through the glass and oxide coating.

Individual planar-diffused diodes made by this technique were subjected to various tests, including the conventional Mil 1-202A as well as much more severe types. In the military tests the devices were cycled between 25 and 65 C while 90 to 95 relative humidity was maintained. No devices failed in five months. Diodes tested under 20 v reverse bias and similar environmental conditions did not show any changes after two months of testing, according to IBM researchers.

A report on the sealing process was made by J. A. Perri, H. S. Lehman, W. A. Pliskin and J. Riseman of IBM's Components Div. at the recent Electrochemical Society Semiconductor Symposium in Detroit.



New low-cost Transient Control* makes silicon rectifiers reliable by clipping voltage spikes

The new Ledex Transient Control guarantees positive dependability of 200 PIV silicon rectifiers. It's a non-polarized device that automatically clips voltage spikes by providing a low resistance shunt for all potentials above 200 volts—on the AC or DC side. It draws no current in normal operation.

As shown in the actual scope shots above, the control will repeatedly clip transients or reverse voltages to a safe level of 200. To the design engineer, it is a guarantee that the maximum voltage will go no higher than 200. Compact, light, and economical, the new development puts low-cost 200 PIV diodes in a reliability class of their own.

While the device is mainly intended for protection of 115 VAC silicon rectifier circuits, it can also be designed to clip spikes and protect other semi-conductor circuits at lower or higher control voltages.



NEW LEDEX TRANSIENT CONTROL is small ($\frac{3}{8}$ " dia. by $1\frac{3}{8}$ " long), lightweight ($\frac{3}{8}$ oz.) low cost (\$1.60 to \$2.05 in small quantities). Part No. A-46800-001 has 200 volt control and 2" leads.



NEW LEDEX SILICON BRIDGE RECTIFIER is protected by a built-in Ledex Transient Control. Voltage spikes are automatically clipped at 200. The rectifier is sealed in epoxy resin and meets the general requirements of MIL-E-5400 on insulation, terminals, vibration, shock, sand and dust, fungus and salt atmosphere. Operating temperature is -65°C to $+120^{\circ}\text{C}$. Part No. A-46501-001 is rated as follows: 115 volt AC input, 100 volt DC output, maximum surge 50 amp for 8 msec. \$6.80 to \$8.15 in small quantities.

VALUE ANALYSIS RECTIFIER TRANSIENT CONTROL KIT consists of Transient Control, Silicon Rectifier with built-in Control and outline for evaluation tests to compare costs and reliability with your present circuits. Part No. A-47609-001. \$11.00 per kit.

Other Ledex products are ready to go to work as compact solutions to your actuating, stepping or circuit switching applications.

FOR LITERATURE, clip this ad, check boxes above, attach to your letterhead and mail to Ledex Inc., Dayton 2, Ohio; Marsland Engineering, Ltd., Kitchener, Ont.; NSF Ltd., 31 Alfred Place, London, Eng.; AEMGP, 115 Ave. Clement, Boulogne, France.

* PAT. PENDING



CIRCLE 22 ON READER-SERVICE CARD

NEW!

4 MAJOR DIGITAL VOLTMETER ADVANCEMENTS FROM NLS

Now Make 15,000 Highly Accurate
DC Measurements Sec... Measure
VDC-Ratio-Ohms to Full 5 Digits
... Buy a Quality DVM or Ohmmeter
for \$1,460... Use Digital Voltmeters
in Go/No-Go Testing



MODEL 15 A/D CONVERTER



484A VOLT-METER-RATIOMETER

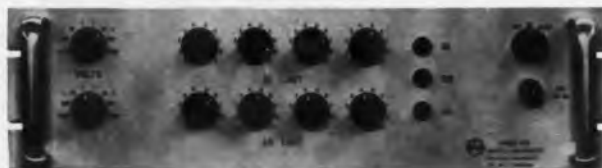


784 DIGITAL OHMMETER

Tag Line: The blue tag indicates that these new models are NLS "off-the-shelf" instruments. Call your nearest NLS office to see demonstrators in action today or take delivery on your own instrument within 10-30 days. Prices are F.O.B. destination in U.S.A.



784 DIGITAL OHMMETER



MODEL 54A DIGITAL COMPARATOR

MODEL 15 A/D CONVERTER—4-digit instrument bringing high accuracy to high-speed measuring and data logging... 15,000 measurements/sec... accuracy: $\pm 0.01\% \pm 1$ digit from 0 to full scale from 0 to 40°C ... any range from ± 1 to ± 100 v. full scale... true bipolar digital output, high output current, uses internal or external clock... constant input impedance. Price: \$6,985.

M25 5-DIGIT VOLT-RATIO-OHMMETER—ultra-reliable instrument measuring DC volts, DC ratio and ohms with full 5-digit resolution of 0.001% and accuracy of $\pm 0.01\%$ of reading ± 1 digit over entire range of ± 0.0001 to ± 999.99 v. and .1 ohm to 1 meg... 10 to 1000 meg input z... twice speed of fastest stepping switch DVMs... advanced transistor circuitry with ultra-reliable mercury relays with 171 years life expectancy... input filter... remotely programmable... fully automatic... data logging output... AC or low-level DC with accessories. Price: \$5,685

484A DIGITAL VOLTMETER-RATIOMETER—most versatile and highest quality instrument at low cost... measures ± 0.001 to ± 999.9 VDC and DC ratio up to $\pm 99.99\%$... $\pm 0.01\%$ accuracy... 10 meg input... auto range and polarity... input filter... built-in auto print control... only a few dollars more than cheapest DVMs without such quality features as plug-in stepping switches that can be replaced in seconds for troubleshooting, snap-out readout, wire-wound resistors, epoxy fiberglass circuit boards... measures AC or low-level DC with accessories. Price: \$1,460.

784 DIGITAL OHMMETER—for precise measuring and logging at low cost... same high quality features as 484A... measures 0.1 ohm to 10 megs with accuracy of $\pm 0.05\% \pm 1$ digit ($\pm 0.1\%$ of reading above 5 megs)... auto ranging and auto control for data logging. Price: \$1,460.

MODELS 54, 54A, 55, 55A DIGITAL COMPARATORS—for go/no-go testing, plug these into any NLS instrument having printer connection... limits set by BCD coded voltages, contact closures, or front panel knobs... each limit can be on any range and of either + or - polarity... signals TOO HIGH, TOO LOW, or OK to recording and control devices. Price: \$2,035 to \$2,935.



Originator of the Digital Voltmeter

non-linear systems, inc.

DEL MAR, CALIFORNIA

CIRCLE 23 ON READER-SERVICE CARD

NEWS

PERT 7070 Program Packet Offered Free to Industry

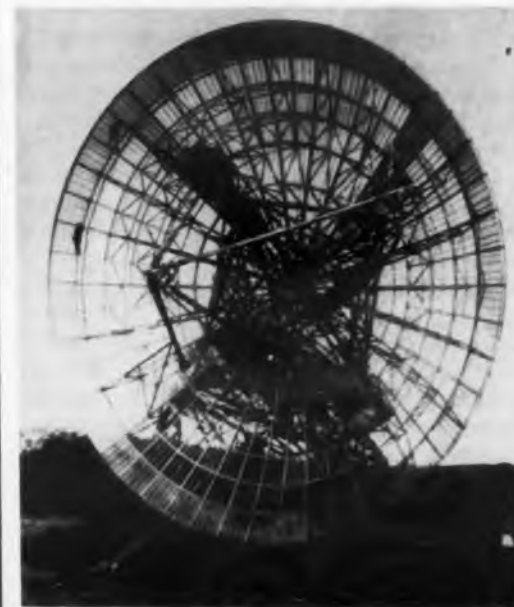
A free program packet is being offered to potential users of a management scheduling and control program.

Collins Radio Co., Dallas, Tex., developers of a PERT (Program Evaluation and Review Technique) is offering the packet, which describes the IBM 7070 computer program. The packet includes a program deck, flow charts, logic diagrams and a description of the company's system.

For the past six months, Collins has been perfecting its use of PERT programming techniques in commercial as well as government contractual work. Developed by the Navy, PERT is said to be particularly effective for the planning and control of complex research and development programs.

Those interested in obtaining copies of the 7070 and 1401 PERT programs should contact Collins' Communication and Data Systems Div., Cedar Rapids, Iowa.

Space-Probe Tracker

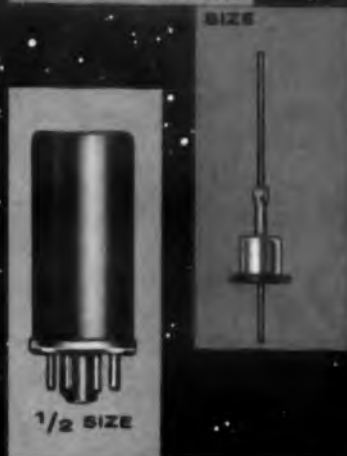


This 85-ft diam tracking antenna in Johannesburg, South Africa, is one of three operated by the California Institute of Technology's Jet Propulsion Laboratory for the National Aeronautics and Space Administration. Each antenna is 110 ft high and weighs 200 tons. The builder is Blaw-Knox Co., Pittsburgh.

CIRCLE 73 ON READER-SERVICE CARD ➤

INVITATION TO INVENTION

CIRCUIT DESIGN



WHERE HIGHEST QUALITY IS IN VOLUME PRODUCTION

Listed below are silicon rectifiers representative of the Tarzian line. They are available in production quantities, at realistic prices, for both commercial and military applications.

Of particular importance in simplifying your power conversion circuitry assemblies are small size, high efficiency, mounting versatility and wide range of ratings offered by the Tarzian line.

In addition, the entire line features extremely low junction current density for maximum reliability and operating life. This is due to the special Tarzian alloy process with supported junction that produces the largest junctions available.

Altogether, the qualities and availability of the units cataloged here are invitations to invention in circuit design. Application engineering service is also available without obligation. Call the Sarkes Tarzian representative near you, or write Sarkes Tarzian, Inc., for complete catalog information.

SILICON RECTIFIERS

amps. DC (100°C)	img	peak inverse voltage	max. RMS volts	Max. amps.		Tarzian Type	Jedec No.	Tarzian Type	Jedec No.	dimensions
				recurrent peak	surge 4MS					
0.5		200	140	5	30	20M	1N1082			
		400	280	5	30	40M	1N1084			
		600	420	5	30	60M	—			
0.5		200	140	5	75	F-2	1N2482			
		400	280	5	75	F-4	1N2483			
		600	420	5	75	F-6	1N2484			
0.5		200	140	5	75	20H	1N2485			
		400	280	5	75	40H	1N2487			
		600	420	5	75	60H	1N2489			
0.45		800	560	4.5	27	80SM	1N1108			
0.4		1600	1120	4	24	160SM	1N1110			
0.35		2400	1680	3.5	21	240SM	1N1112			
0.325		2800	1960	3.25	19.5	280SM	1N1113			
1.5		200	140	10	100	20J1	1N1618			
		400	280	10	100	40J1	1N1620			
		600	420	10	100	60J1	—			
10		200	140	50	150	20J2	1N1622			
		400	280	50	150	40J2	1N1624			
		600	420	50	150	60J2	—			
12		200	140	72	150	20J3	—			
		400	280	72	150	40J3	—			
		600	420	72	150	60J3	—			
2		200	140	30	100	20LA	1N1086			
		400	280	30	100	40LA	1N1088			
		600	420	30	100	60LA	—			
20						NEGATIVE		POSITIVE		
		200	140	120	200	20R3N	—	20R3P	—	
		400	280	120	200	40R3N	—	40R3P	—	
35		200	140	210	350	20S3N	—	20S3P	—	
		400	280	210	350	40S3N	—	40S3P	—	
		600	420	210	350	60S3N	—	60S3P	—	
50		200	140	300	500	20T3N	—	20T3P	—	
		400	280	300	500	40T3N	—	40T3P	—	
		600	420	300	500	60T3N	—	60T3P	—	
100		200	140	600	1000	20V3N	—	20V3P	—	
		400	280	600	1000	40V3N	—	40V3P	—	
		600	420	600	1000	60V3N	—	60V3P	—	
150		200	140	900	1500	20W3N	—	20W3P	—	
		400	280	900	1500	40W3N	—	40W3P	—	
		600	420	900	1500	60W3N	—	60W3P	—	
250		200	140	1500	2500	20Y3N	—	20Y3P	—	
		400	280	1500	2500	40Y3N	—	40Y3P	—	
		600	420	1500	2500	60Y3N	—	60Y3P	—	
350		200	140	2100	3500	20G3N	—			
600		420	1500	2500	60Y3N	—	60Y3P	—		
1000		200	140	6000	10000	20ZB	—			

HIGH VOLTAGE SILICON CARTRIDGE RECTIFIERS

Each of the two series of Tarzian Silicon Cartridge Rectifiers shown below includes 18 different types with operating temperatures ranging from -55°C to 150°C ambient. Both the ferrule mounted series and the axial lead series feature low voltage drop and low reverse current. Tarzian High Voltage Cartridges are manufactured to meet standard Jedec classifications.

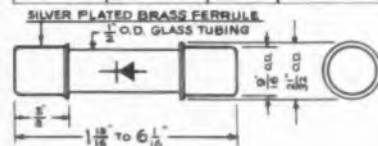
FERRULE MOUNTED SERIES—This high voltage series is equipped with a ferrule type mounting of silver plated brass and is available in both hermetically sealed glass or phenolic tubing in voltages ranging from 1000 to 10,000 peak inverse volts.

AXIAL LEAD SERIES—This high voltage series is available in units ranging in size from $\frac{1}{2}''$ to $2\frac{1}{2}''$ and lead lengths varying from $1''$ to $2\frac{1}{2}''$. Peak inverse voltage ratings are available from 1500 to 16,000 volts.

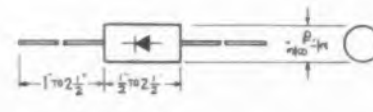


FERRULE MOUNTED SERIES			
Operating Temperature Range -55°C to 150°C Ambient		Max. Ratings Half Wave Res. Load at 75°C Ambient	
Jedec Type	Sarkes Tarzian Type	Peak Inverse Volts	Max. Rectified DC Output MA
1N1133	S-5490	1500	75
1N1140	S-5497	3600	65
1N1143A	S-5501	6000	65
1N1146	S-5504	8000	45
1N1148	S-5506	14000	50
1N1149	S-5507	16000	45

AXIAL LEAD SERIES					
Operating Temperature Range -55°C to 150°C Ambient					
Jedec Type	S.T. Type	Peak Inverse Volts	Max. RMS Input Volts*	Max. Rect. DC Output (MA)	
				25°C	100°C
1N1730	S-5518	1000	700	200	100
1N1731	S-5519	1500	1050	200	100
1N1734	S-5522	5000	3500	100	50
1N2375	S-5525	1500	1050	200	100
1N2379	S-5529	4000	2800	100	50
1N2385	S-5535	10000	7000	70	55



When ordering phenolic tubing as a substitute for glass tubing, add the letter "P" to S.T. Type No.

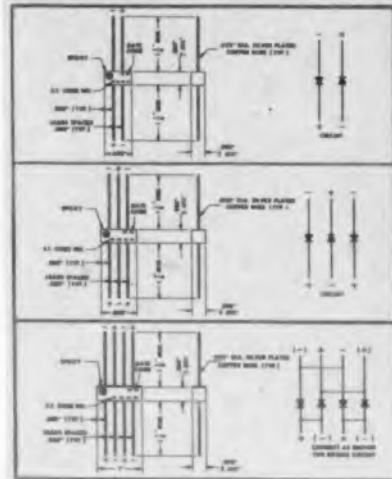


*Derate 50% for capacitive load in half wave circuits. For capacitive, motor, or battery loads, derate DC current by 20%.

MODULAR SILICON RECTIFIERS

Modular Silicon Rectifiers can be used individually—as open bridges—or in a variety of circuit combinations, and are designed for printed circuits on terminal strips. Each of the units illustrated and tabulated below is only one of a series of six in the 18-unit Tarzian line.

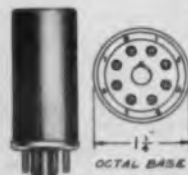
Tarzian Code Number	Individual Diode Current Rating	Circuit Connections	Piv
S-5541	500MA	Center tap, Doubler	600
S-5549	500MA	3 phase Half Wave	600
S-5467	500MA	Bridge	600



TUBE REPLACEMENT SILICON RECTIFIERS

Tarzian tube replacement rectifiers, in addition to being directly interchangeable with over 95% of all popular vacuum tube rectifiers, are smaller, more compact, and carry dc current ratings as much as three times as great as the tubes they replace. They have proved highly satisfactory in applications requiring high efficiency,

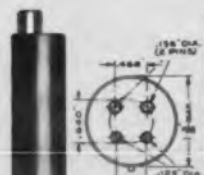
long life, rugged construction and wide temperature ranges. Tarzian solid state rectifiers are available in ten standard models, with special designs and modifications on request. Special tube replacement units designed by Tarzian engineers include special designs with peak inverse voltages to 19,000 volts.



S-5018
Pin Connection
Pin #8 (Cathode)
Pin #1 and #6 (Anode)
Replacement for types 5AU4, 5AW4, 5AZ4, 5Y4, 5U4, 5V4, 5W4, 5Y3, 5Z4, 5931, 6087, 6106.



S-5019
Pin Connection
Pin #8 (Cathode)
Pin #5 and #4 (Anode)
Replacement for 5R4



S-5130
Pin No. 1 is Pos.
Replacement for 866, 866A, 3B28



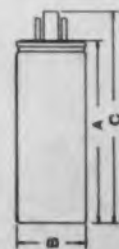
S-5207
Pin Connection
Pins #1 and #6 are A.C. (Anode)
Pin #7 is Pos. (Cathode)
Replacement for 6X4, 6063, 6202.






S-5367
Pin No. 1 is Pos.
Replacement for GL-8020 at reduced voltage

Tarzian Type	JEDEC Number	Max. Peak Inverse Voltage	Max. RMS Voltage	Max. Peak Current (ma)	Max. DC Current (ma)	Circuit	Type Load	Max. Ambient Temp.	Dimension "A" (inches)	Dimension "B" (inches)	Dimension "C" (inches)
S-5018	1N-1238	1,600	1,100	8,000	750	F.W.	Any	100°C	$2\frac{21}{32}$	$1\frac{1}{4}$	$3\frac{3}{32}$
S-5019	1N-1239	2,800	1,950	5,000	500	F.W.	Any	100°C	$3\frac{3}{4}$	$1\frac{1}{4}$	$4\frac{1}{16}$
S-5130	—	10,400	7,400	3,000	300	H.W.	Res.-Ind.	100°C	$4\frac{7}{16}$	$1\frac{1}{32}$	$8\frac{1}{2}$
S-5207	1N-2490	1,600	1,100	5,000	500	F.W.	Any	100°C	$1\frac{1}{2}$	$1\frac{1}{16}$	$1\frac{1}{4}$
S-5367	—	19,000	13,400	2,500	250	H.W.	Res.-Ind.	100°C	6	$2\frac{1}{16}$	$6\frac{1}{32}$

*For capacitive loads derate input voltage 50%, and current 20%.



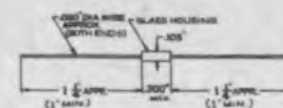
SARKES TARZIAN SILICON VOLTAGE REGULATORS

 1/4 WATT REGULATORS Specifications 25°C.					 1 WATT REGULATORS Specifications 25°C.				 10 WATT REGULATORS Specifications 25°C.				
Tarzian Type	Zener Volt. (V)	Test Cur. (Ma)	Dyn. Imp. (Ohms)	Jedec Type	Tarzian Type	Zener Volt. (V)	Test Cur. (Ma)	Dyn. Imp. (Ohms)	Tarzian Type	Zener Volt. (V)	Test Cur. (Ma)	Dyn. Imp. (Ohms)	Jedec Type
.25T5.6	5.6	25	3.6	1N708	1T5.6	5.6	100	1.2	10T5.6	5.6	1000	1	1N1803
.25T6.2	6.2	25	4.1	1N709	1T6.2	6.2	100	1.5	10T6.2	6.2	1000	1	1N1804
.25T6.8	6.8	25	4.7	1N710	1T6.8	6.8	100	1.7	10T6.8	6.8	1000	1	1N1805
.25T7.5	7.5	25	5.3	1N711	1T7.5	7.5	100	2.1	10T7.5	7.5	1000	1	1N1806
.25T8.2	8.2	25	6.0	1N712	1T8.2	8.2	100	2.4	10T8.2	8.2	1000	1	1N1807
.25T9.1	9.1	12	7.0	1N713	1T9.1	9.1	50	3.0	10T9.1	9.1	500	1	1N1808
.25T10	10	12	8.0	1N714	1T10	10	50	3.5	10T10	10	500	2	1N1351
.25T11	11	12	9.0	1N715	1T11	11	50	4.2	10T11	11	500	2	1N1352
.25T12	12	12	10	1N716	1T12	12	50	5.0	10T12	12	500	2	1N1353
.25T13	13	12	11	1N717	1T13	13	50	5.8	10T13	13	500	2	1N1354
.25T15	15	12	13	1N718	1T15	15	50	7.6	10T15	15	500	2	1N1355
.25T16	16	12	15	1N719	1T16	16	50	8.6	10T16	16	500	3	1N1356
.25T18	18	12	17	1N720	1T18	18	50	11	10T18	18	150	3	1N1357
.25T20	20	4	20	1N721	1T20	20	15	13	10T20	20	150	3	1N1358
.25T22	22	4	24	1N722	1T22	22	15	16	10T22	22	150	3	1N1359
.25T24	24	4	28	1N723	1T24	24	15	18	10T24	24	150	3	1N1360
.25T27	27	4	35	1N724	1T27	27	15	23	10T27	27	150	3	1N1361
.25T30	30	4	42	1N725	1T30	30	15	28	10T30	30	150	4	1N1362
.25T33	33	4	50	1N726	1T33	33	15	33	10T33	33	150	4	1N1363
.25T36	36	4	60	1N727	1T36	36	15	39	10T36	36	150	5	1N1364
.25T39	39	4	70	1N728	1T39	39	15	45	10T39	39	150	5	1N1365
.25T43	43	4	84	1N729	1T43	43	15	54	10T43	43	150	6	1N1366
.25T47	47	4	98	1N730	1T47	47	15	64	10T47	47	150	7	1N1367
.25T51	51	4	115	1N731	1T51	51	15	74	10T51	51	150	8	1N1368
.25T56	56	4	140	1N732	1T56	56	15	88	10T56	56	150	9	1N1369
.25T62	62	2	170	1N733	1T62	62	5	105	10T62	62	50	12	1N1370
.25T68	68	2	200	1N734	1T68	68	5	125	10T68	68	50	14	1N1371
.25T75	75	2	240	1N735	1T75	75	5	150	10T75	75	50	20	1N1372
.25T82	82	2	280	1N736	1T82	82	5	175	10T82	82	50	22	1N1373
.25T91	91	1	340	1N737	1T91	91	5	220	10T91	91	50	35	1N1374
.25T100	100	1	400	1N738	1T100	100	5	260	10T100	100	50	40	1N1375

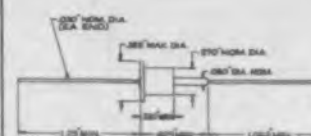
NOTES: Standard tolerance is $\pm 10\%$ however, closer or wider tolerances are available on request.
Also available on request: (a) Special voltage ratings. (b) Symmetrical double anode types (for clippers).

The full line of constant voltage devices tabulated here are used to control output voltage of power sources and as voltage reference elements capable of operating over a wide temperature range. Hermetic sealing and mechanical ruggedness provide long term reliability even under the most adverse conditions. These three power classifications cover a wide range of applications. The regulators also are available in production quantities. Call your nearest Tarzian representative for application assistance.

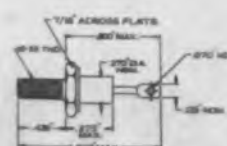
1/4 WATT



1 WATT



10 WATT



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NBS Peru Installation to Use Scatter Radar In Space Study

An installation for ground-based explorations of the upper atmosphere and outer space is being constructed 17 miles east of Lima, Peru.

The facility, called the Jicamarca Observatory, is being built by the National Bureau of Standards Laboratories, Boulder, Colo. and the Instituto Geofísico de Huancayo, Peru. The observatory will have a 6-mw pulse transmitter and a 22-acre antenna with 9,216 crossed dipoles mounted 6 ft above a reflecting ground screen.

The antenna will transmit a pulse lasting from 50 to 1,500 μ sec. When switched to receiving, it will detect the faint re-radiation of the pulsed radio wave by free electrons in the upper atmosphere.

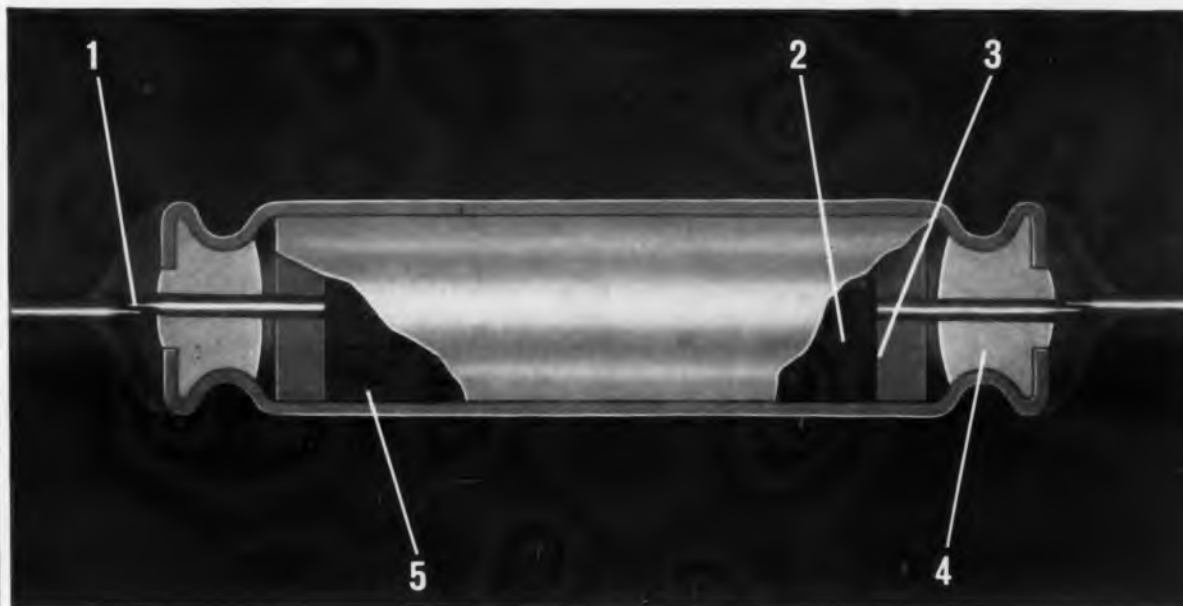
This scatter-radar technique was developed by K. L. Bowles of the Bureau's Central Radio Propagation Laboratory. The observatory will be used in the measurement of electron densities at heights from 60 to 1,860 miles; the kinetic temperature of the ions at 125 to 1,860 miles; the percentage composition of major ionic components, 125 to 435 miles and 744 to 1,116 miles; and the intensity of the earth's magnetic field.

It also will be used in observations of radar echoes from the sun's corona and from solar gas clouds emitted by solar disturbances; in studies of small-scale irregularities in the outer atmosphere and in studies of the D-region of the ionosphere. Other applications include the calibration of satellite instrumentation.



Acres of antenna being constructed by NBS and the Instituto Geofísico de Huancayo, Peru, will be used in conjunction with a 6-mw transmitter for ground-based exploration of space. A total of 9,216 crossed dipoles covers 22 acres.

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Here are inside facts on the better materials, designs and production techniques which give improved reliability and performance to **iei** capacitors.

1. No external butt welds. Leads are flattened, lap-welded to foil terminations, then surrounded by a tough resin that helps absorb strains on the welded connections. Negative leads of polar units are securely soldered to the metal case which hermetically seals the case end.

Use of soldered and lap-welded connections results in lower ESR (equivalent series resistance) and lower DF (dissipation factor).

2. Superior etching permits smaller units.

Greater active area without weak spots, permitting smaller size capacitors or larger engineering margins.

3. Clean-cut foil edges withstand vibration.

No microscopic burrs or slivers to shake loose and short against the case or adjacent turns.

4. Long-life seal. Made by compression of flexible bushing. For increased mechanical strength, an outer seal of tough resin is added.

5. Tighter packed foil. Allows further miniaturization and maintains high reliability without sacrifice of voltage ratings.

iei offers full polar, partial polar and non-polar construction in aluminum foil, 85° and 125° tantalum foil. Tantalum wet slug and solid tantalum types in polar only.

For technical specifications, request Forms 2773 and 2745.

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CIRCLE 25 ON READER-SERVICE CARD



MICRO-MINIATURE (SERIES 3)

ACTUAL SIZE

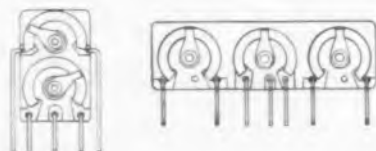


Single trimmer measures only 0.250" square, 0.100" deep, rated at .05 watts at 70° C. Multiple trimmers can include up to 5 fixed resistors, depending upon value and voltage rating.

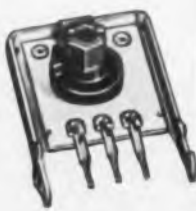


SUB-MINIATURE (SERIES 4)

ACTUAL SIZE

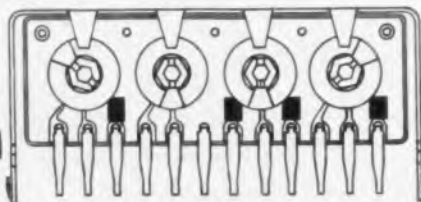


Single trimmer measures only 0.406" x 0.438" x 0.125", rated at 0.1 watts at 70° C. Triple trimmers can include up to 8 fixed resistors, depending on value and voltage rating.



MINIATURE (SERIES 5)

ACTUAL SIZE



Single trimmer measures 5/64" x 45/64" x 19/32". Rated at 1/4 watt at 70° C. Available with leads, solder or wire-wrap terminals, in a wide range of mounting styles for modern production techniques. One to four variable resistor elements and up to 12 fixed resistors on a single plate. Knob permits adjustment by finger tip, internal or external hex wrench, or screwdriver.

For additional information on these units write for CENTRALAB Engineering Bulletin 42-1216.

Y-6147

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NEWS

Planar Transistor Has Current Gain at 1 Pa

A developmental double-diffused planar silicon transistor with a 0.6-micron-thick base region has significant current gain at 1 pa and 1 v, according to CBS Laboratories, Stamford, Conn.

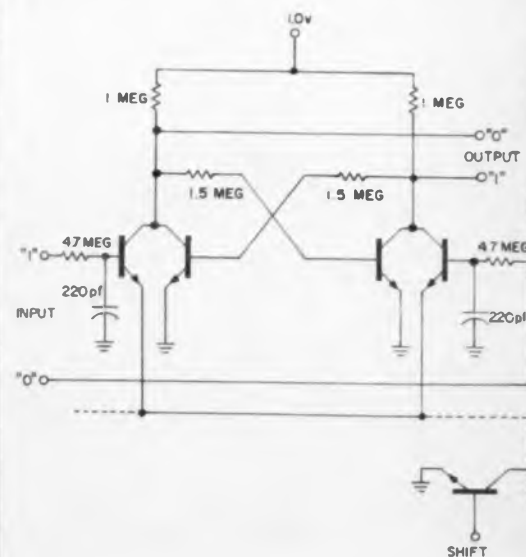
CBS has built and demonstrated models of the microwatt transistor and says it is completing design of a production version.

According to the company, the developmental transistor has a large beta (around 10); a reasonable alpha (above 0.9 at 1 μ a collector current); insignificant leakage current, in the millimicroampere range; and can take up to 100 mw. Its speed in a working circuit, however, is relatively slow.

This is said to be not a result of its cutoff frequency but of the load resistance and capacity characteristics of circuitry able to take advantage of the transistor's low power requirements and heat dissipation.

Company engineers say the transistor probably could never be made to operate at above 100 kc; present versions have been used at about 1 kc.

To demonstrate the device, CBS has developed 2- and 4-bit shift registers, multipliers and other basic computer circuitry. The device is intended for use in computing



Microwatt planar transistor enables shift register to operate on power consumption of only 1.5 μ w per bit. Shown is one stage of a multi-stage register developed by CBS Laboratories for its new transistor.

systems where low power and heat requirements, rather than high speeds, are important, the company says. The transistor was developed with the partial support of the Signal Corps.

The CBS shift registers use four transistors per bit and require $1.5 \mu\text{w}$ per bit; the basic design can be cascaded to 40 bits, CBS says. The multivibrator consumes $3 \mu\text{a}$ for three transistors using a 1-v supply voltage.

Another application mentioned for the device is special medical electronic circuitry where electric power, rather than output power, is the key requirement.

CBS says it has made design studies of a billion-circuit computer in which its transistor could be used to hold heat dissipation to feasible amounts.

2-Man Sub for Research



This is an artist's rendition of Seapup VI, a two-man research submarine developed by General Mills, Minneapolis. The craft is powered by 16 batteries of 12 v each, can hover at any depth up to 6,000 ft or can touch bottom on ski-type skids. Electro-mechanical arms would perform research tasks. The craft has a low weight-in-air (12,600 lb) and could remain submerged for 12 hr, the company said. Seapup has its own air-regeneration system and can carry a payload of 200 lb besides the occupants, according to the company.

Accuracy Is Our Policy

A number of errors crept into the "Spectrum Analysis Error Nomogram" which appeared in *ED*, June 7, 1961. The nomogram should be corrected by halving the values on the *B* scale. Thus, 0.5 cps should be 0.25, 2 cps should be 1 cps, etc.

In Example 1, the answer should be 3.3 per cent, rather than 4.8 per cent. In Example 2, the answer is 1.25 sec, rather than 2.4 sec.

Now, with one instrument,
you can instantly measure **1 mv**

at
1,000 mc!

or any rf voltage 1 mv to 10 v,
from 500 KC to 1,000 MC.
Measuring is as simple as
"touch and read;" resolution is
high, thermal drift errors are
virtually eliminated!



Specifications

Voltage Range:	10 mv rms full scale to 10 v rms full scale in seven ranges. Full scale readings of 0.01, 0.03, 0.1, 0.3, 1, 3 and 10 v rms.
Frequency Range:	500 KC to 1 GC with accessory probe tips. Usable indications to 4 GC.
Accuracy:	1 MC to 50 MC, $\pm 3\%$ of full scale; 50 MC to 150 MC, $\pm 6\%$ of full scale; 500 KC to 1 GC, 1 db.
Meter Scales:	Two linear voltage scales, 0 to 1 and 0 to 3, calibrated in the rms value of a sine wave. Db scale, calibrated from +3 to -12 db; 0 db = 1 mw in 50 ohms.
Probe Tip Furnished:	411A 21E BNC open circuit tip, 500 KC to 500 MC. Shunt capacity less than 4 pf. Max. input 200 v dc. Input resistance at 10 MC typically 80 K ohms.
Galvanometer Recorder Output:	Proportional to meter deflection, 1 ma into 1000 ohms at full scale deflection.
Power:	115/230 v $\pm 10\%$, 50 to 60 cps, 35 watts
Dimensions:	Cabinet Mount: $11\frac{3}{4}$ " high, $7\frac{1}{2}$ " wide, 12" deep. Rock Mount: $6\frac{3}{4}$ " high, 19" wide, $10\frac{3}{8}$ " deep behind panel.
Price:	411A (cabinet) \$450.00. 411AR (rock mount) \$455.00.

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



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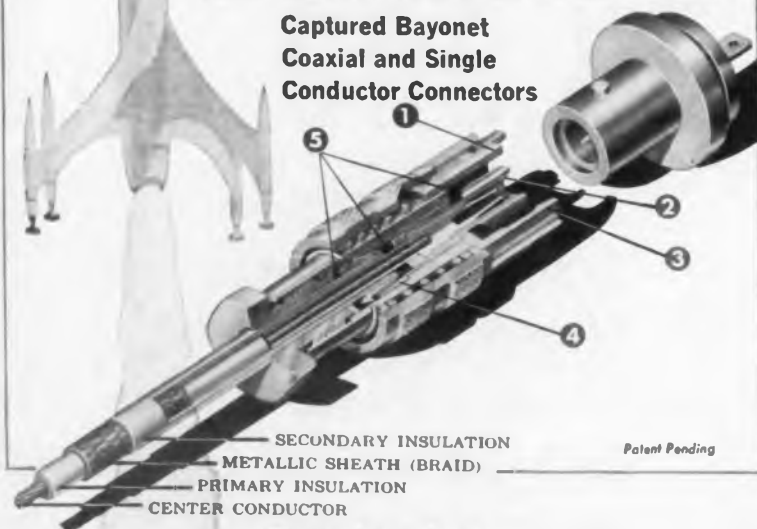
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NEWS

Optical Space Radar To Be CW

*Sperry's Doppler System for Air Force
Based on Electro-Optical UHF Modulator*

A CONTINUOUS-WAVE optical radar for use in space is being developed for the Air Force by Sperry Gyroscope Co., Great Neck, N. Y. The classified project is believed to have been made possible by development at Sperry of a light modulator that operates at microwave frequencies. The modulator will be used with a continuous gaseous optical maser to make a Doppler radar for ranging.

The company reports it has built, and is operating, several light modulators based on the Pockels electro-optical effect. The Pockels effect is similar to the Kerr effect, but uses a solid crystal, rather than a liquid cell. In the Sperry modulators, a crystal of ammonium dihydrogen phosphate (ADP) is fixed in a microwave cavity, which is operating at its resonant frequency and has a light polarizer at each end.

While an electric field is impressed

across it in the proper direction, the crystal is able to rotate the polarization vectors of light passing through it as a function of the field strength. Therefore, light polarized by the input flat is turned enough to be passed by the analyzing polarizer.

The light's intensity varies with that of the impressed microwave field. A peak voltage across the crystal gives maximum rotation of the light beam, which must be highly collimated for the effect to occur.

Typical operating parameters of the 0.75-x-3.5-in. modulator are reported to be: cavity resonance frequency, 850 mc; bandwidth, 2 mc; modulation factor, 30 per cent. These figures are for operation at 25 C with a power input of 8 w at 50 ohm and an effective aperture of 0.25 in.

One version, operated at extinction at a resonant frequency of 1 Gc in a frequency-doubling mode, provid-



Light modulator mounted in front of arc light modulates beam aimed at mirror target at right. Square frame holds cylindrical resonant cavity containing an electro-optical crystal subjected to an electric field. Lens-like polarizer is one of two that pass light beam turned by crystal. Intensity of passed light varies with that of impressed field. This unit operates at 870 mc with a 2-mc bandwidth and a modulation factor of 30 per cent. Device was developed by Sperry for use in a cw optical radar for space use.

ed a modulation frequency of 2 Gc. However, the company reports, the higher frequencies cause severe heat problems and reduce modulation efficiency. Sperry engineers are studying methods of cooling the modulators to raise their efficiency, which would be greatest at or near the curie point of ADP—about 140 K.

Range of parameters, either achieved or expected, for the modulators built at Sperry are: frequency, 500-2,000 mc; bandwidth, 1-10 mc; beam aperture, 0.25-1 in.; driving power, 2-10 w.

The company says it has not pushed high-frequency systems because of the lack of detectors for frequencies above several gigacycles. Similar Pockels-effect modulators, designed for high-frequency operation, at Bell Telephone Laboratories, Holmdel, N. J., and at Harvard University, Cambridge, Mass., have achieved X-band frequencies, but with pulsing.

Light-Modulation Detector Designed For 1 Gc Frequency

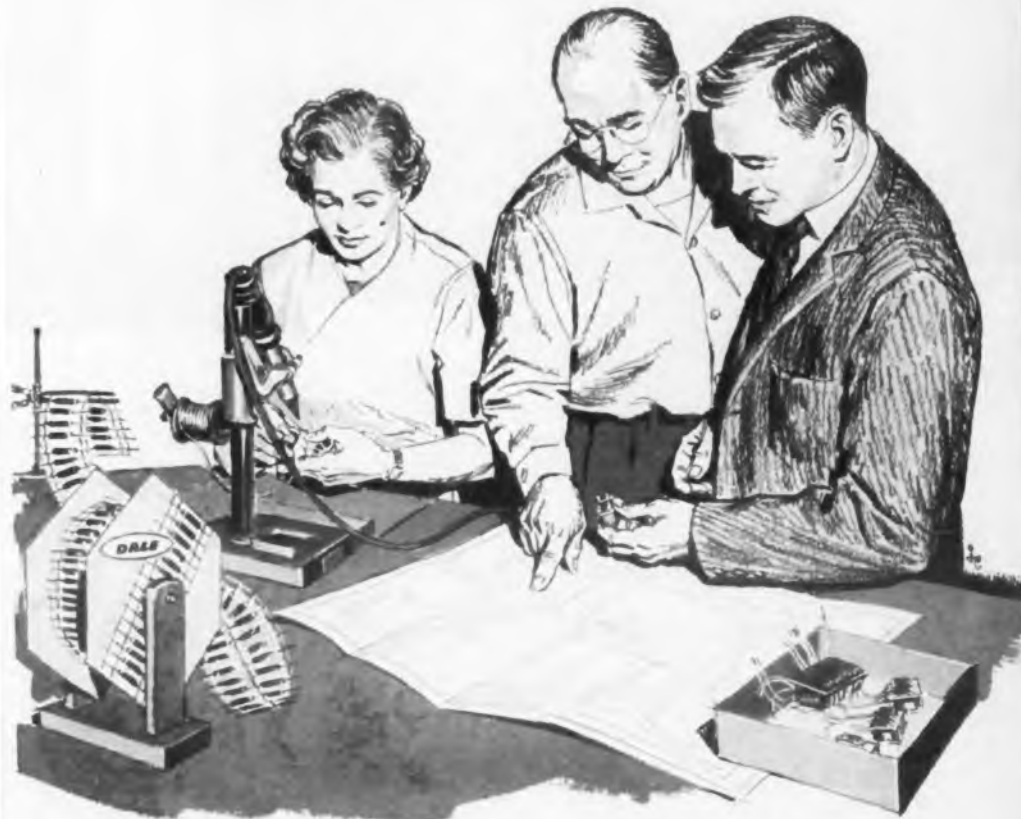
If detection methods for frequencies above the present limits were available, Sperry says it would broaden its program because of an interest in optical communication systems. The company reports it has developed efficient techniques for detecting modulation of light at frequencies as high as 1 Gc by using mixing and modified photomultiplier tubes.

Sperry is building a cw gaseous optical maser, which it expects to have in operation by the end of the year. At that time it plans to try to modulate the laser's light with its modulators as a step in the development of the cw doppler radar. Optical masers, which naturally provide extremely narrow, collimated beams, can be designed to give plane polarized light.

In addition to application in doppler radars and pulsed optical radars, which the company also is studying, Sperry modulators are expected to be used in laboratories as controlled-light sources for measuring response in photomultiplier tubes and for measuring relaxation times of optical masers. The modulators also could be used for measuring the velocity of light. ■ ■

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- RESISTANCE RANGE from 1 ohm to 150 megohms.
- FULL LOAD OPERATION to 70° C, derating to 0 at 150° C.

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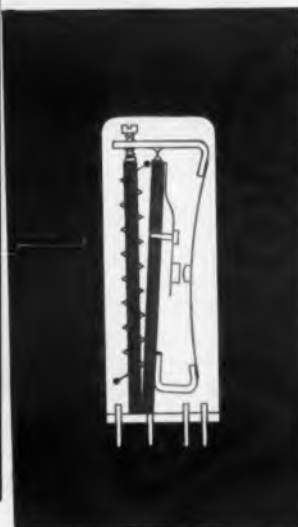


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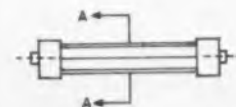
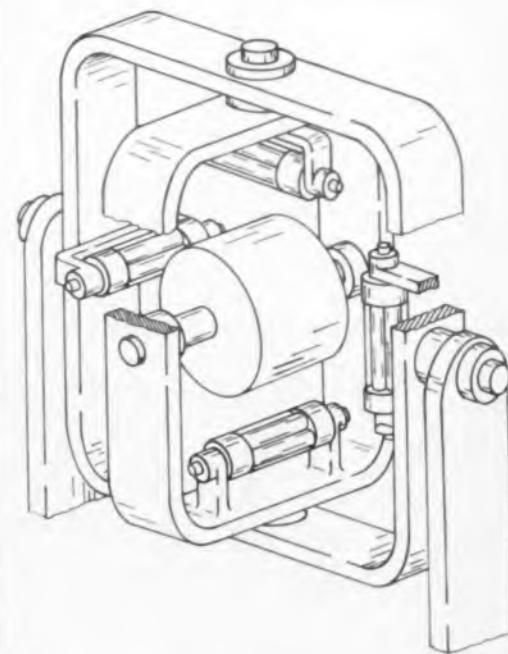
NEWS

Electrolytic Cell Compensates For Mass Shift in Gyros

A new device for electrically providing compensating torque to keep precision gyroscopes in balance uses an electrolytic deposition technique.

The device is an electrolytic cell with two equal masses of metal aligned at opposite ends of a small glass electrolyte-filled cylinder. Metal can be removed from either side of the cylinder and plated on the other side by the action of dc current of any waveform. Polarity of the current determines the direction of plating. The resultant shift in mass provides compensating torque to balance the gyro.

Known as the Avcon Mass Shift Compensator, the device was developed to overcome the problem of the interaction of accelera-



DETAIL OF COMPENSATOR



SECTION A-A
(ENLARGED)

Two-degree-of-freedom gyro has two Avcon Mass Shift Compensators mounted on each gimbal. Electrolytic action removes metal from mass at one end of the cell and deposits it on mass at the opposite end to provide compensating torque to balance gyro.

ELECTRONIC DESIGN • October 25, 1961

tion and mass shift in precision gyros. The effective mass of a gyro assembly sometimes moves off the spin axis due to minute shifts of balls in bearing raceways or small motions of ball retainers. Deformation can also result from stresses set up by angular motion.

With the use of mass-shift compensators gyros do not have to be built to as great a precision as previously because of the compensation, according to Edward J. Mullarky, president of Avcon Corp., Scarsdale, N. Y., and inventor of the device.

Avcon is marketing mass-shift compensators that weigh 3 g and are 1-9/16 in. long and 0.25 in. in diam. They are designed for rigid mounting on gyro gimbals and operate on less than 1 mw power. They are capable of providing compensation up to $\pm 10^{-6}$ g cm/sec to a total of 0.030 g cm.

YIG Yields New Clues



New insight into the properties of yttrium iron garnet (YIG) has been gained by two Bell Telephone Laboratories scientists. E. G. Spencer (left) and R. C. LeCraw report that they have measured what appears to be the inherent resonance linewidth of perfect YIG. They found that YIG has a sharper resonance peak than any other ferromagnetic material. This property could widen its use in microwave applications. The Bell scientists reported ferromagnetic resonance linewidths of only 0.14 oersteds at room temperature and 6,000 mc. The best ferrites, they said, have linewidths of about 5 oersteds.

ELECTRONIC DESIGN • October 25, 1961



HOTTEST NEWS

in the industry

Super-Temps new versatile wire and cable with an operating temperature of 1000°F... flexibility... moisture resistant properties is bringing a new high standard of quality to today's most demanding industries.

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TEST	SPECIMEN #1	SPECIMEN #2
Dielectric 1.5 KV 1 Min. 5% Salt Solution Test #1	Passed	Passed
1000°F. for 30 Minutes Dielectric Insul. Res.	1500 for 20 sec. 6000 Megohms	1500 for 60 sec. 1530 Breakdown 12,000 Megohms
Cycle Test		
4.1 800°F. for 30 Minutes Cool to Room Temp. Insul. Res.	infinite	infinite
4.2 Saltwater Bath 1 Hr. Insul. Res.	infinite	infinite
4.3 800°F. for 30 Minutes Cool to Room Temp. Insul. Res.	infinite	infinite
4.4 Hi-Pot 1 KV for 1 Min 4.5 Breakdown	infinite Passed 4.8 KV	infinite Passed 2.7 KV
Cycle Test (conducted on single specimen)		
5.1 1000°F. for 30 Minutes Cool to Room Temp. Insul. Res.	infinite	infinite
5.3 1000°F. for 30 Minutes Insul. Res.	infinite	infinite
5.4 Hi-Pot 1 KV for 1 Min 5.5 Insul. Resist.	Passed 300,000 Megohms	Passed infinite
5.6 Breakdown	2 KV	2.2 KV

INSULATION RESISTANCE CHECKED AT 500 VOLTS D.C. EXCEPT WHERE NOTED ABRASION TEST—(JANCO) Specimen #1—39.8 Inches; Specimen #2—61.3 Inches.

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Power Rating	1/4 W at 125° C, derating to zero at 165° C
Tolerance	± 1%
Resistance range	10 ohms to 100K ohms
Temperature coefficient	± 25 PPM/°C ± 50 PPM/°C (-55° to +145° C) ± 100 PPM/°C
Type	Evaporated metal film
Construction	Hermetically sealed glass, helium atmosphere
Leads	Weldable (gold-plated Dumet)
Body Length	.281 ± .030"
Body Diameter	.155 ± .015"



When Reliability Counts Most

EDITORIAL

Keeping Your Head (If Not Ahead) In the Packaging Revolution

How can an electronics company make sure it is not left behind in the swirl of the "packaging revolution? How can it stay ahead while it continues to make the deliveries that contribute to today's profits?

ELECTRONIC DESIGN's editors combed the field for the answers, and present some of them in this issue's staff report: "Interim" Packaging.

One of the solutions, we found, is to set aside a corner of the engineering laboratory for a packaging R&D group. The important consideration now is not the size of the group, but that the company is sufficiently alert to have one at all.

The functions of the packaging R&D team appear to be:

- To keep abreast of the rapidly advancing state of the packaging art.
- To work aggressively ahead, even if on a tentative basis, by making trial breadboards of advanced packages.
- To serve as a liaison center for vendors of the swelling stream of new packaging products, methods and services. (This means being in a position to take advantage of the "free" application engineering and consulting available.)

If this R&D group is to help the company, the rest of the organization must be alert to its existence.

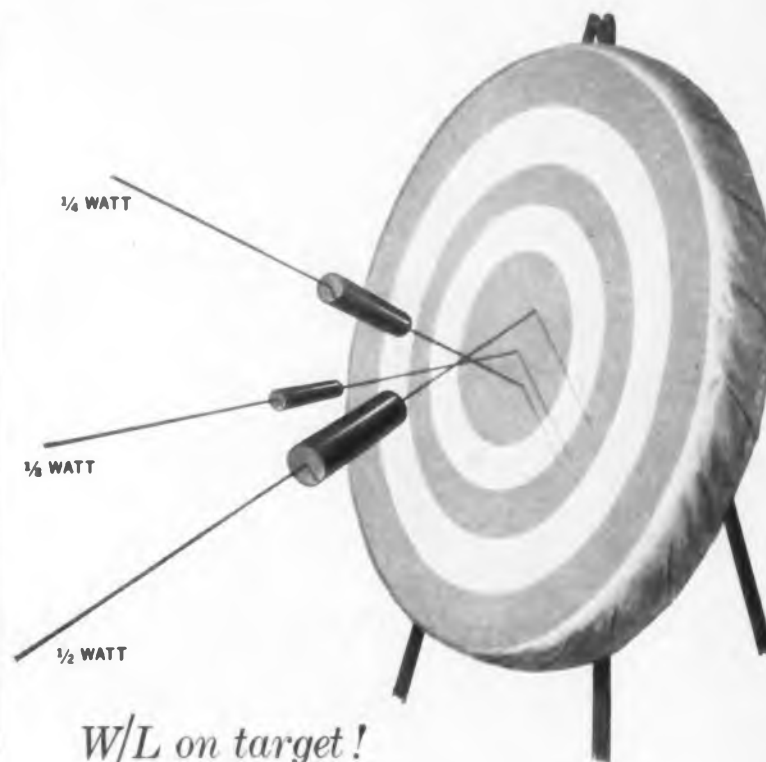
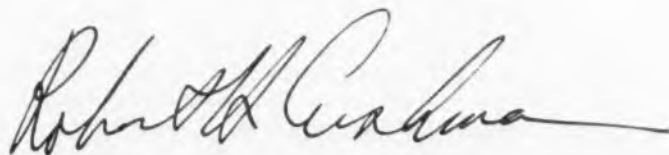
The circuit designers, for example, should observe and criticize, and let their imaginations be stirred by the experimental packaging techniques.

The product engineers constantly should measure the new packaging "twists" against current designs of their packages.

The manufacturing department's foremen should anticipate difficulties for their plant personnel in adapting the methods used by the R&D group.

Not only should a group of this sort encourage a natural phasing-in of improved methods, but it also should prepare the company for the day when it tackles its first bid on a "functional-block" system.

Not to have even one packaging R&D man in your plant is to court "liquidation" in the packaging revolution.



W/L on target!

New METOHM line exceeds MIL-R-10509D

As a supplement to the unexcelled VITROHM resistors, Ward Leonard now offers to designers of commercial, military and industrial electronic equipment a line of molded metal film precision resistors, designed and tested to exceed the requirements of MIL-R-10509D, characteristics B, C and E. You can stake your reputation on Ward Leonard resistors.

Available in 1/8, 1/4 and 1/2 watt sizes, W/L METOHM precision resistors feature the highest degree of built-in reliability and operating stability. Temperature coefficients, over the range -55°C to $+175^{\circ}\text{C}$, may be as low as ± 25 parts per million. Standard tolerance $\pm 1\%$. Tolerances down to $\pm 0.1\%$ on special order.

METOHM TYPE	MIL EQUIVALENT	RATED WATTS	OHMIC VALUES		MAX. VOLTAGE RATING
			MIN.	MAX.	
WL 60	RN 60	1/8	30	500K	250 V.
WL 65	RN 65	1/4	50	1 meg.	300 V.
WL 70	RN 70	1/2	50	1.5 meg.	350 V.

Write for complete specifications and a list of distributors. Ward Leonard Electric Co., 77 South Street, Mount Vernon, New York. © 1961



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'interim' packaging

An ELECTRONIC DESIGN Staff Report

Robert H. Cushman
Technical Editor

Today's Production Methods Can Be Upgraded Progressively to Satisfy Tomorrow's Designs

If the shape of today's electronic packaging were as crystal clear as that predicted for the "functional-block" packaging of tomorrow, there would be no need for this report. Everybody knows that by 1965 (or at least by 2000) the universal method of physically realizing any electronic circuit or system will be to splice together a program (from a library of tapes) that will automatically control a machine, which in turn will set each electron neatly in place. And all this will be accomplished at tremendous rates, untouched by any of those human hands that are causing so much trouble in electronic production today.

However, this report is concerned with the lot of present-day designers, caught in an interim trap: they can't ship anything that looks "old fashioned" but must still live with manufacturing departments which seem to have enough trouble with more conventional methods.

We asked: what is the best that can be done today . . . with today's manufacturing equipment, with today's manufacturing personnel, with today's value-analysis squeeze between reliability and cost?

We learned, as we hope the following pages show, that much can be done today to produce better electronic packages.

We found that what counts is not always that a company has found the very best packaging method, but that it follows through on the one it has.

We found that many companies are finding the answer to today's packaging turmoil in progressive schemes that allow them to keep producing while they integrate better methods into their production line. Progressive schemes are likely to have a key role as long as the turmoil persists.

Often, as in the case of the computer-development group at Bendix, this means deciding what element in the package can be frozen while another element is advanced. In the case of the group at Bendix, the motherboards, with their investment in multilayered printed-circuit layouts, were held constant while the modules were reduced in size on the one dimension that did not affect their pin connections to the motherboard. At the same time, the system was progressively miniaturized by mounting the motherboards closer together.

We found that those in nonmilitary fields who were not trying to imitate military packaging appeared to be coming up with ideas that were really better for them. Western Electric's Amplas is a good example of this. Also, we found those in analog areas who wisely were not trying to follow digital packaging.

The most impressive, yet practical, gains appeared to be from stepwise incorporation of new materials and methods with older ways, as well as new designs based on rearrangements of familiar methods. Then, too, we found some new methods that were actually easier than the old, familiar ones.

In general, we found that the trend continues to be a progressive doubling up of functions. The electrical-signal flow, mechanical-stress flow, and thermal-heat flow are being performed more and more by the same material and in the same space. The problem is that these three types of flow paths must not get in the way of circuit maintenance and must be capable of being broken at certain circuit levels for replacing faulty circuit units.

The improvements in packaging appear to be progressing from the extremities of the system to the spinal chord and system envelope container. That is, the modules appear to be better than



the means of interconnecting them; the means of interconnecting the modules into the subsystems seem better than the means of interconnecting these subsystems into the main system; and, often, at the bottom of the order of improvement, is the housing for the entire system.

At present there is every indication that the 19-in. relay track is the predominant main-system type of housing, but for mobile and other nonlaboratory systems there are signs that much more rugged over-all housings are on their way.

As for standardization, we found that the closer one gets to actual standardized systems, the less standardization one finds. As an example of this paradox, consider AMP's all-pervading answer to the interconnection problem—the MECA system. If MECA really were such an all-encompassing system, designers might shun it on principle, lest they find themselves turning to the East in unison—frozen to a master interconnection system.

However, when we visited AMP's application group and later talked to some of the users of this system, we were impressed with how little standardization there actually is once a customer gets involved with a specific application. It appeared that in each case the user, instead of treating the "master system" as a final answer, treated it rather as a guide, finding plenty of latitude within the system to develop his special order. No two modules observed appeared alike.

This report, of necessity, is disjointed. Our purpose is not to show all the good packaging methods that have emerged recently, but to sketch in enough of the good case histories so that engineers, discouraged by the packaging interim, can see that progress is being made.

Packaging Solutions From Engineering Projects

Digital Packaging—

p 36

An advanced computer-development group achieves a balance between today's modules and tomorrow's computer. Breadboarding with realistic, production-type modules increases the confidence factor in the new computer's final ability, but it means that the modules themselves must be progressively updated to keep the over-all computer competitive.

Analog Packaging—

p 43

Typically, a special-purpose analog package cannot use the finely divided, highly standardized modular approach of digital packages. Instead, it should go its own way; in this case the project finds that a rather complicated over-all envelope buys simplicity.

Packaging Solutions From User-Conscious Suppliers

A Systems-Level Interconnection Scheme—

p 46

Reactions of design engineers to one of the first systems-level answers to the twin problems of module interconnection and support. Use of such a vendor-supplied system diminishes the designer's packaging freedom but can speed delivery.

New Products Update Designs—

p 48

New packaging products, such as flexible and multi-layered printed circuits, are solving a number of problems in one blow.

Clues From Components—

p 51

Circuit packaging methods of the future are getting their shakedown in component manufacturing.



Some Project Solutions—

At Bendix:

Packaging Is a Problem in R&D, Too



Fig. 1. Breadboard for present Mark I version of Bendix airborne digital computer is being built up with "first-generation" production modules being used as "plug-in logic." Some of these modules can be seen in the foreground. The unit in the left foreground is the computer's arithmetic unit. The input-output unit is along the bench to the left and the fast memory units are on the bench at the rear. Engineer Rod Simister is standing.

THE packaging approaches of the advanced-systems development laboratories are worth examining. During the coming turmoil and transition, these laboratories must solve the following problems if they are to justify the large sums invested in them:

- They must have hardware systems to "demonstrate" their grasp of the concepts they preach, both to their customers and to themselves.
- They must be able to "peel off" specific projects if the orders come in.
- They must be continually upgrading their packaging as well as their logic and circuitry if they are to remain competitive.

The advanced airborne digital-computer development group at the Eclipse-Pioneer division of Bendix Corp., Teterboro, N. J., is a good example of a development group trying to maintain a working balance between pushing advanced-systems concepts and continually updating its packaging methods.

Working on company funds, the development group's mission is to enable Bendix to demonstrate that it has the digital-computer ability for major space-vehicle-control projects. The contracts for which Bendix and other companies are preparing their computers are expected to be some of the largest and most important in this country's space and military programs. But the requirements in this area are nebulous in that most of the expected contracts have not yet been formulated by the military.

Meanwhile, the companies preparing to compete in this area are struggling to make the best compromises between how much computer performance to bite off, how much miniaturization they should attempt, and



Fig. 2. Close-up of first approach to packaging being used on the Mark I. Though these soldered cordwood modules were quite compact in themselves, by the time they were mounted on the motherboard and mounted in a system, the amount of interconnection space they used up more than offset their individual packaging densities. Besides, these modules had high center-of-gravities off the motherboard and needed additional support. The cable was used to connect test leads out of the tops of the modules during development.

what target dates they should schedule for various phases of their system's readiness.

Most of them are wondering if they can achieve the reliabilities needed for long-term manned space flights.

What does this type of project mean to packaging? Visits to two of the dozen or so industry groups at work in this area (Bendix and Kearfott) proved that packaging must be an integral part of the group. Unlike customary electronic projects where the packaging problems are left to the end and dumped in the laps of lower-echelon "manufacturing-type" engineers, the packaging occupies a prominent position in these advanced space-computer development groups.

The packaging is so intertwined with the logic, speed, power, cooling, space, and reliability aspects of the design, that in Bendix's 88-man (45 engineers) group, it is very hard for a visitor to tell if a man is working on computer design per se or packaging.

Naturally, the job of squeezing a computer with the power of an IBM 7090 into a suitcase and having the result reliable enough for an interplanetary journey tends to make everyone on the project packaging-conscious.

Bendix Gets Hardware Running While Upgrading Packaging

Bendix has the Mark I version of its 1-mc add-time, parallel, asynchronous computer in partial operation. The breadboard shown in Fig. 1 is a good example of the sort of hybrid packaging that probably will be com-

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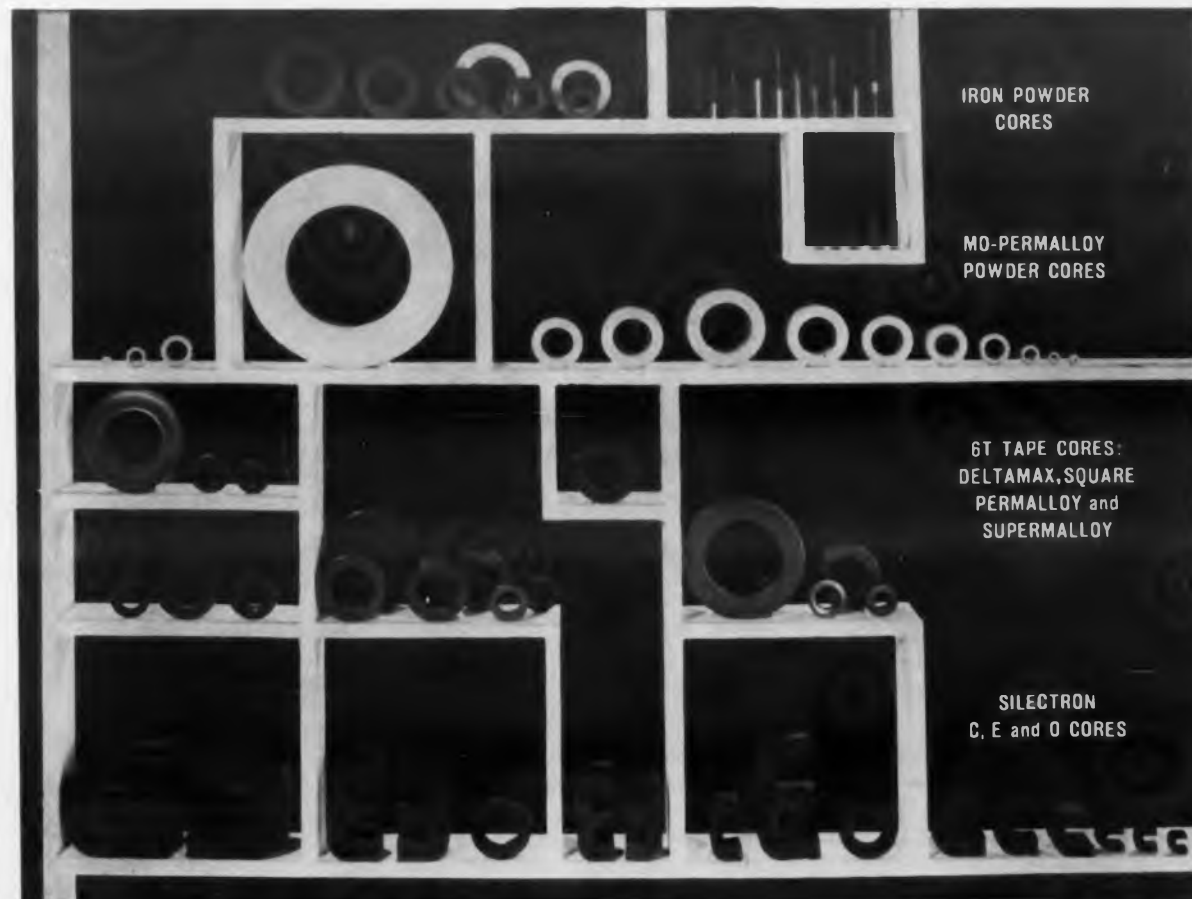
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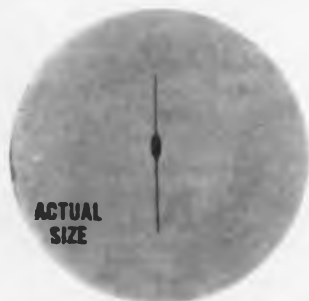
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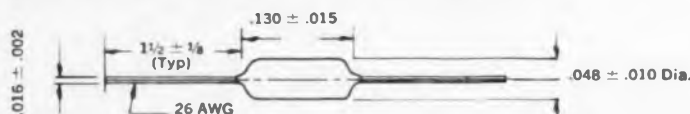


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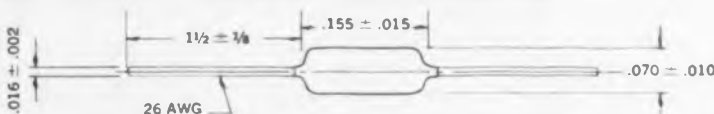
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Temp. Coefficient:
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mon as long as the "packaging revolution" persists. While it is obviously a breadboard on the system and subsystem level, it uses actual, production-type plug-ins on the logic-module level. (See Fig. 2.)

There are definite advantages and conveniences in using finished production-type modules as "plug-in-logic" during a digital computer's development, Dr. David Blauvelt, group director said. They restrict the laboratory breadboard to a manageable size. They make for rapid system- and subsystem-level changes. They lend themselves to organized trouble-shooting and keep this insidious form of developmental delay to a minimum. They accumulate reliability histories. For high-speed computers, the signal-propagation problems will be shown up in terms of actual modules. (Indeed, with the highly miniaturized nanosecond computers of the future, it may not be possible to breadboard at all, unless actual modules are used).

But perhaps most important, using actual modules indicates early in the design the interconnection problems.

The new approaches suggested during the evolution of the first modules and breadboard for the Mark I have resulted in four different module approaches, each with its own form of interconnection. All the modules developed so far have potential applications in possible special-purpose digital computers which Bendix may "peel off" from its over-all know-how. But Bendix's next complete system approach will be to jump to its No. 3 module design for the Mark II. The Mark II will be a "flying" package, not a breadboard. It will have a 1/2- μ sec add time (operating asynchronously at an equivalent clock rate of about 40-50 mc) and is expected to be in operation by next spring.

The Four Module Progressions Show What Bendix Has Learned

The progressive improvements in Bendix's modules tell the story. An over-all view of the progress made in evolving these modules is given in Table 1 which lists the four modules along with their important parameters. Note in particular the relationship

Table 1. Packaging Density

Package	Module Density (Parts per ft ³)	Arithmetic Unit Density (Parts per ft ³)
1- 10-NOR Soldered Sandwich	292,000	29,000
2- 10-NOR Welded Module	81,000	40,000
3- 1-NOR (a)	112,000	44,000
4- 1-NOR (b)	288,000	—

between the packing densities at the module level and at the system level. The most important lesson which Bendix feels it learned is that crowding of parts into a module does not insure the production of a small computer. Only by working with modules breadboarded into an actual operating system was Bendix able to assess in what direction and how far it should go in correcting this situation.

First Package: Soldered Cordwood Sandwich

The main difference between Bendix's first package and other soldered cordwood sandwiches was that Bendix made rather extensive use of five different printed-circuit overlays to make special-purpose modules out of the basic 10-NOR circuit sandwiches.

The modules are designed to be mounted by miniature connectors and hold-down straps to printed-circuit boards that have wiring on both sides. Tom Lavin, Bendix engineer, pointed out that the wiring on the two sides was purposely run in straight lines and at right angles so that the capacitance effects, critical at the computing rates, would be minimized.

The present package and its manner of end-mounting is ideal for breadboarding, but improvements of this sandwich include a lengthwise connector that will lower the module's center of gravity away from the board and give more connection points with less crowding.

Second Package: Welded 10-NOR

Welded construction was used in the second packaging version in an effort to achieve increased freedom of configuration and to eliminate space-consuming reliability-degrading connectors. Extensions of the welding leads used as module pins would be soldered to the "mother" boards, which would

Newest Hermetically Sealed SHAPE

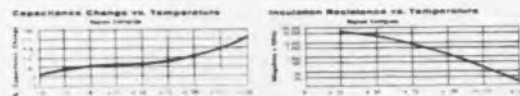
- Extremely small size provides maximum capacity per unit of chassis area.
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This rugged, dependable 50 Volt series was developed specifically for military applications. It combines the thin, flat shape of popular Good-All instrument grade 601PE capacitors with a hermetically sealed metal case of oval cross-section.

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Winding Construction — Extended foil (non inductive) MYLAR® Dielectric.
CASE — Metal enclosed, Hermetically sealed.
Temperature Range — -55°C to +125°C at full rated voltage.
Life Test — 250 hours at 125% of rated voltage and 125°C.
Vibration — Meets all requirements of specifications MIL-C-25C and MIL-C-19978A.
Temperature and Immersion Cycling, and Moisture Resistance — Meets all requirements of specifications MIL-C-25C and MIL-C-19978A.
Insulation Resistance — Greater than 75,000 megohms when measured at 100 volts D.C. at 25°C for a maximum of 2 minutes.
Capacity Tolerance — Available to ±20% ±10% ±5%.

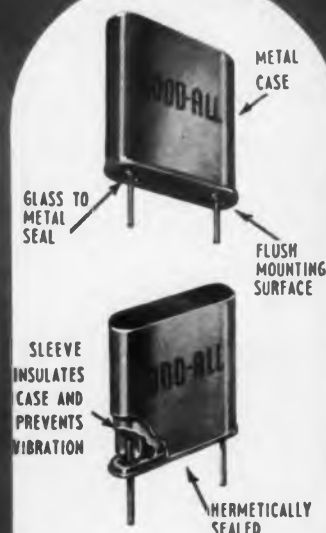
The 605 is capable of being produced to **HIGH-RELIABILITY** specifications comparable to MIL-C-14157 and MIL-C-26244(USAF)



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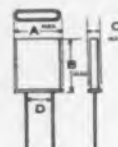


605 SERIES CAPACITORS

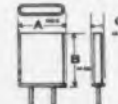
50 VOLT DIMENSIONS

CAP. MFD	A	B	C	D
.01	.426	.534	.176	.200
.022	.426	.534	.176	.200
.033	.560	.575	.235	.300
.047	.560	.575	.235	.300
.068	.560	.575	.235	.300
.10	.760	.575	.355	.500
.15	.760	.575	.355	.500
.22	.760	.790	.355	.500
.33	.760	.790	.355	.500

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CIRCLE 35 ON READER-SERVICE CARD



then plug groups of welded 10-NORs into the system.

This type of module-interconnection system would, of course, be less handy for module-level changes. However, since many problems at that level are being solved with the plug-in modules in the present breadboard, this would be less important than the progress made toward more compact system interconnections.

A manufacturing attraction of the welded modules is that all the components are accessible for replacement prior to potting. The construction steps in fabricating the welded modules are detailed in pictures on this page. Note that if the pre-potting electrical tests reveal a faulty component it can be replaced by opening the two 5-NOR halves of the modules like a book. Note also how welding affects the configuration.

Steps in Fabricating the Second Module



Components are mounted in copper-lined holding jig which serves as the lower welding electrode. Each of the 10 NOR's is welded in this manner into a ladder network. Bendix believes this process could be automated to produce a long line of NOR's which could then be cut up as desired.



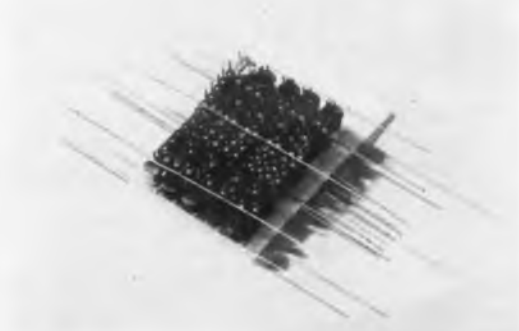
The ladder networks are folded into "U" groups in special bending fixture.



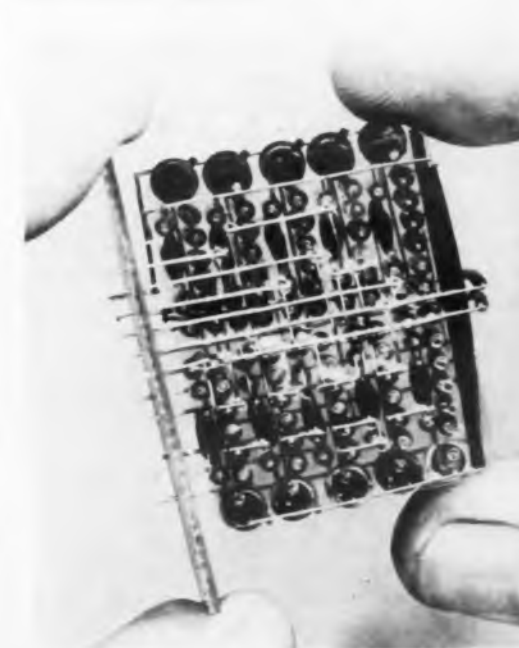
The "U" groups are inserted into a holding jig and their common power buses are welded on with hand-held tweezer electrodes.



By adding another part on to the fixture, the "U" groups can be assembled into units of five NORs.



The 5-NOR units are mounted in pairs to form the complete 10-NOR modules. A multilayered welded-wire matrix separated by Mylar sheet insulation forms the module interconnections.



A strip of laminated glass-epoxy board is slipped over the extensions of the welded-wire matrix which are to serve as the module's connector pins and the unit is ready for prepotting checkout. A final epoxy potting operation completes these modules.

Third Package: Single, Self-Jigged NOR

Based on what was learned in designing, manufacturing, and breadboarding the first two packaging progressions, Bendix engineers have developed the package they are designing into their Mark II "flying" version. After comparing the computer systems that would result from the first two packages, Bendix concluded that, although the 10-NOR modules were ideal from the logic standpoint, they were not the most efficient grouping from the system-packaging standpoint.

The third package, therefore, was built around a single NOR logic unit. The engineers felt that by extensive use of multiple-layer printed-circuit interconnections, these single-NOR's would achieve the best over-all system density.

As Fig. 3 shows, the single NOR units are cleverly assembled in a potting capsule, which also serves as the welding jig. The recesses and component lead holes molded into these capsules are tailored to the shapes of the components so that once the components are laid in place no other holding means are needed while their leads are being welded together. These molds readily can be mass-produced by the epoxy transfer-molding proc-



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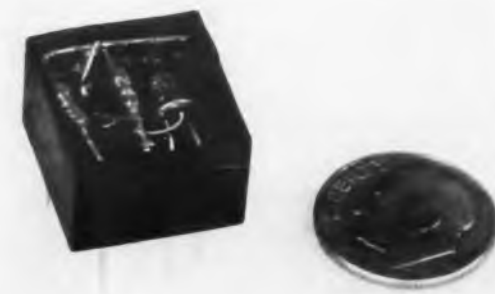


Fig. 3. Third and fourth progressions of the module are built around single-NOR units cleverly potted in their own welding fixtures, using the leads of their components as pins.

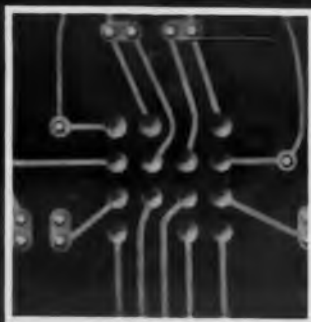




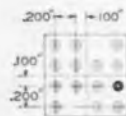
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Printed Circuit
Features



Diagram



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ess, described elsewhere in this report. Potting is then accomplished by simply pouring in the resin.

As for interconnection efficiency, the single-NOR uses the extensions of the component leads themselves for module mounting pins. They would be inserted into mating holes (probably staggered because of the tight spacing) in the multiple-layer printed circuit boards and soldered in place by a wave-type soldering machine. Bendix attributes the increase in system density with these modules to the fact that connectors and mounting hardware virtually have been eliminated.

Fourth Package: "Lowered" Single NOR

The final packaging progression seen by Bendix as being within the present state-of-the-art is a further compacting of the single-NOR by using highly miniaturized components. But, rather than scrapping the elaborate multiple-layer printed circuits being developed for current single-NOR, Bendix plans to keep the same general module size on the sides that touch the board and compress the module height as future components

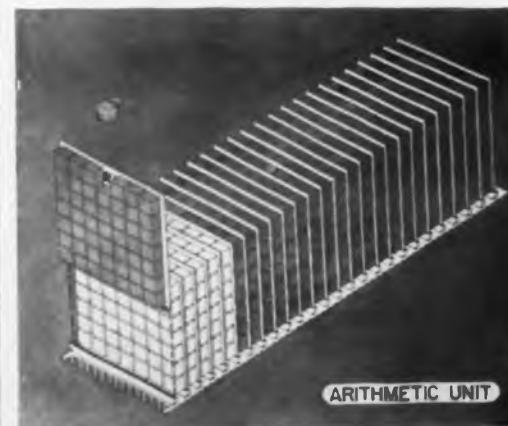


Fig. 4. Drawing of how Bendix plans to assemble the single-NOR modules into a computer's arithmetic unit. As smaller components become available, the NORs would be reduced in height and the length of the motherboard stack would be decreased.

permit. Thus the same connecting holes in the board can be used. Meanwhile, with each lowering of the module height the boards themselves can be pushed closer together and the over-all computer "accordioned" down into a more compact unit. (See Fig. 4.)

An advantage of this "one-dimensional" miniaturization will be that heat-dissipation will be automatically taken care of by the cooling-fin action of the large fixed-dimension areas of the modules and boards. For this reason Bendix hopes to avoid going to forced-air cooling.

At Adage:

A Break With Digital Packaging

A MISSILE-checkout digital multimeter illustrates the special type of packaging appropriate to certain military ground-support and vehicle-mounted equipment and corresponding types of industrial installations.

Here, extreme miniaturization was not the overriding aim, though the space available was limited. The goal was an exceptionally rugged and maintainable package, since this type of equipment is useful only if it does its job with little fuss.

The decisions by the builder, Adage, Inc., Cambridge, Mass., which led to the unusual configuration and construction details of this package are noteworthy. They indicate a willingness on the part of the designers to discard standard concepts and to tailor the packaging to meet the rather special conditions of the application.

The first step in Adage's unfettered approach to this package was to eliminate the 3-in. by 4-in. module size favored by the procuring agency. Adage's studies indicated that the over-all component density could not be achieved with modules this size. The connectors, interconnecting wiring and module mounting hardware (the really critical items today) would take too much space.

Further, while the 3-in. by 4-in. modules might have been all right for digital circuitry, the precision analog amplifiers, which were an important part of this multimeter system, could not be conveniently broken down into such small modules. Noise and



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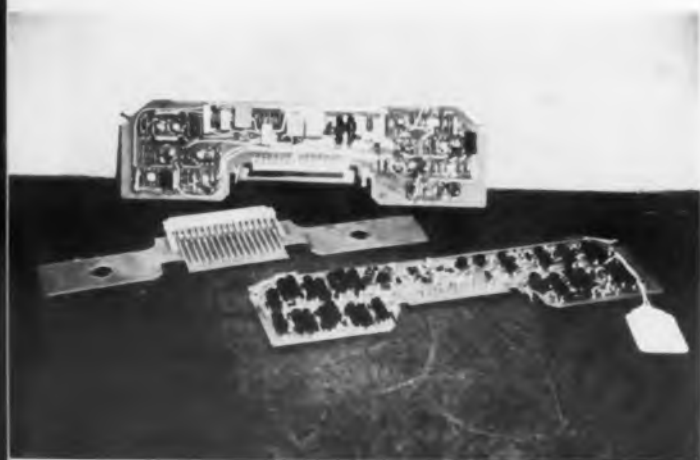


Fig. 5. Unusually shaped modules for the analog amplifiers. The middle unit is an extender for in-place checkout.



Fig. 6. The casting was quite intricate but made up for this by simplifying other parts of the package.

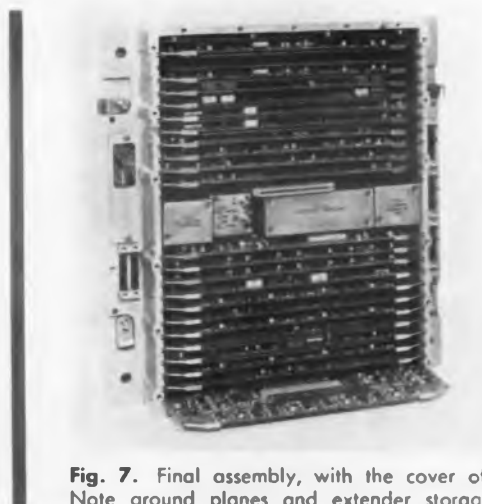


Fig. 7. Final assembly, with the cover off. Note ground planes and extender storage.

stray capacitance effects militated against the fragmenting of the analog units among several modules.

Efficient use of the volume and more natural division of the circuitry both dictated the use of fairly large etched card modules.

Space Limitation Led To Novel Module Shape

Two problems remained: the form factor of the modular cards and provisions for shock and vibration in the module mounting. To achieve accessibility within the specified envelope (electronic equipment typically seems to have to fit into spaces left after nonelectronic engineers have laid out the structural aspects of the system), the module mounting axis had to be parallel to the shortest envelope dimension. This resulted in an unorthodox module: a long, narrow, rectangular shape with the connector centered on one of the long edges.

Because of the unusual module shape and size, there was the problem of how to "rack" or otherwise mount it. The solution was to merge the rack and housing into one integral casting. The racks were formed by recesses cast into the inside of the housing. Another recess was cast into the back of the housing so that the cabling leading to the connectors would usurp little of the internal volume.

The photographs show the complexity of the casting. However, the photographs also show that there was little space left for any other module-board mounting method.

Housing and Cover Made Of Aluminum Sand Casting

The housing and its cover were thin-walled aluminum sand castings. In the housing casting can be seen the grooves for card modules and inter-module shields. Note the cast-in crenellations, which provide bearing surfaces for the insert-extract levers mounted on the front corners of the modules.

The connectors are fastened to the pads cast in the rear of the assembly. A rear plate provides access to the connector taper pins. A self-storing chassis extender permits access to all the components for in-system checks of the boards.

The levers on the front corners of each module permit the boards to be inserted and extracted with low manual forces and without additional tools.

Adage points out that the surface area on the modules available for components is a high fraction of the total area within the

housing. The firm says that reasonably high component density was achieved in this case without going to high-density techniques, such as cordwood, which compromise component accessibility.

One of the Newer Materials Used to Damp Vibrations

The valleys cast into the rear inside surface of the housing (barely discernible in the photo) and in the inside of the door are lined with an energy-absorbent elastic material selected for its vibration-absorbent characteristics. When a module is inserted, its back edges on either side of the connector push into one of these valleys and compress the elastic slightly.

When the cover is closed and secured the long front edge of the card between the levers also compresses its valley. The elastic linings press the back and front of the module boards together, holding the boards tightly in place and accommodating to any tolerance differences. As with the other card mounting features, this anti-vibration function takes up very little of the precious envelope volume.

The energy-absorbent cushioning provides an efficient means of overcoming the susceptibility of the large unsupported cards to become sounding boards. Usually, large boards of this sort must be either supported at many points by a rigid metal frame, which moves the resonant frequencies to higher frequencies where the board is "lossy" enough to prevent large, persistent vibration amplitudes, or the module is isolated from mechanical energy in its range of resonant frequencies by shock mounts or vibration isolators.

But both of these techniques are space consumers. The cushioning approach is more effective, Adage said, because it gives the energy transmitted to the boards some other place to go rather than "fanning the air" and fatiguing the component leads.

Adage said that despite the apparent complexity of the casting and the unusual module configuration, the packaging was designed and reduced to hardware in four months after the award of the contract. It was turned over to the customer one week after the promised delivery date and has since performed well electrically and mechanically in acceptance tests.

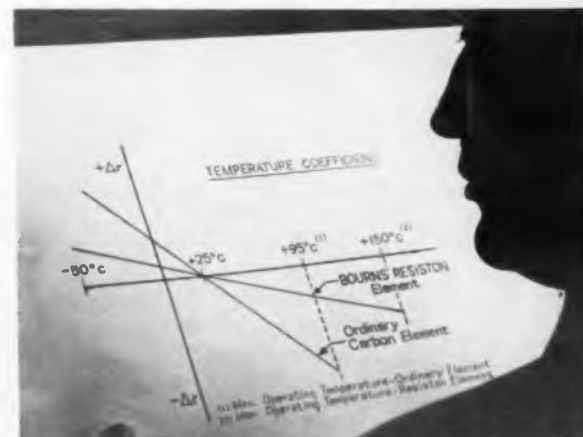
This package demonstrates that the electronics industry need not blindly follow the space-oriented designs, whether they need extreme miniaturization or not.

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Some Product Solutions—

At AMP:

Getting Into the Design Act

AMP INC's MECA interconnection system has been available for over a year. Since it is intended as an all-encompassing answer to the "interconnection problem," *ELECTRONIC DESIGN* checked the reactions of several engineering-project groups, which have been evaluating it and are starting to incorporate it into some of their systems.

The applications of two of these project groups, one at the National Bureau of Standards and the other at the Federal Systems Division of International Business Machines

Corp., were quite diverse. The group at the National Bureau of Standards is using MECA for some of its small data-logging systems in connection with potted soldered cordwood modules. The group at IBM is using MECA for a satellite application in connection with welded modules.

MECA Termed Good For In-Use Maintenance

MECA was chosen for the NBS data systems for the ease with which the modules

can be plugged in and out, one of the engineers on the project told *ELECTRONIC DESIGN*. It was felt that the critical module-to-side-rail rib connection in the MECA system was adequate electrically and that the plug-gability that stemmed from this connection more than made up for the fact that soldering the "cordwoods" directly to the motherboard probably would have been the most reliable method.

The NBS engineer said the criterion was not so much just the MTBF (mean-time-

How Does MECA Function?

Whether one cares for AMP's MECA system or not, it is worth analyzing since it represents the first "commercialized" interconnection scheme. Certainly those hoping to come up with a better all-encompassing scheme should first appreciate what has been attempted in MECA.

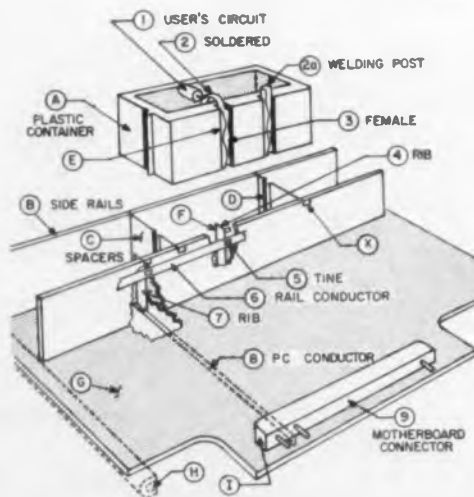
The diagram shows the essential electrical and mechanical energy-flow paths. The elements called out by numbers trace the flow of an electrical signal out of the user's circuit module to the motherboard connector. The elements called out by letters trace the progression of the mechanical support loads for the user's circuit module out to the chassis supports for the motherboard. (The thermal paths also could be traced in this manner, but would be more complicated since they would be a combination of the two above paths as well as the air around the module.)

Note how many of the MECA members serve dual mechanical-support and electrical-communication functions. This is the secret of efficient packaging. For example, all the ribs mechanically tie the

siderails to the motherboards. By virtue of their friction connection to the female connectors on the plastic containers the ribs also hold the containers down in their "corrals." The long wiping action gives this critical joint its reliability.

Electrically, if the female connector on the module is tied to the user's circuit inside the container, the same rib will carry a signal from the cell to any siderail conductor or any motherboard circuit with which one of the rib's tines makes contact.

Also, consider the MECA system from a "value-analysis" point of view. Note that, although it is a three-dimensional system, it is built up mainly of easy-to-manufacture-and-modify two-dimensional elements. Both the siderails and motherboards can be mass-produced in special configurations for special applications. The one three-dimensional element in the MECA system, the plastic circuit container, also is perhaps the most uniformly repeated element in the system and therefore can be standardized and economically mass-produced by plastic molding machines.



between-failure) but the amount of time spent in trouble-shooting to get the system back in operation, after a failure.

As for the structural integrity of the MECA system, the NBS man recalled that the parts of the first evaluation kit had looked flimsy enough when he received them in knock-down form. But, once assembled, they produced a surprisingly sturdy result. The fact that MECA's side rails are anchored at right angles to the main motherboard increases that board's moment of inertia and helps it to carry beam load without deflection, he said.

The engineer said that for this NBS application his group will plug the motherboards in vertically, but he is not worried about the side-mounted modules working loose. The MECA system is replacing four layers of printed circuitry which did not permit unplugging the modules.

Potting in the NBS project is being accomplished by first metering an amount of resin into the MECA cells, then pushing in the cordwood circuit modules.

Environmental Tests Indicate MECA Acceptable for Satellites

The satellite for which IBM is readying a MECA-packaged electronic system is NASA's OAO (Orbiting Astronomical Observatory). In this case MECA will support and interconnect a sophisticated data collection, storage and control system, which must last one year as it directs and records the observations made by the satellite's telescope and, upon ground command, transmits back to the earth.

The engineer in this group contacted by *ELECTRONIC DESIGN* said the project has put MECA packages under rigorous environmental tests. (While the OAO may have a fairly serene mechanical environment as it orbits in space—except for thermal stresses resulting from alternate sunlight and shadow—during the boost into orbit it will of course have to withstand the thrust *g* of the booster as well as the intense vibration caused by the rocket engine's "noisy" burning.)

This engineer said the MECA cubes had not

"walked" out of their friction connections during 100 *g* at up to 2,000 cps. This has lead him to believe that no hold-down is necessary. (However, for this application more module connections than usual—24—are used, some of these being only mechanical and not serving as electrical paths).

But to arrive at a more rugged over-all package, the 8-in. by 11-in. motherboards, each supporting 54 MECA cells, will be compressed together into 12-layer groups with sheets of Mylar between for insulation. Silicon sponge had been tried but found to permit too much "travel" under vibration.

Reliability Control Stressed in Production

Why was IBM willing to pay the weight and reliability penalties that would accompany even the best of any "pluggable" system like MECA for equipment that will spend its year of life in a satellite beyond maintenance? With complicated systems the "time-and-place" where maintainability really is needed is when the system is being built up on the factory floor, *ELECTRONIC DESIGN* was told. IBM has found that good circuit units go bad just due to handling as they go down the production line and as the system to which they are attached is checked out and readied for the countdown. Even if this were not so, engineers have been known to change their minds and only an interconnection system that permits adjustments and improvements is realistic. (In this connection Harry Wasiele of AMP says that he sees no reason why universal logic system breadboards cannot be made out of MECA).

The MECA package for the OAO is somewhat different from other MECA units. The "U"-shaped female connectors recessed into the cell sides are extended up to form welding posts for the all-welded OAO circuits. These posts are kept below the side-rail height by cutting down the cell sides.

The ends of the OAO MECA cells are full height and when a Diallyl Pthalate cap is put over the cells the result is an even surface along the top of each string. (The cost of having molds made for special modules is in

Designing With MECA



AMP's John Shue breaks down a customer's computer logic diagram for MECA packaging. AMP has been doing some "free" engineering of this sort for potential customers who have reasonably promising applications for MECA. As the close-up of the layout worksheet, which AMP has developed for MECA, shows, AMP has developed a way of indicating the three-dimensional connections in two dimensions. The siderail connectors are depicted by the vertical lines while the dashed horizontal lines represent the printed circuits on the underside of the motherboard. AMP says this approach reduces MECA applications to routine.





New MECA Developments



A flexible-circuit connector and a compact computer push-button assembly are two recent developments observed by ELECTRONIC DESIGN in AMP's MECA engineering development group. The flexible circuit connector makes use of the long over-travel connections developed for the MECA cells. The computer push-button assembly uses just about all the elements of the MECA system but rearranges them to accommodate lighted push-button switches. AMP says that this assembly is more reliable and easier to maintain than previous switch assemblies.



the order of \$900, AMP told ELECTRONIC DESIGN. Also, the company said some customers have been asking for "upside-down" modules with circuit identifications silk-screened on.)

'Flushed' Coating Replaces Solid Potting In Circuits

Instead of solid potting, a "flushed" coating is used for the circuits housed in the cells. A silicon-phenolic resin is poured into the cells, with the circuit modules in place, and then drained out. What is left clinging to the parts hardens and affords extra strength at less weight than a solid potting. However, an RTV (room-temperature-vulcanizing) silastic will be used for those few higher-powered modules in the system with heat dissipation problems.

The only complaint the engineer at IBM said he has against the MECA system is that he thinks MECA should either have more side-rail conductors or should go to multi-layer printed circuit motherboards. (AMP, however, said the IBM circuit, possibly because it has higher circuit density per module, represents an unusual case. It is the only application that has had to resort to printed circuitry on both sides of the motherboard.)

In summary, this user said that MECA was chosen because, of all the "pluggable" systems available, it appeared to offer most regarding weight, volumetric efficiency, and reliability.

This engineer estimated that, once a firm accepts MECA as the way to do a packaging job, it can speed the design procedure by some 25-30 per cent. The IBM project has developed its own method of reducing logic diagrams to MECA. The problem is to get used to the fact that, with the side-rail connections the designer has a true third wiring dimension. IBM's method uses an IBM 7090 computer to automatically decide the MECA interconnections.

Cost of MECA Moderate In Many Applications

One user estimated that MECA adds slightly more than \$1 to the cost of a circuit module. That is, if a circuit module cost \$16, packaged in MECA it would cost about \$17. This would be for orders of a thousand modules, he said. AMP's official viewpoint is that for orders of 10,000 cells and over the per-cell cost should be 50¢ to 75¢, depending upon the number of cell contacts.

Both the users agreed that interconnection systems such as MECA and multiple-layer printed circuit boards have not entirely solved the interconnection problem. What they have done is push the problem around a bit, making the real interconnection culprit the connector by which the motherboard subsystems are inserted into the system wiring. The more circuitry is crowded on motherboards, the more the motherboard connector becomes the weak link.

At Comar:

New Method 'Saves' Bad Design

IN THE flood of new products that probably will continue as long as the revolution in electronic packaging persists, the designer should be alert for products that may "save" bad designs.

The following is a case history of a design good enough in every way except one: it almost defied efforts to produce it.

This was a military relay already under manufacture by Comar Electric Co., Chicago. The problem was that many connections had to be made in the small area between the relay-contact assembly and the connector plug. Originally, Comar had been producing the interconnections by hand-soldering the 14 lead wires to the 28 connections. While



No hoses, seals or pumps! FC-75 Coolant helps reduce "cube" of new welding transformer by 75%

Electrical resistance welding of tubing has been greatly improved by 3M Brand FC-75 Inert Fluorochemical Liquid Coolant. The Yoder Company has introduced a welding transformer using FC-75 that's only $\frac{1}{4}$ as large as previous models—yet can raise tube output as much as 60%!

The original water-cooled transformer required hoses, seals, and pumps: FC-75 eliminated these accessories. One water-cooled transformer was a 3 foot cube in size. The new comparable transformer now measures only 9" x 21" x 36"! The transformer primaries and cores are submerged in FC-75. As heat builds up, the coolant liquid vaporizes, carries heat to the transformer case, condenses, and returns to the liquid state.

A secondary conductor system is eliminated, secondary impedance is greatly reduced, and current travels directly from the transformer to the electrode. For example, on one size, amperes are up from 41,000 to 51,000, increasing performance. Less input, smaller generator, motors and starters are required.

With FC-75 coolant, the Yoder Transformer can be pushed to capacity, with safe internal temperatures of 300° F! Corrosion and short circuiting are practically impossible. Units designed to take advantage of FC-75 coolant offer you compactness, more efficiency and less maintenance. See the Properties Profile for full specifications. And write us today for more information on FC-75 and FC-43.

PROPERTIES PROFILE

on

3M INERT LIQUIDS BRAND FC-75 and FC-43

These unique dielectric coolants possess unusual properties that can prove advantageous to the designer of electrical devices and instruments, as well as to the manufacturer. Increased range of operating temperatures, improved heat dissipation which permits miniaturization, and greatly increased protection from thermal or electrical overload are possible with their use.

FC-75 and FC-43 are non-explosive, non-flammable, non-toxic, odorless and non-corrosive. FC-75 is stable up to 750° F., FC-43 to 600° F. Both are completely compatible with most materials... well above the maximum temperatures permissible with all other dielectric coolants. Both are self-healing after repeated arcing in either the liquid or vapor state.

ELECTRICAL PROPERTIES

	FC-75	FC-43
Electrical Strength	35KV	40KV
Dielectric Constant (1 to 40 KC @ 75° F)	1.86	1.86
Dissipation Factor (1000 cycles)	<0.0005	<0.0005

TYPICAL PHYSICAL PROPERTIES

	FC-75	FC-43
Pour Point	<-100° F.	-58° F.
Boiling Point	212° F.	340° F.
Density	1.77	1.88
Surface Tension (77° F) (dynes/cm)	15	16
Viscosity Centistokes	0.65 min.	2.74
Thermal Stability	750° F.	600° F.
Chemical Stability	Inert	Inert
Radiation Resistance	25% change @ 1 x 10 ⁶ rads	25% change @ 1 x 10 ⁶ rads

FC-75 and FC-43 have nearly equivalent heat capacities in the liquid and gaseous states.

For more information on FC-75 and FC-43, write today, stating area of interest to: 3M Chemical Division, Dept. KAP-101, St. Paul 6, Minn.

MINNESOTA MINING & MANUFACTURING CO. **3M**
CIRCLE 40 ON READER-SERVICE CARD

CIRCLE 41 ON READER-SERVICE CARD FOR AMPHENOL-BORG >

The cost of miniaturization just dropped 20%

Trends can be overpowering. Once established, they're tough to reverse.

Take the cost of miniaturization, for example. As electronic packages get smaller, price tags get bigger. No one seems surprised. It's a trend.

There's a reason, of course. Tiny things are hard to build, especially within space-age reliability requirements.

Amphenol designers decided that if ever a trend needed reversing—it was this one.

"How" was another question. They knew that conventional miniaturized pin and socket connectors were about as small as they were ever going to be. The spring member in the female contact (necessary for a snug, low-resistance connection) took up valuable space and set a lower limit for practical center-to-center contact spacing. The spring was obviously holding up progress in miniaturization. It had to go.

So, it went.

► Amphenol designers developed the Wire-Form Poke-Home® contact, a male contact that supplies its own tension and can be crimped or welded before assembly. Overnight, contact spacing plunged from .175 inch to .100 inch. And, best of all, the new contact was less costly to manufacture. (It's built on automatic equipment.)

The trend reversal was well on its way. Amphenol designers had a new contact—the next step: putting it to work in connectors.

To answer the need for an economical micro-miniature rack and panel connector, the Micro-Rac was unveiled. Space-saving Wire-Form contacts and an integral-body-dielectric construction made it possible to pack 20% more connections in the same space—and at nearly half the previous cost. As for reliability, after 1,000 repeated insertion and withdrawal cycles, the Micro-Rac retained its original low resistance characteristics.

► Next came the Strip Connector, six-inch lengths of Lexan* plastic with contact holes on .100 inch centers. A do-it-yourselfer's delight, strips can be cut and stacked to suit hundreds of applications where a connector is a must—but for which no other economical connector exists. Example: strips can be stacked to form micro-miniature programming boards or instrumentation terminations. They also

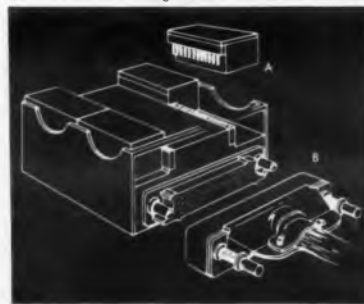
can be used as economical tape cable connectors, modular connectors, logic card connectors, to mention a few.

Wire-Form contacts can be used separately, too. Example: contacts can be crimped or welded to modules and plugged into special eyelet-type receptacles on printed circuit boards. Non-modular components, such as transistors, become pluggable by crimping Wire-Form contacts to their leads.

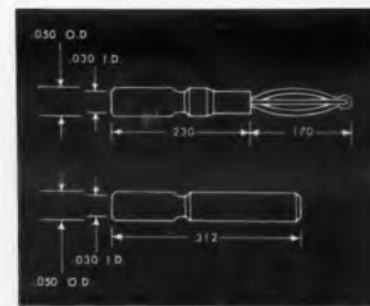
And that was that. The trend was reversed.

► If you would like more information about Wire-Form Poke-Home contacts, Micro-Rac 52- and 104-contact rack and panel connectors, Strip Connectors (or any Amphenol Connector for that matter) call your Amphenol Sales Engineer. Or, write to Dick Hall, Vice President, Marketing, Amphenol Connector Division, 1830 S. 54th Avenue, Chicago 50, Illinois.

* Registered TM General Electric Co.



The Amphenol Wire-Form contact at work. Multi-purpose Strip Connectors (A) connect modules to chassis; Micro-Rac Connectors (B) connect chassis to cable assembly.



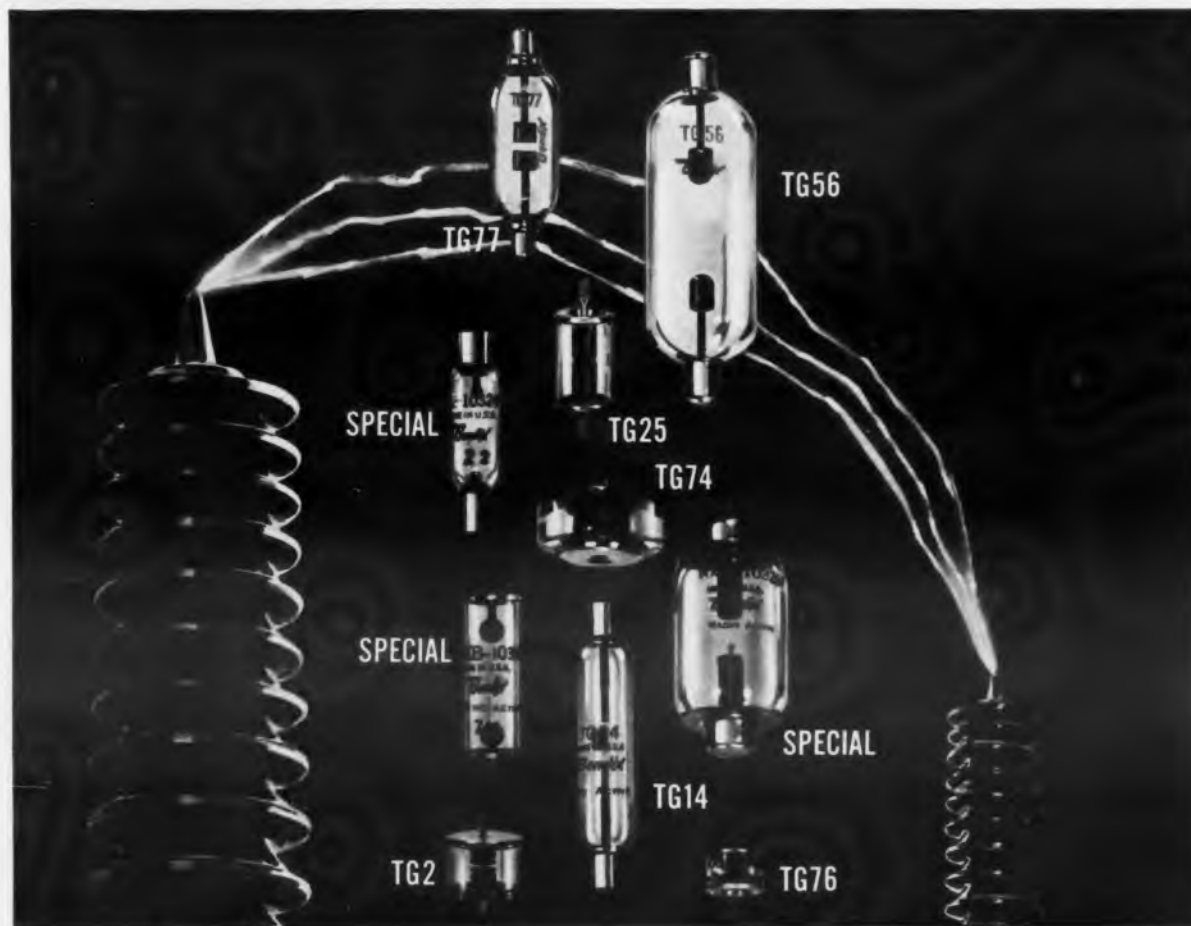
Acting like four spring fingers, Wire-Form beryllium-copper beam sections assure a low resistance connection (.0025 to .0030 ohm) even after 1,000 insertion-withdrawal cycles.

AMPHENOL Connector Division / Amphenol-Borg Electronics Corporation





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BENDIX® SPARK GAP TUBES SPECIALLY DESIGNED TO PROTECT RADAR AND OTHER ELECTRONIC CIRCUITS

These versatile tubes do two major jobs in electronic circuits: first, protect radar and other electronic circuits against voltage overload, keeping high voltage surges from getting through to damage circuit components; second, act as a "triggering" switch in such applications as jet ignition systems. These tubes pass high currents with relatively low voltage drop, handle high voltages in small space. If this spark gap line—ranging from 750 V to 50 KV DC breakdown voltages—doesn't meet your needs, we'll design and produce special units for you. Write for details. Electron Tube Products, The Bendix Corporation, Eatontown, N. J. Export Sales: Bendix International, 205 E. 42nd St., New York 17, N. Y.

Red Bank Division



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Fig. 8. Redesigned relay assembly: connections had been made by tedious point-to-point wiring and then, unsuccessfully, with a printed-circuit board. The flexible circuit made of thin etched copper wires embedded in Teflon folds into the relay assembly between relay contacts and base.

this was reliable, it was a tedious, costly manufacturing procedure.

To cut the time needed to make connections, Comar turned to a printed-circuit board with a standard dielectric. While this did eliminate the need for time-consuming individual connections between the relay and plug, the printed-circuit board created some problems of its own.

Printed-Circuit Board Lifted Production—And Reject Rate

With hand-wiring, Comar had been producing 3.8 relays per hour with a rejection rate running between 7 and 8 per cent. With the printed-circuit board, Comar's production rate was substantially increased but so was the rejection rate. Rejections soared to a prohibitive 20 per cent. The problem was that the printed-circuit dielectric began to burn during the soldering operation. This not only caused problems during soldering but later also caused operational problems when the temperature inside the relay rose to over 100 C. The outgassing from the PC board's dielectric would contaminate the relay contacts and produce high-contact resistance.

The new product that "saved" Comar's relay was a Teflon-encapsulated flexible printed-circuit board by Garlock, Inc., Palmyra, N. Y.

The known temperature inertness of Teflon not only eliminated the burning of the dielectric and the outgassing during high-temperature operation, but, according to Comar, also made it possible for them to automate their soldering operation by pass-

FASTER AND SIMPLER PRODUCTION-RUN TESTS WITH NEW DIGITAL READOUT OSCILLOSCOPE



DIGITAL READOUT of time differences to 50 picoseconds.

DIGITAL READOUT of pulse risetimes to one-half nanosecond.

DIGITAL READOUT of pulse amplitudes to 2 millivolts peak-to-peak.

With a Tektronix Readout Oscilloscope you can check production-run units faster and easier—for simultaneously with the analog display on the 5-inch crt, you have a digital presentation on the automatic computing programmer.

You set the program *once* for all successive similar measurements.

For each quality-control check, you merely read the up-to-4-digit decimal units of actual measurement.

Indicators light to designate the readout status—whether *in* the preset-limit range, *below* it, or *above* it.

In a typical application such as transistor-switching-time measurements, you can read directly such characteristics as the delay, rise, storage, and fall times; the total turn-on and turn-off times; the width of pulse A and pulse B; and time and amplitude between two selected points on either or both waveforms. You know immediately by the digital presentation and indicator lights whether or not the item tested has met specifications.

On a production line, in a laboratory, or for sustained testing programs, the digital readout convenience of a Type 567 can speed-up and simplify measurement of pulse amplitudes and time increments between percentages of selected amplitude levels on an *absolute or relative basis*. In addition, you can also measure pulse amplitudes and time increments on differential signals between A and B inputs.

To achieve this faster and simpler approach to precision measurement, the Type 567 incorporates many features *new* to an oscilloscope. In the automatic computing programmer, for example, some of these new features include: positionable measurement-reference zones, automatic normalization, zone-intensity markers, automatic and manual start-timing and stop-timing systems, preset-limit selector and indicators, provision for external programming. These features—and others in the two sampling plug-in units and the oscilloscope itself—enable the new Type 567 to greatly increase your measurement proficiency.

Type 567 Readout Oscilloscope (without plug-ins)	\$ 700
Plug-In Units include:	
Type 3D1 Digital Unit (Automatic Computing Programmer)	\$2500
Type 3S76 Sampling Dual-Trace Unit	\$1100
Type 3777 Sampling Sweep Unit	\$ 650
<small>U.S. Sales Prices, f.o.b. Beaverton, Oregon</small>	

For complete information about the characteristics and capabilities of this new Digital Readout Oscilloscope, please call your Tektronix Field Engineer.

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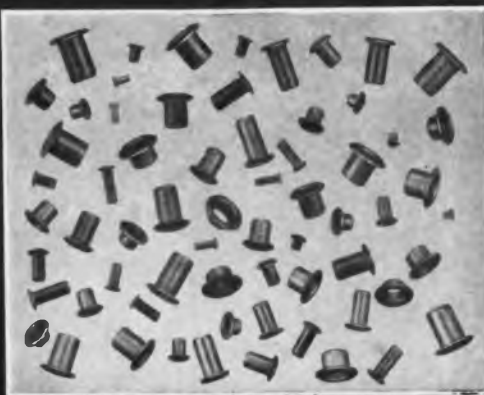
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true measure of
**eyelet
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Installed Cost



* **IC** Installed Cost... not the initial cost of eyelets, but the total cost when the eyelets have been installed in your product.



United's complete lines of Eyelets, Eyeletting Machines and Setting Tools are engineered and produced to work together as a coordinated team. This—plus the uniformly high quality and accuracy of United Eyelets—insures fast, efficient production, with costly jams, stoppages and reworks cut to a minimum. In addition, United's system of Standardized Eyelets (with only 7 sets of tools needed to set all 65 sizes) greatly reduces down-time for tool changes. Delays caused by tooling lead-time are virtually eliminated, because Standardized Eyelets do away with the need for special eyelet sizes and tools.

REDUCED DOWN-TIME!

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Fastener Division

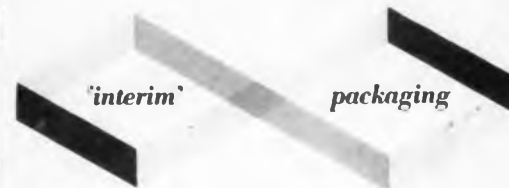
United Eyelets



UNITED SHOE MACHINERY CORPORATION Shelton, Connecticut

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CIRCLE 44 ON READER-SERVICE CARD



ing the whole assembly into an infra-red oven. (The PC boards burned up when this was attempted.)

The oven-soldering was an interesting production innovation in itself. The flexible printed-circuit pads, two per relay, were positioned within the relay with a small ring of solder on each connection and carried through the oven on a moving asbestos belt. Because all of the parts were simultaneously raised to soldering temperatures in this process, Comar said, cold solder joints were completely eliminated and the production rate was increased by 400 per cent. The rejection rate for the relays now is less than 1 per cent.

Life tests showed that the new relays with the flexible Teflon circuits continued to meet the military specification on contact resistance and drop-out rates after 20 million cycles.



Fig. 9. Relays are placed on asbestos conveyor belt which carries them into the oven for automatic soldering. The Teflon in the flexible circuit is able to withstand the temperatures needed for soldering. The first relay in a batch would be soldered in 45 sec and then would be followed by a stream of relays coming through back-to-back.

At Hull:

'Methods in Transition'

ENGINEERS interested in practical avenues for advancing circuit packaging should keep up with the manufacturing methods being used successfully by component producers. The tendency has been for methods first used in making components to be applied later to advancing circuit packaging.

Welding is perhaps the best known example. It has been used for many years for fabricating assemblies inside vacuum tubes and now is giving vigorous competition to soldering for making circuit connections.

But some of the lesser known techniques in component manufacture also should be studied by packaging engineers. Take, for instance, the machine-molding of plastics. One of the newer processes in this field is the epoxy encapsulation of resistors, capacitors and choke coils in transfer-molding machines. Diodes (and even transistors) also are being encapsulated in this manner.

To gain an appreciation of the difficulties faced by an engineer in using transfer-molding techniques for encapsulating circuit assemblies and to learn how to go about designing a circuit for encapsulation by this method, ELECTRONIC DESIGN visited the Hull Corp., Hatboro, Pa.

Here Hull's small model shop was working the bugs out of a fairly large (5-in. diam.) encapsulation of a copper coil. We were told by John Hull, vice president, that a few companies had begun to investigate circuit encapsulation by this method and that it would be justifiable if the demand for a circuit reached 5,000 units within a three-month period.

The process has been made feasible by the development of epoxy molding powders that become "syrup-thin" under heat and thus can be "transferred" under pressure into intricate mold cavities.

The beauty of the method, Mr. Hull says, is that once a production line has been tooled up (the mold costs run from \$300 to \$1,000 for single-cavity molds, to \$5,000 for complicated multiple-cavity molds and the molding machines run in the order of \$7,000), as many as 20,000 to 25,000 parts per week can be encapsulated by a single machine and operator. The costs per unit for small parts, such as diodes and capacitors, can be less than 1¢ as compared to 2¢ each for cup-and-pellet hand potting. ■ ■

Linde *materials & Coatings* News

LINDE COMPANY, DIVISION OF UNION CARBIDE CORPORATION

Polish semiconductors scratch-free with 99.98% pure alumina powders

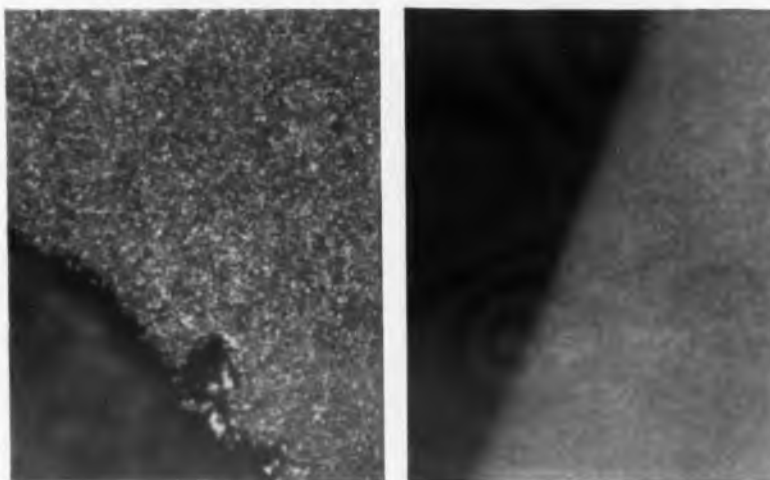


Photo at left: A typical as lapped silicon wafer, showing edge chip, prior to finishing. (Magnified 42X). Right: Complete polishing with LINDE alumina abrasives leaves edge of silicon and wafer scratch-free. (Magnified 144X).

The surfaces of the semiconducting wafers used in the new high-speed mesa switching transistors and planar diodes must have a superior surface finish, flatness, and parallelism—prior to final etching and diffusion. This effect is now being achieved in full production with high-purity alumina abrasives produced by LINDE.

Three particle sizes

Three basic particle size ranges of aluminum oxide powders suitable for polishing silicon and germanium wafers are available for this application, as well as many others. The difference in size and hardness, as listed below, give these 99.98% pure powders their individual properties.

	TYPE 0.3A	TYPE 0.05B	TYPE 1.0C
Formula	Al ₂ O ₃ (Alpha)	Al ₂ O ₃ (Gamma)	Al ₂ O ₃ (Alpha)
Crystal System	Hex.	Cubic	Hex.
Hardness, MOHS'	9	8	9
Size, Microns	0.3	0.05	1.0

Type 1.0C is used to remove stock from surfaces that are rougher than 6 micro-inches rms; Type 0.3A for preliminary polishing, and Type 0.05B for final polishing of the wafers.

In the initial stages of junction transistor or diode production, the powders can be used for preparing metallographic cross-sections of the assemblies according to standard methods on a horizontal polishing wheel. For semiconductors, LINDE has developed several adaptations of standard techniques.

Extremely uniform

LINDE Types A, B, and C alumina powders are chemically prepared and have an extremely uniform ultimate particle size which obviates any further levigation before use. By simple reference to a specific lot number, succeeding production lots can be ordered with abrasive properties tailored to an individual application.

For data on semiconductor and other critical polishing, check the coupon.

Flame-Plated tungsten carbide coatings precision-finished

Tungsten carbide coatings, applied with the LINDE Flame-Plating process, are being used successfully on hundreds of precision parts because the coatings are well suited for finishing down to 1 microinch rms.

Most frequently used precision grinding equipment is diamond wheels, resulting in lowest overall cost on ordinary cylindrical and flat work. On many contour grinding jobs, special grades of silicon carbide wheels will do the job, eliminating the high cost and lack of precision associated with shaped diamond wheels. Diamond-abrasive lapping techniques give high finishes.

Get complete data on Flame-Plating precision parts—send the coupon.

Plasma-Plate process applies thin dielectric coatings

Next time you need a low-cost, thin dielectric coating for cathode cups, consult Linde Company. LINDE's Plasma-Plate process has economically put alumina insulation coatings on molybdenum cups, and has even built structures on mandrels—for example, the grid cage shown below. This inert gas process can apply refractory metals melting up to 7100° C., also metal carbides, borides, and oxides, to a variety of base metals. Discuss your requirements with us. For further information, check and send the coupon.



Tungsten grid cage—intricate structure built up on mandrel using the Plasma-Plate process.

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How to Use SCR's in Power Supplies

Part 2

In the first part (ED, Oct. 11, p 46) the author described what he thinks is a better approach to the design of silicon-controlled rectifier (SCR) power supplies. Now he sets forth the design steps for his circuit.

Albert C. Leenhouts
Transitron Electronic Corp.*
Wakefield, Mass.

IN THE FIRST part of this article, a new way of using silicon-controlled rectifiers (SCR's) in higher-power dc supplies was described. The over-all circuit diagram for this new type of circuit is repeated here (with possible component values) in Fig. 1. The essential feature is that R_{18} and C_{11} provide damping to prevent control loop oscillations, yet that the over-all system be capable of fairly quick response (within a couple of cycles of line) to disturbances.

The design of this type of regulated power

supply starts with the analysis of the main current loop, Fig. 2. A number of assumptions and definitions are made to simplify the analysis:

1. The momentary value of the input voltage will be $E_p \sin \omega t$.

2. During the interval $\pi/2 < \omega t < 3\pi/2$ which will be considered for the analysis, it will be assumed that $\sin \omega t$ can be approximated by the straight line relationship $\pi - \omega t$ (see Fig. 3). Thus

$$e_{in} = E_p (\pi - \omega t) \quad (1)$$

3. The SCR is fired at the moment t_f ($\pi/2 < \omega t_f < \pi$).

4. Assumed are a constant dc output voltage E_{out} , and no losses in transformer, choke, diodes or SCR.

Thus, when current i flows through the primary of the transformer (turns ratio n_1/n_2), the voltage at the primary of the transformer will be clamped to $n_1/n_2 \cdot E_{out}$.

The moment at which the voltage across the inductance, e_L , reaches zero will be named t_o . The value of ωt_o is determined by

$$e_L = 0 \rightarrow \frac{n_1}{n_2} \cdot E_{out} = E_p (\pi - \omega t_o) \quad (2)$$

$$\omega t_o = \pi - \frac{n_1}{n_2} \cdot \frac{E_{out}}{E_p} \quad (3)$$

Further,

$$e_L = L \frac{di}{dt} = E_p (\omega t_o - \omega t) \quad (4)$$

$$\frac{di}{dt} = \frac{E_p}{L} (\omega t_o - \omega t) \quad (5)$$

As $i = 0$ at the time t_f when the SCR is fired,

$$i = \frac{E_p}{L} \int_{t_f}^t (\omega t_o - \omega t) dt \quad (6)$$

$$= \frac{1}{2} \cdot \frac{E_p}{\omega L} (\omega t_f - \omega t) (\omega t - 2\omega t_o + \omega t_f)$$

From Eq. 6, it can be seen that:

$$i > 0 \text{ during the interval } \omega t_f < \omega t < 2\omega t_o - \omega t_f \quad (7)$$

and the SCR continues to conduct.

At the moment $\omega t = 2\omega t_o - \omega t_f$ the current reaches zero and the SCR turns off, ending the current pulse.

The peak current occurs at the moment t_o :

$$i_{peak} = \frac{1}{2} \cdot \frac{E_p}{\omega L} (\omega t_o - \omega t_f)^2 \quad (8)$$

The amount of energy delivered by this pulse into the transformer equals

Design Procedure For SCR Power Supply

1. Determine the turns-ratio of the transformer, based on the maximum output voltage required at the minimum line input voltage.

$$\frac{n_1}{n_2} \cdot \frac{E_{outmax}}{E_{pmin}} = (\pi - \omega t_o) \text{ (using Eq. 2)}$$

$$\frac{n_1}{n_2} = \frac{E_{pmin}}{E_{outmax}} (\pi - \omega t_o)$$

The approximate power rating of the transformer is given by:

$$E_{outmax} \cdot I_{outmax}$$

2. Determine the inductance of the choke, based on the maximum output current and the minimum line input voltage.

$$L = \frac{n_1}{n_2} \cdot \frac{2}{3\pi} \cdot \frac{E_{pmin}}{I_{outmax}} \cdot \frac{(\omega t_o - \omega t_f)^2}{\omega}$$

(From Eq. 12)

3. Determine the peak current through the choke to obtain the maximum current rating of the choke, based on the maximum line input voltage (Using Eq. 8).

$$i_p \text{ (choke)} = 1/2 \cdot \frac{E_{pmax}}{L} (\omega t_o - \omega t_f)^2$$

4. Determine the minimum average current rating of the SCR, based on maximum output current (Using Eq. 14).

$$I_{avg} = \frac{n_2}{n_1} \cdot I_{outmax}$$

5. Select the SCR and diodes D so that their voltage ratings safely exceed E_{pmax} . The current ratings of diodes D is one-half the current rating of the SCR.

6. Select diodes D so that their average current rating exceeds I_{outmax} , at a piv safely exceeding E_{outmax} .

7. Determine the value of C_F to obtain your desired ripple percentage at minimum E_{out} and maximum I_{out} , assuming momentary recharge every half-cycle with a continuous discharge between recharge periods. Thus a good safety margin is obtained and as electrolytic capacitors lose some capacitance during their lifetimes, this is no luxury.

8. Determine experimentally R_{18} and C_{11} .

*Now with HI-G Inc., Bradley Field, Windsor Locks, Conn.

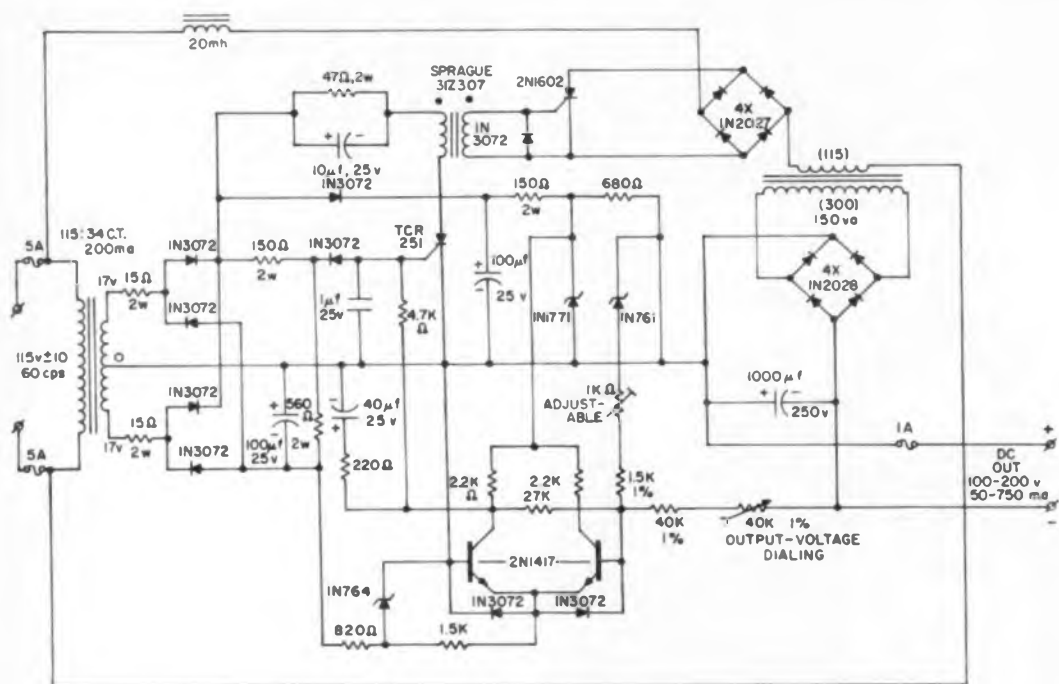


Fig. 1. Over-all circuit for new type of SCR regulated power supply. The component values are for the design example in the text.

$$\begin{aligned} & \frac{n_1}{n_2} \cdot E_{OUT} \int_{t_F}^{2t_o - t_F} idt \\ &= \frac{n_1}{n_2} \cdot E_{OUT} \cdot \frac{1}{2} \cdot \frac{E_F}{\omega L} \\ & \int_{t_F}^{2t_o - t_F} (\omega t_F - \omega t)(\omega t - 2\omega t_o + \omega t_F) dt \\ &= \frac{2}{3} \cdot \frac{n_1}{n_2} \cdot E_{OUT} \cdot \frac{E_F}{\omega L} \frac{1}{\omega} (\omega t_o - \omega t_F)^3 \quad (9) \end{aligned}$$

As the SCR operates in a full-wave ac circuit, ω/π pulses occur per second. The ideal energy delivered into the transformer is:

$$\frac{2}{3\pi} \cdot \frac{n_1}{n_2} \cdot E_{OUT} \cdot \frac{E_F}{\omega L} (\omega t_o - \omega t_F)^3 \quad (10)$$

By the law of conservation of energy, this must equal the power dissipated in the load:

$$\frac{2}{3\pi} \cdot \frac{n_1}{n_2} \cdot E_{OUT} \cdot \frac{E_F}{\omega L} (\omega t_o - \omega t_F)^3 = E_{OUT} \cdot I_{OUT} \quad (11)$$

$$\rightarrow I_{OUT} = \frac{n_1}{n_2} \cdot \frac{2}{3\pi} \cdot \frac{E_F}{\omega L} (\omega t_o - \omega t_F)^3 \quad (12)$$

From Eq. (3) and (12) it can be seen that the firing angle ωt_F of the SCR, required to maintain a given E_{OUT} and I_{OUT} , is determined by the addition of two intervals. The first interval $(\pi - \omega t_o)$ is determined by E_{OUT} , the second interval $(\omega t_o - \omega t_F)$ by I_{OUT} .

ωt_F can be rewritten as $\pi - [(\pi - \omega t_o) + (\omega t_o - \omega t_F)]$ or:

$$\omega t_F = \pi - [F_1(E_{OUT}) + F_2(I_{OUT})] \quad (13)$$

Finally, the average current through the SCR is given by

$$I_{AVG} = \frac{n_2}{n_1} \cdot I_{OUT} \quad (14)$$

In a practical design, the range of line in-

put voltages, line frequency, maximum output current, and maximum output voltage is given, resulting in well-determined values for E_F , ω , I_{OUT} and E_{OUT} . Therefore the designer's decisions are directed towards $(\omega t_o - \omega t_F)$ and $(\pi - \omega t_o)$. From Eq. (2) it can be seen that a small value of $(\pi - \omega t_o)$ results in a high ratio n_2/n_1 of the transformer and thus, according to Eq. (14), to a high average current through the SCR. A value of $(\pi - \omega t_o)$ between $\pi/8$ and $\pi/4$ has proved practical.

From Eq. (7) it can be seen that the duration of each current pulse equals $2(\omega t_o - \omega t_F)$. To make proper use of the SCR's current rating under full-load conditions, an on-off ratio of at least 50 per cent is necessary, resulting in a minimum theoretical value for $(\omega t_o - \omega t_F)$ of $\pi/4$. An actual circuit, with component values based on $(\omega t_o - \omega t_F) = \pi/4$ will show an on-off ratio of approximately 60 per cent, which is very acceptable. The difference between the theoretical 50 per cent and the actual value is due to the losses, especially in the transformer, which were neglected in the analysis.

Once values for $(\pi - \omega t_o)$ and $(\omega t_o - \omega t_F)$ are chosen, the design procedure is after the eight steps given in the box on p 52. A design example will now be given based on these steps.

Design Example Illustrates the Eight Design Steps

A power supply is required to deliver 100 to 200 v (adjustable) dc at load currents between 0.05 and 0.75 amp. The input voltage will vary between 105 and 125 v; the frequency of the input is 60 cps. A ripple of 2

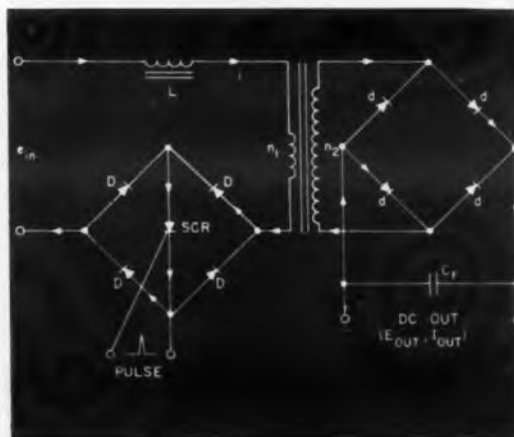


Fig. 2. Main current loop is that portion of the total regulating loop where the designer must start his efforts to tailor the circuit to his needs.

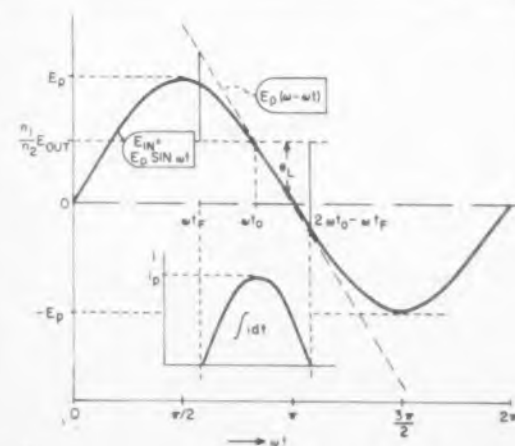


Fig. 3. Voltages and current in main current loop portion of total loop showing how a straight line approximation, $E_F (\pi - \omega t)$ can be made for sine curve.

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IN THE GREATER NEW YORK AREA... Helipot, Mountainside, New Jersey. Phone from New York City and Long Island: Barclay 7-9891. Phone from northern New Jersey: ADams 2-7600. Teletype: WSFD nj 68.

IN THE GREATER LOS ANGELES AREA... Servomotor Sales Department, Helipot, Fullerton, California. Phone: TROjan 1-4848. Teletype: FULLERTON CAL 5210.

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INSTRUMENTS, INC

HELIPOT DIVISION

Fullerton, California - Mountainside, New Jersey
POTS: MOTORS; MCTERS



		Size 5 Servomotor Model 9005-1502-0	Size 5 Servomotor Damping Generator Model 9005-1102-0	Size 8 Servomotor Model 9008-1501-0	Size 8 Servomotor Model 9008-1502-0	Size 8 Velocity- Damp Servomotor Model 9008-1301-0	Size 8 Servomotor Damping Generator Model 9008-1101-0	Size 11 Servomotor Model 9011-1501-0	Size 11 Velocity- Damp Servomotor Model 9011-1301-0	Size 11 Servomotor Damping Generator Model 9011-1101-0	Size 11 Servomotor Damping Generator Model 9011-1102-0
Excitation	Fixed Phase	26v	26v	26v	115v	26v	26v	115v	115v	115v	115v
400 cycles	Control Phase	33v	33v	53/16.5v	33/16.5v	33/16.5v	33/16.5v	40/20v	40/20v	40/20v	40/20v
Length, inches		0.865	1.565	0.840	1.165	1.332	1.350	1.340	1.915	2.049	2.552
No-load speed, RPM		10,000	10,000	6,000	6,000	5,000	6,000	6,000	5,300	6,000	5,900
Torque at stall, oz. in. (nominal)		0.1	0.1	0.22	0.33	0.22	0.22	0.6	0.6	0.6	0.6
Acceleration at stall, rad/sec ²		50,000	37,000	86,500	86,500	33,800	67,800	41,500	26,500	38,500	34,200
PRICE, single unit		\$200.00	\$300.00	\$75.00	\$80.00	\$120.00	\$125.00	\$75.00	\$125.00	\$130.00	\$135.00

CIRCLE 46 ON READER-SERVICE CARD

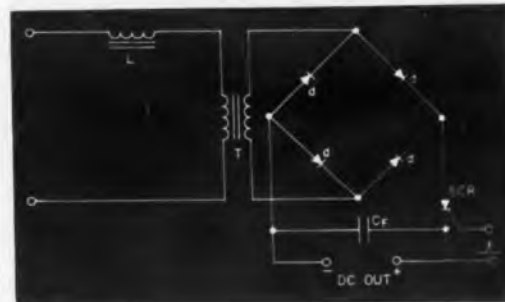


Fig. 4. Alternate main current loop arrangement which economizes on diodes. It is possible only if output dc voltages are less than seven-tenths of the rms line voltage.

per cent is specified, along with a better than 1 per cent regulation.

Based on the previously mentioned factors, the designer chooses a $(\pi - \omega t_o)$ of $\pi/6$. Therefore $(\omega t_o - \omega t_f) = \pi/4$. The rest of the design follows the eight steps outlined in the box.

$$1. \frac{n_1}{n_2} = \frac{105\sqrt{2}}{200} \cdot \frac{\pi}{6} \approx \frac{115}{300}$$

Rating of the transformer: $200 \times 0.75 = 150$ va

$$2. L = \frac{115}{300} \cdot \frac{2}{3\pi} \cdot \frac{105\sqrt{2}}{0.75} \cdot \frac{\pi^3}{4} \cdot \frac{1}{2\pi \cdot 60} \approx 20 \text{ mh}$$

$$3. i_f \text{ choke} = \frac{1}{2} \cdot \frac{125\sqrt{2}}{2\pi \cdot 60 \cdot 20 \cdot 10} \cdot \frac{\pi^2}{16} = 7.2 \text{ amp}$$

$$4. I_{AV} = \frac{300}{115} \cdot 0.75 = 2 \text{ amp, current}$$

rating of SCR > 2 amp

5. Minimum voltage rating of SCR: $125\sqrt{2}$
(A possible SCR then would be 2N1602)

5a. Voltage rating for diodes $D = 200$ v
Current rating for diodes $D = 1$ amp
(Type 1N2027 satisfies these requirements)

6. Diodes d must be rated at 300 v and 750 ma.

(Type 1N2028 satisfies these requirements)

7. For 2 per cent, rms of 100 v ≈ 5.6 v peak-to-peak

$$\frac{I_{OT} \cdot T_{discharge}}{C_F} < 5.6 \text{ v} \rightarrow \frac{0.75 \cdot 8.3 \cdot 10^{-3}}{C_F} < 5.6$$

$$\rightarrow C_F > \frac{0.75 \cdot 8.3 \cdot 10^{-3}}{5.6} \rightarrow C_F > 1,100 \mu\text{f}$$

8. When the supply was built it was found that the minimum value of C_{11} was approximately 20 μf . The range of R_{18} , for stable operation over the full input

voltage, output voltage and output current range, extended rapidly for capacitance increases going from 80 ohms to 400 ohms at 40 μ f. Further increases at greater capacitance values proved to be insignificant. Thus *C11* was chosen at 40 μ f, and *R18* in the middle of its range at 220 ohms.

A ripple of 1.2 per cent was measured at 100 v, 750-ma load, and the filter capacitor was therefore reduced to 1,000 μ f — 250 v. The complete values for the final circuit are shown in Fig. 1.

Test Results Showed Example More than Met Specs

The supply met its specifications. While in the lower output range the regulation was well within ± 1 per cent, it was 1.2 v off at 200 v, 0.75 amp at a 105-v line input voltage. The actual currents and voltages in the main current loop were very close to calculated values:

	Calculated	Actual
$i_{p\text{max}}$ choke, SCR	7.2 amp	6.5 amp
I_{AVO} (SCR)	2.0 amp	2.0 amp
on/off ratio, SCR, at full load	50%	60%

Further increase of load current or decrease of line voltage resulted in rapid decrease of the output voltage.

The response times for load variations less than ± 50 per cent and line voltage variations between 105 and 125 v were in the order of 25 msec. Total efficiency was measured as 79.5 per cent under maximum load conditions.

Short circuit protection for this type of regulator can be obtained with normal fuses in input or output lines, as all fault currents through current-sensitive devices are limited by the presence of the choke in the primary circuit.

When complete automatic short circuit protection is required, two ways are available. The first is to rate all components vulnerable to currents at the maximum fault currents, particularly *L*, the SCR, and diodes *D* and *d*. The second, and more usual, way is to add electronic circuitry to the feedback system to provide quick turn-off of the supply when a short or overload occurs.

If lower output voltages had been required ($< 0.7 E_{(line\ rms)}$), a main current loop as shown in Fig. 4 can eliminate four rectifiers. As the basic operation and performance remain the same, the choice between the arrangements of Fig. 2 and 4 is merely a question of economy. ■ ■



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CIRCLE 47 ON READER-SERVICE CARD

...variations
on a
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POWER



BR-12P (case removed)

In one versatile new BR-12 micro-miniature series, Babcock offers relay types suitable to a wide range of novel uses in extreme environments. The BR-12P is an especial boon to those designing for both sides of the component card due to low profile and side header mounting arrangement. A second type, the BR-12K, provides sensitivity down to 20 mw. Both types have contacts rated at dry circuit through 3 amps resistive.

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BR-12

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to 50g on special units.

Shock: Standard, 75g or special, 125g.

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Note: All Babcock Relays are checked out for
leakage rate of 10⁻⁶ cc per second
on mass spectrometer

BABCOCK RELAYS, INC.

1645 Babcock Avenue
Costa Mesa, California

CIRCLE 48 ON READER-SERVICE CARD

PRODUCT FEATURES

Fluid-Sphere Gyro Has High Sensitivity

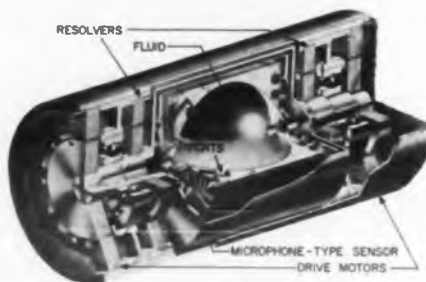
A RADICAL departure from conventional gyro design has resulted in a device that can detect motion too minute to be measured. The miniature gyro's unique sensing ability makes it especially suitable for stabilizing

space platforms, carrying extremely delicate equipment.

The new space-system component, according to the manufacturer, Sperry Gyroscope Co., Great Neck, L. I., N. Y., is a fluid-sphere gyroscope, called the SYG-2000. It has a sensitivity believed to be as low as 1/100 of a sec of arc.

The heart of the mechanism is a spinning mass of liquid, confined within a hollow sphere.

In operation a cylinder is constantly rotated by two hysteresis motors at either end. Inside this cylinder is the hollow sphere filled with silicon fluid. Any angular motion of the rotor from this axis produces variations in



Vacuum System Is Automated

SEQUENCING of valves for vacuum processing has been automated. With an air-operated, solenoid-controlled bellows sealing valve, the 401 series of 4-in. vacuum systems has all the advantages of an automated system without loss of the quality and versatility associated with manual systems.

Vacuum Electronics Corp., Terminal Drive, Plainview, L. I., N. Y., has introduced a series of 4-in. vacuum systems that are modular in construction. They are available individually, in groups or as a complete system.

The automatic station achieves pump down to 5 x 10⁻⁶ mm Hg in less than 35 sec with a blanked port. Ultimate pressure is less than 5 x 10⁻⁷ mm



pressure between the fluid and the cavity wall. Pressure is sensed by a series of diaphragms buried in the rotor-cavity assembly. Pressure variations force the diaphragms to oscillate at an amplitude proportional to the angular displacement between the rotor and fluid axes. The diaphragms act as elements of a miniature microphone to convert pressure variations into electrical signals.

The two-axis SYG-2000 contains fewer than half the number of parts required by a conventional gyro. Anisoelectric drift is 0.003 deg per hr per g^2 .

The tolerance requirements for the fluid-containing sphere are so lax that Sperry is able to use an investment casting without further machining.

The unit can be delivered in five to six months at less than \$2,000. For further information on this low-cost, high-sensitivity gyro turn to the Reader-Service Card and circle 250.

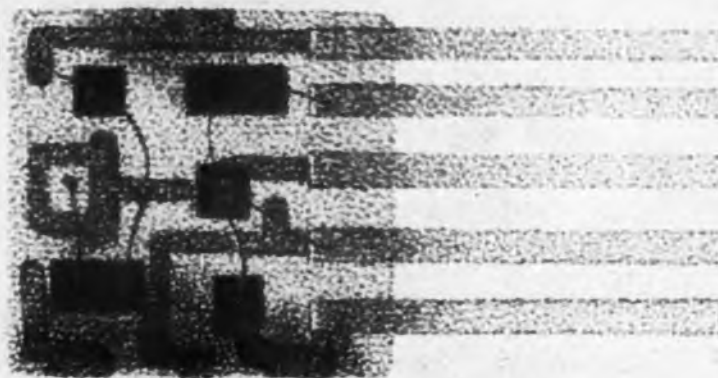
Fig. The complete cycle is controlled by two push buttons. A start button initiates the roughing cycle. Upon reaching a predetermined pressure setting, a Veeco type "TC" controller automatically switches the valves from roughing to high-vacuum position.

After completing a process, the second, or stop button, is pressed to vent the system automatically in preparation for the next cycle. An automatic bell-jar lift is incorporated in the circuit. After the stop button is depressed, the bell-jar vents and lifts, ready for reloading and recycling.

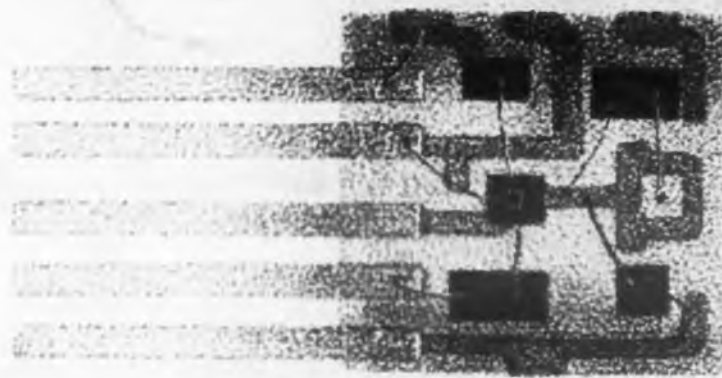
The 401 series is being offered at prices up to \$8,000 with delivery of two to four months. For further information on this automated vacuum system, turn to the Reader-Service Card and circle 251.

CIRCLE 49 ON READER-SERVICE CARD >

Flip



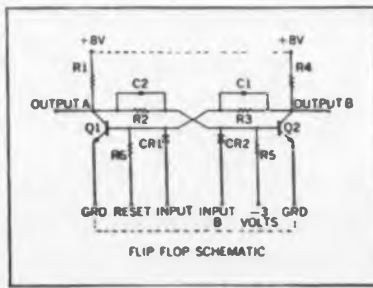
These magnified halves when combined in this actual size Flip Flop  contain 2 transistors, 2 diodes, 6 resistors, and 2 capacitors



Flop

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Source for Silicon Nanocircuits. Now you can design military and industrial computer circuits with high-speed, silicon Nanocircuits whose substrates measure as little as 0.17 x 0.17 inches. Latest example of General Instrument's Nanocircuit Program, these new flip-flops utilize matched pairs of semiconductors and operate at speeds in the nanosecond range. The flip-flop shown, typical of the many configurations available, consists of two planar epitaxial transistors, two microdiodes, six semiconductor resistors and two silicon oxide capacitors. ■ Silicon Nanocircuits need no encapsulation. Each compo-



nent (preselected and pretested for reliability prior to bonding to the substrate) is passivated by General Instrument's unique Molecular Shield™ process. Nanocircuits are unaffected by external ambients. The coating serves only to provide mechanical rigidity. ■ Complete details on all Nanocircuits and other General Instrument semiconductor devices to meet your specific requirements, are available at the General Instrument engineering sales office or franchised distributor nearest you, call or write today. General Instrument Semiconductor Division, 65 Gouverneur Street, Newark 4, New Jersey.

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PRODUCT FEATURES

Multiplier Phototubes

With spectral response ranging from S 11 to S 20, multiplier phototubes are being offered for applications ranging from star-tracking to underground geological explorations. Presented here for your information are three types recently announced.

Multiplier Phototube Has "Venetian-Blind" Dynode Structure 252



The large photocathode area in the 5-in. multiplier phototube RCA-8055 makes it suitable for applications requiring good photon collection from distant or diffuse radiation sources. The 10-stage, head-on type tube utilizes a "venetian-blind" dynode structure. Spectral response of S-11 covers the range of 3,000 to 6,500 Å. Maximum response occurs in the blue region at approximately 4,400 Å. Design of the tube includes: a semitransparent photocathode having a minimum useful diam of 4.38 in.; a first dynode having large area; a flat window to facilitate the mounting of flat scintillators and 10 dynode (secondary emitter) stages.

Radio Corp. of America, Dept. ED, 30 Rockefeller Plaza, New York 20, N. Y.
P&A: \$195; from stock.

Multiplier Phototubes Have High White Light Sensitivity 253



High sensitivity to the white light spectrum is obtained by the application of tri-alkali photo surfaces to a broad line of multiplier phototubes. Tube diameters range from 1-1/4 to 5 in. The 2-in. K 1927, the 3-in. K 2167 and the 5-in. K 2173 have a typical spectral response of S 20. Peak sensitivity is approximately 4,200 A with 50% of peak response maintained at 7,000 Å in the red portion of the spectrum. Particular applications for the tubes lie in the fields of star tracking, missile tracking and satellite tracking. Specifications and operating characteristics include cathode sensitivity in the range of 120 to 150 μ a per lumen, with current amplification factors between 200,000 and 300,000 at 1,800 v. Anode dark current at 150 v per stage is 0.03 μ a.

Fairchild Camera and Instrument Corp., Allen B. Du Mont Laboratories, Electron Tube Div., Dept. ED, 750 Bloomfield Ave., Clifton, N. J.
P&A: K 1927, \$375; 4 to 6 weeks.



Photomultiplier For Severe Environments 254

The ruggedized construction of the WX 4582 3/4-in. photomultiplier tube makes it suited for underground geological explorations. Flexible leads in polyvinyl-chloride sleeves are potted with silastic to permit the tube to be soldered directly into the circuit and yet insure against electrical leakage paths. The photocathode of the tube has an S-11 spectral response, peaking at 4,400 Å. With 105 v applied per stage, the average anode sensitivity is 9 amp per lumen and the cathode sensitivity is 50 μ a per lumen. Dark current under these conditions is generally less than 0.01 μ a. The tube also has applications in portable scintillation counters, industrial computers and punch-card sorting.

Westinghouse Electric Corp.,
Electronic Tube Div., Dept. ED,
Elmira, N. Y.

P&A: on request; immediate.

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Voltage Regulator Tube Maintains Stable Voltage

255

Voltage is held constant within ± 2 v throughout its ambient temperature range of -65 to $+400$ C by the ZR-7501 ceramic voltage regulator tube. The tube operates at a design point of 103 v over a current range of 5 to 100 ma. Its dc starting voltage is 150 v max. The two-electrode, cold cathode tube weighs 0.4 oz, is 0.7 in. in diam and 0.75 in. long. It has a vibration-proof mounting that provides insulation of 1,500 v to ground.

General Electric Co., Power Tube Dept., Dept. ED, Schenectady 5, N. Y.

P&A: \$132; from stock.

Phase-Lock Discriminator 256 Utilizes Phase Coherent Detection

The advantages of phase coherent detection are utilized in the phase-lock discriminator model 0447. Tracking loop and output filter parameters are closely controlled by a pluggable selector, in several percentages of the total IRIG bandwidth for each channel.

The Siegler Corp., Hallamore Electronics Div., Dept. ED, 714 N. Brookhurst St., Anaheim, Calif.

P&A: \$1,195; 45 days.



Three Dimensional Antenna Contour Plotter

257

Three dimensional antenna contour plotter model ACP 1 maps angle and amplitude coordinates in the new IRIG format. Used with the company's automatic positioner programmer and two-axis positioner a complete contour plot can be made by "raster scanning" over the sphere of radiation of an antenna missile or scale model of an airframe. Contour increments are selectable, 1, 2 or 3 db. The unit also records antenna patterns.

Scientific-Atlanta, Inc., Dept. ED, 2162 Piedmont Road, N.E., Atlanta 9, Ga.

P&A: \$7,200; 60 to 90 days.



Voltmeter Has Full Scale DC Ranges 258 Of $\pm 0.1 \mu\text{V}$ To $\pm 100 \text{ MV}$

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Astrodata, Inc., Dept. ED, 240 E. Palais Road, Anaheim, Calif.

P&A: 8825; 30 to 45 days.



DC Power Supplies Employ "On-Off" Regulation

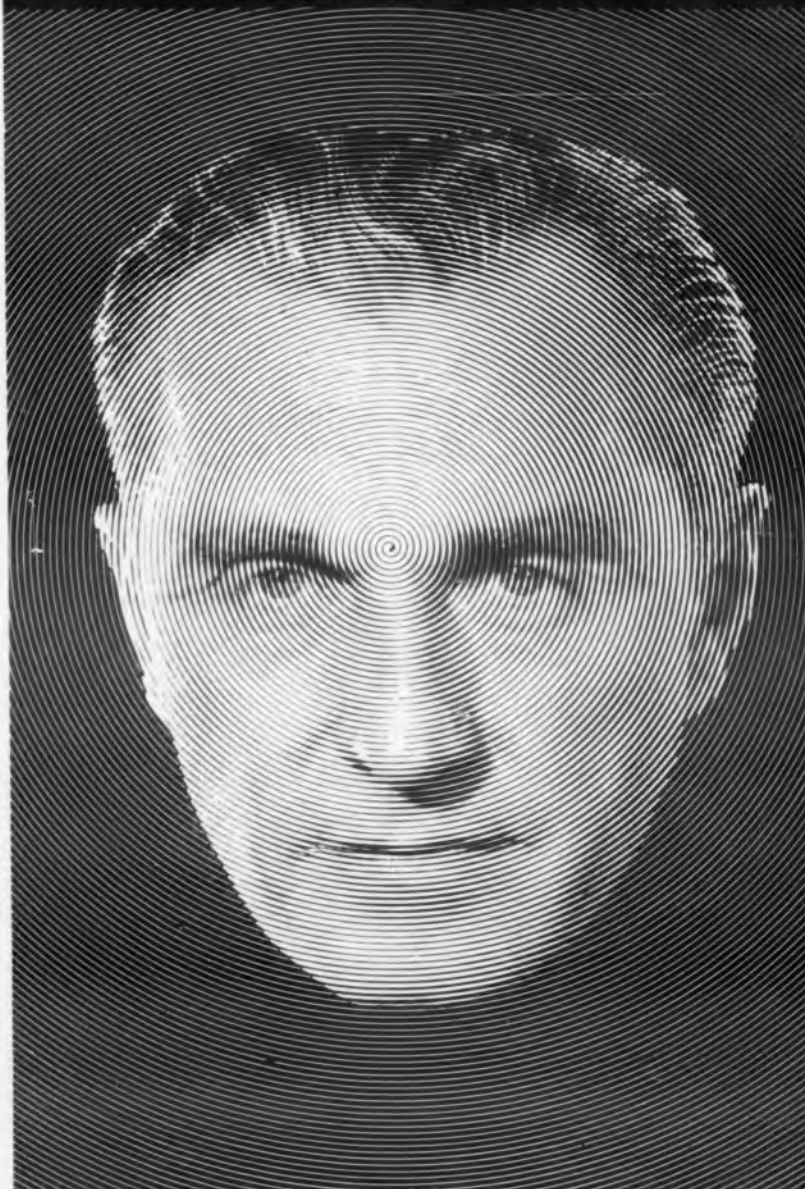
259

High current, transistorized dc power supplies, series SP employ an "on-off" type voltage regulation circuit. The voltage regulation circuitry is responsive to the power demand of the load and varies the duty cycle to match the demand. A pulse averaging circuit maintains constant voltage output so that the effect of the "on-off" regulation is removed prior to the output terminals. Line regulation is 100 mv from no-load to full-rated load. Ripple is 35 mv rms.

Consolidated Avionics Corp., Dept. ED, 800 Shames Drive, Westbury, N. Y.

P&A: from \$450 to \$1,125; stock to 8 weeks.

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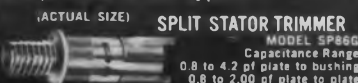
These two versatile solid dielectric JFD trimmers provide excellent stability...extreme compactness... resist shock and vibration. Both employ the superior JFD rotating piston with patented telescoping adjust mechanism and anti-backlash assembly.

Result: velvet-smooth ultra linear tuning...much more capacitance per unit volume...and JFD trouble-free patented design simplicity adds to your product's reliability.

Write today for complete trimmer catalog C-61 or contact your local JFD field office. Quantities up to 299 pieces of one model are available from your local JFD franchised Industrial Distributor for fast, off-the-shelf delivery.



Features capacity that increases in one gang as capacity decreases in the other gang. The sum of the capacitance of both gangs remains constant in the peak-to-peak area of the tuning curve. Low expansion invar and precision bore glass provides increased stability across a wide operating temperature range (from -55°C . to $+125^{\circ}\text{C}$.) 35 standard models available in panel mount and printed circuit types.



Features balanced electrode construction ideally suited for push-pull radio frequencies circuits, and similar networks where physical size is limited. When tuning, capacitance varies simultaneously from each plate to bushing, as well as plate to plate. 25 standard models are available in panel mount and printed circuit types.

Sliding piston differentials or split stators can be designed for use with cam or motor driven mechanisms. For these modifications or any special design to your requirements, please get in touch with one of our sales engineering offices or one of our 25 sales representative's organizations.

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CIRCLE 52 ON READER-SERVICE CARD

New Products Directory

A complete index of all new products contained in this issue of ELECTRONIC DESIGN, including page and reader-service numbers.

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plotting board	120	612
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Amperex® announces a new twin-tetrode...type 7854...



for special mobile VHF/UHF transmitter applications which require 50% greater plate dissipation than the renowned Amperex 5894

With exceptional reliability assured by unique ratings for both heat sink and forced-air operation, the new Amperex 7854 is applicable for either mobile or base station applications.

The 7854 is designed to assure unrivalled performance as an RF power amplifier, oscillator, modulator and frequency multiplier in land-based and airborne VHF and UHF transmitting equipment – for amateur, professional, military and police.

Typical Operation—Class C Push-Pull RF Power Amplifier and Oscillator

	FORCED AIR ICAS	HEAT SINK ICAS
D.C. Plate Voltage	1000 volts	760 volts
D.C. Grid No. 2 Voltage.	262 volts	260 volts
D.C. Grid No. 1 Voltage		
Fixed or from common resistor of	2x30 K ohms	2x30 K ohms
D.C. Plate Current2x120 ma	.2x120 ma
D.C. Grid No. 1 Current.	5.7 ma	5.5 ma
Driving Power	3.5 watts	3.5 watts
Power Output163 watts	.123 watts
Frequency175 Mc	.175 Mc

Category	p	rsn
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In Canada: Philips Electronics Industries, Ltd., Tube, Semiconductor & Component Depts., 116 Vanderhool Avenue, Toronto 17, Ontario

NEW PRODUCTS

Current Regulator

577



Polar, two terminal device regulates current with a voltage applied. Operating voltage range is 10 to 28 v. Twelve types of regulators are designated KI series and have regulation of $\pm 5\%$ at 70 F and 20 v. Units are potted in a rugged miniature package.

Grafix Co., Dept. ED, 2841 San Mateo Blvd. N. E., Albuquerque, N. M.

Price: 1 to 9, \$18.00 ea.

Line Insulation Foam

647



High-temperature insulating foam can operate continuously at 2,000 F. Called Eccofoam SI, the material is 95 percent silica and has a fine grained structure with cells less than 100 microns in diameter. It can be glazed to form a waterproof, hermetically-sealed foam. Microwave dielectric constant is 1.8. The material, rugged and readily machined, is available in 6 x 6 x 1/8 in. sheets.

Emerson and Cuming, Inc., Dept. ED, Canton, Mass.

Pressure Transducer

628



Dynamic pressure transducer model 176 provides high frequency response on pressure ranges from 0 to 300 to 10,000 psig. Exposed parts are stainless steel. Linearity deviation is less than 0.25 percent. Unit may be used with either constant voltage or constant current system.

Taber Instrument Corp., Dept. ED, 107 Goundry St., North Tonawanda, N. Y.

Remote Control System

627



Wireless remote control of four independent functions can be accomplished with this ultrasonic system. Control can be achieved with up to 30 ft separation. Transistor system consists of a hand-held 40-kc transmitter and a compact receiver.

RMS Associates, Inc., Dept. ED, 805 Mamaroneck Ave., Mamaroneck, N. Y.

P&A: \$125; 15 days.

Navigation Equipment

565



Smaller weight, size and power consumption are featured in two new pieces of airborne navigation equipment. The 51Z-3 Marker Beacon and the 51V-4 Glidescope Receiver both have solid-state design. Model 51Z-3 is for general aviation use, has no moving parts and weighs 2.9 lbs. Model 51V-4 covers 20 channels with no moving parts and weighs only 3.5 lbs.

Collins Radio Co., Dept. ED, P. O. Box 1891, Dallas 21, Tex.

Wire Stripper

656



Thermal wire stripper model G-1 is claimed to be the smallest one commercially available. The tweezer strippers are 1/4 x 1/4 x 5 in. for easy access to difficult locations. They can strip wire from No. 16 to No. 40 with no adjustments.

Western Electronic Products Co., Dept. ED, 2420 N. Lake Ave., Altadena, Calif.

P&A: \$74.50; immediately.

Static Switch

597



This 40-w magnetic static switch is suited for use where a solenoid must be switched on-off in continuous use. It functions at 600 on-off cycles per min; turn off time is 5 cycles, while on time is one cycle. Output is 0.4 amp at 100 v ac.

Magnetics Inc., Dept. ED, Butler, Pa.
P&A: \$17.00, 1 to 9; stock.

High-Gain Amplifier

546

For data handling systems, model 3PA6D amplifier has a maximum output range of ± 10 v. Power requirements are -12 v and $+12$ v at 10 ma each. The emitter follower output stage can be connected either in phase or out of phase with the input; with feedback brought back to the input, giving a low input impedance; or to the opposite side of the first stage difference amplifier, giving a high input impedance.

Navigation Computer Corp., Dept. ED, Valley Forge Industrial Park, Norristown, Pa.

Silicone Rubber

648

Suitable for molding, extruding or calendaring, Silastic 241U may be used from -80 to $+500$ F. Manufacturer claims good flexibility and physical strength after long exposure to temperatures in this range, as well as good electrical properties and low compression set. This compound meets mil spec.

Dow Corning Corp., Dept. ED, Midland, Mich.

Printed-Circuit Frame

366



Exposure time is cut in half by this printed-circuit exposure frame. One or two sides of a laminate may be exposed at once. It will take laminates up to 20 x 25 x 1/2 in. and both sides may be viewed after contact.

Colwell Litho Products, Inc., Dept. ED, 123 N. Third St., Minneapolis, Minn.

Electronic Gages

655



Measure to 0.000002 in. Transistorized electronic gages include bench comparators, dice thickness gages, and height gages. They are available for use with 110 v ac or self-contained battery.

Techni-Rite Electronics, Inc., Dept. ED, 61 Centerville Road, Warwick, R. I.

Ceramic Rectifiers

566



Three-amp ceramic stud rectifiers and 10-w Zener regulators make up the Slim-Silhouette series. These devices use 1/3 of the above-chassis area in conventional designs. Due to high-temperature, hydrogen brazing and soldering, the units are said to be unaffected by environmental conditions. They are available with piv from 50 to 1,200 v and tolerances of 2, 5, and 10%.

Argyle Electronics Corp., Dept. ED, Argyle, N. Y.

RF Filters

569



Have central point multi-circuit rf filtering. This single package contains all the necessary rf filters needed for power lines, lighting circuits, communications lines at missile sites and other applications. Units handling up to 1,000 circuits are now in use, but there is no limit to size or number of circuits.

Filtron Co., Inc., Dept. ED, 131-15 Fowler Ave., Flushing, N. Y.

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available

on many

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TERMINALS

Never before has a glass been developed that is so compatible for use with 52% nickel alloy leads.

The result is a compression between the glass and pins so tight that twisting and bending of the pins to the breaking point will not cause rupture or leakage. (Determined by Veeco Leak Detector with sensitivity at 10^{-10} std. cc/sec.) Thermal shock is excellent with this new TR-Glass. Salt spray resistance exceeds 100 hours.

Every performance feature is well in excess of Mil Specs. The use of TR-Glass may be considered for all types of Fusite solid glass headers as well as many other style terminals.

Samples on request. Write Fusite, Department C-6



Fusite Corporation, Cincinnati, O.
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CIRCLE 54 ON READER-SERVICE CARD

Globe's basic high quality motors are designed hysteresis-synchronous and induction in various stack lengths. Our a.c. motors span the torque spectrum through 10 oz. in. at synchronous speed (induction torques are 50% higher). New frame sizes of 1/2" and 2 1/2" dia. are coming. Units are for 60, 400 cycles, variable frequency, very high cycle, or special square wave power. Our d. c. motors span the same performance and size range.

We furnish gearmotors—using standard odd or even ratio gear reducers—providing the exact speed-torque output

you need in one compact package. This is the most efficient way to meet your requirements from the standpoints of good design, reasonable cost, undivided responsibility. Many available for immediate prototype delivery.

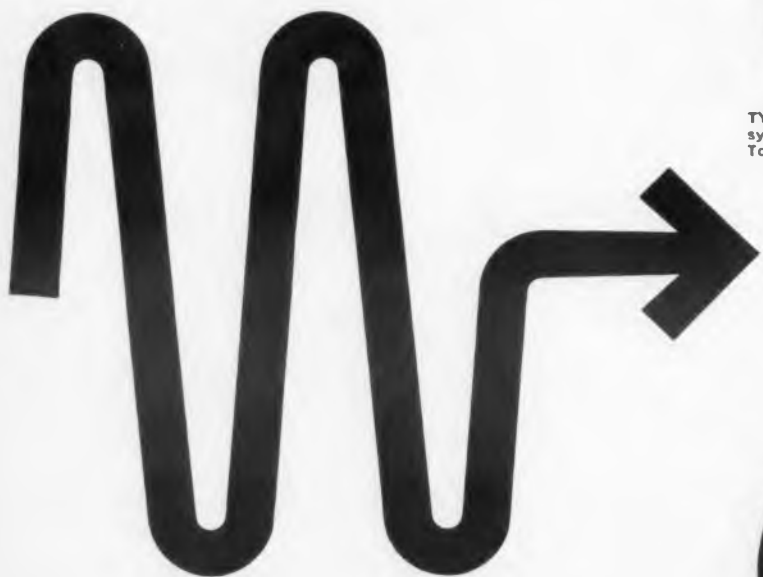
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TYPE SC Sub-miniature motor rated .15 oz. in. max. sync. torque. Size: 1.07" dia. x 1.32" long. 2.4 oz. To 200 v. a. c. 2, 4, or 6 poles. 49 std. gear ratios.



TYPE MC Miniature motor rated 0.8 oz. in. max. sync. torque. Size: 1 1/4" dia. x 2 1/4" long. 6.5 oz. To 200 v. a. c. 2, 4, or 6 poles. 101 std. gear ratios.



TYPE FC Small motor rated 1.6 oz. in. max. sync. torque. Size: 1 1/2" dia. x 2 1/2" long. 13.4 oz. To 200 v. a. c. 2, 4, or 6 poles. 101 std. gear ratios.



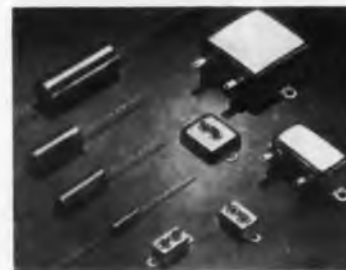
TYPE LC Small motor rated 10 oz. in. max. sync. torque. Size: 3 3/4" dia. x 3 3/4" long. 53 oz. To 200 v. a. c. 2, 4, or 6 poles. Gearing to order.

CIRCLE 55 ON READER-SERVICE CARD

NEW PRODUCTS

Mylar Capacitors

658



Metallized mylar capacitors are made in bath-tub and tubular types. Ratings range from 100 to 600 wvdc, 0.1 to 35 μ f, 125 and 150 C operation. The layer-wound units are claimed to have the capacity and voltage ratings of standard types five times as large.

The Potter Co., Dept. ED, 7351 Lawndale, Skokie, Ill.

Selenium Diodes

567



Six cell sizes are available in selenium Thyrector diodes. Reverse break-down characteristic enables the device to suppress transient voltages. Units range from 9/32 in. diam to 5 x 6 in. plates. Steady-state ratings are from 30 v rms to 500 v rms, in stacks.

General Electric Corp., Rectifier Components Dept., Dept. ED, Carroll Ave., Lynchburg, Va.

Molded Chokes

657



Color-coded, fixed inductance rf chokes have good self resonant frequency and current carrying capacity. Units are encapsulated in epoxy resin for mechanical stability and environmental protection. The 2960 series meets MIL-L-LT-7K and range from 0.15 μ h to 27.0 μ h.

Cambridge Thermionic Corp., Dept. ED, 445 Concord Ave., Cambridge 38, Mass.

Price: \$0.51 to \$0.54 from 100 to 249.



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Griggs Midway Bldg.
1821 University Ave. MIDway 6-1891

SAN DIEGO, California
3620 30th St. CYpress 7-3708

SAN FRANCISCO, California
535 Middlefield Rd.
Palo Alto, Calif. DAvenport 1-2064

SEATTLE, Washington
3466 East Marginal Way South. MAIn 4-0783

SYRACUSE, New York
2360 James St. HOWard 3-4502

WINSTON-SALEM, North Carolina
Nissen Building
310 W. Fourth St. PArk 3-0363

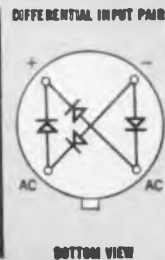
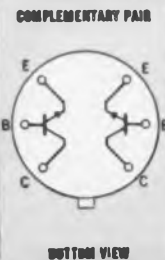
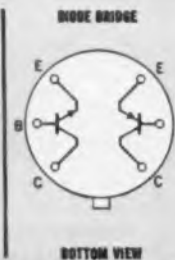
CANADIAN SALES:
Transitron Electronic Corporation of Canada Ltd.
Toronto and Montreal

TRANSITRON EXPANDS ITS PACKAGED ASSEMBLY PROGRAM

First to introduce the REF-AMP, Transitron, a 5-year pioneer in the development of packaged semiconductor assemblies, is pleased to announce the broad expansion of its Special Products Service Department. In response to the increasing demand for packaged assemblies, Transitron offers the electronic industry a growing line of standard assemblies as well as a highly versatile and flexible custom design service.

MULTIPLE SEMICONDUCTOR ASSEMBLIES

An extension of standard assembly techniques has resulted in the packaging of a number of devices in the same space normally occupied by one standard transistor package. Transitron's compact packaging features electrical isolation, close thermal proximity between junctions, matching of specific electrical specifications, and reduction of external connections. Three typical Transitron Multiple Assemblies are:



PACKAGED REFERENCE ASSEMBLIES

A further diversification of Transitron's packaged assembly program has produced two new additions to the firm's broad standard line of quality silicon references . . . Selecting from among its most reliable and stable units, including devices used in the Minuteman missile, Transitron combines for the first time both temperature-compensation and close tolerances in a double anode packaged reference assembly. Further efforts have also produced a low current reference assembly which offers precision tolerance reference voltages (10 to 100 volts) in a package especially suited for high-density circuitry. For further information, ask for Transitron's "Packaged Reference Assembly" bulletins.

WELDED CIRCUIT PACKAGES Transitron custom-assembles and encapsulates any variety of three-dimensional circuit configurations of conventional, miniature or micro-miniature components. Utilization of advanced production processes, including precision welding, assures strong, uniform joints and results in high packing density, light weight and high structural reliability. Typical custom-made packages are:

FLIP-FLOP

A general purpose flip-flop module capable of counting at speeds of 3-5Mc and operating as a logic element at bit rates in excess of 2Mc.

(Tentative Data)
Frequency in excess of 3Mc
Supply Voltage 12 Volts DC $\pm 30\%$
Power Dissipation (typical) 150mW
Clock Rate in excess of 2Mc
Maximum Load 1.5K Ω



LOW LEVEL AMPLIFIER

Gives high input impedance and low noise performance with a voltage gain of approximately 20.

(Tentative Data)
Input Impedance 500K Ω
Output Impedance 3K Ω
Voltage Gain 20
Equivalent Input Noise Voltage 5 μ V
Voltage Supply +18 Volts
Band width DC to 100Kc



3 to 5 WATT AUDIO AMPLIFIER

Contains a stable gain push-pull amplifier circuit capable of up to 5 Watts.

(Tentative Data)
Voltage Supply 18 Volts
Maximum Input Voltage 1 Volt p.p. from 3K Ω source resistance
Maximum Linear Output (Push-Pull) 3 Watts (20 Ω load)
Band width 20-20,000 cps



VIDEO AMPLIFIER DOUBLET

Utilizes a stable gain circuit giving a broad flat band width and relatively low noise operation.

(Tentative Data)
Band width 20 cps to 7Mc
Voltage Supply 22 Volts

Current Gain of approximately 20 per doublet
Equivalent Input Noise Current over entire band width is typically less than 0.02 μ A RMS

Transitron
electronic corporation
wakefield, massachusetts
Some offices in principal cities throughout the U.S.A. & Europe
cable address: Trelco

CIRCLE 56 ON READER-SERVICE CARD
CIRCLE 57 ON READER-SERVICE CARD

Transitron
electronic corporation
wakefield, melrose, boston, mass.

SALES OFFICES IN PRINCIPAL CITIES THROUGHOUT THE U.S.A. AND EUROPE • CABLE ADDRESS: TRELCO

NEW PRODUCTS

Isolation Amplifier

467



Gain of 40, with an accuracy of 0.1% from -55 C to $+125\text{ C}$, is offered in model 260 transistorized isolation amplifier. Input impedance is 20-K, max output voltage is 40 v rms. Phase shift through the unit is 0 deg within ± 2 min and output impedance is 5 ohms or less.

Control Technology Co., Inc., Dept. ED, 41-16 29 St., Long Island City 1, N. Y.

Silicon Rectifier

578



Rated at 150 amp, the 6RW56 series silicon controlled rectifiers has 9 models. They differ by piv ratings of 50 v to 500 v, from the 6RW56AC to the 6RW56KC. Peak one cycle surge current is 3,000 amps and max gate current to fire the silicon controlled rectifier is 100 ma at 25 C.

General Electric Co., Rectifier Components Dept., Dept. ED, Auburn, N. Y.
Availability: from stock.

Digital Recorder

608



Transistorized digital recorder features high speed and flexible data input. Model 562A can print up to 5 eleven-digit lines per sec. Four line codes other than 1-2-2-4 binary-coded decimal may be used as inputs, by substituting plug-in cards. Ten-line code operation is also available by card substitution.

Hewlett-Packard Co., Dept. ED, 1501 Page Mill Road, Palo Alto, Calif.
P&A: \$1,625 for six digits; 12 weeks.

Heat Sink

393



Liquid-cooled transistor heat sink dissipates 500 w. At 500 w the heat sink temperature does not exceed 110 F. Maximum wattage dissipation is obtained in heat sink area of 1 sq ft. Temperature gradient is 0.04 C per w.

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

Multiplexing Modules

643

Input range is 0 to 10 v. A selected channel is gated on by a -6.8 v gating signal. A feedback loop combines the input stage for that channel with the output amplifier to form an amplifier with unity gain and a high input impedance. Model 371 contains two channels of input gates and amplifiers, and an output amplifier. Model 372 contains four channels of input gates and amplifiers.

Navigation Computer Corp., Dept. ED, Valley Forge Industrial Park, Norristown, Pa.

Epitaxial Transistors

432

Low-noise, 1,000-mc epitaxial mesa transistors have a noise figure of 4 db and power gains of 20 db at 100 mc. Saturation voltage is 0.3 v typical at 50 ma. Oscillator efficiency exceeds 20% at 400 mc; total device dissipation is 750 mw for these TO-5 packaged transistors.

Motorola Semiconductor Products, Inc., Dept. ED, 5005 E. McDowell Road, Phoenix 8, Ariz.

Digital Voltmeter

568



Five-digit display is feature of model 650 digital voltmeter. Range is ± 0.0001 v dc to $\pm 1,200.0$ v dc, with accuracy of 0.05% ± 1 count. The unit has automatic polarity sensing and display, an internal calibration cell and an essentially infinite input impedance, except 20 meg on 1,200 v range.

Franklin Electronics Inc., Dept. ED, Bridgeport, Pa.

P&A: \$1850; stock to 60 days.

Ultrasonic Welder

592



Peak acceleration of 30,000 g enables many uses of the Ultrasonic Toolshop. The probe of this unit is vibrated at 25 kc and permits soldering without flux. Other applications of this tool include heatless sealing of plastic. Weight is under 8 lbs and operation is 110 v ac.

Electromotion Components Corp., Dept. ED, Norden Lane, Huntington Station, L. I., N. Y.

Direct-Writing Oscillograph

638

Utilizing a tungsten light source, model 444 offers four to six channels and four selectable chart speeds ranging from 1 to 50 ips. Other features include the use of model 210 galvanometers with sensitivities from 0.4 mv per in. and 2,000 cps ($\pm 5\%$) frequency response. Unit uses ac or dc power by 110 v, 60 cps; other models are available using 12 or 28 v dc.

Century Geophysical Corp., Dept. ED, 515 S. Main St., Tulsa 3, Okla.

Availability: immediate.

Pulse Generator

593



Repetition rate of 10 mc and a broad range of pulse widths and delays are combined with fast rise time, in model 138. This unit provides both a positive and a negative pulse simultaneously. Low jitter and good waveform enable its use for general laboratory service.

E-H Research Laboratories, Inc., Dept. ED, Oakland, Calif.

Magnetic Switch

570



Biassing is not needed to keep this switch normally closed. The switches come in a hydrogen, or an inert atmosphere cell. Both the DRG-DT and the DRG-DTH are spdt switches. Contact ratings are resistive; 3 w dc, 10 w ac, for the DT and 20 w dc, 40 w ac for the DTH.

Hamlin Inc., Dept. ED, Lake Mills, Wis.
P&A: \$3 up; immediately.

Coupling Capacitors

589



For uhf applications, these coupling and bypass capacitors have 360 deg current pattern from center terminal and are custom designed. Working voltages are from 350 v dc to 500 v dc and nominal capacity range is 100 pf to 5,000 pf. Units will be made to customer specifications.

Erie Resistor Corp., Dept. ED, 644 W. 12 St., Erie, Pa.

Voltage Comparator

395



Transistor circuit module can detect voltages in range of -6 v dc to $+6$ v dc. Sensitivity is 0.1 v from -54 C to $+71$ C. Unit is compatible with T-series digital circuit modules. The unit is $7/8$ in. in diam by $2-3/16$ in. seated height, with standard 9 pin miniature base.

Engineered Electronics Co., Dept. ED, 1441 E. Chesnut Ave., Santa Ana, Calif.
P&A: \$23.00, 1 to 9; stock to 2 weeks.

Wire Stripper

576



Tweezer-like wire stripper operates at 480 F. The ST-6 has separate heating elements in each arm and stainless steel stripping heads. Length is 6 in.; weight is 2 oz. A 6 v, 3 amp ac or dc power supply is needed. Power consumption is 12 w.

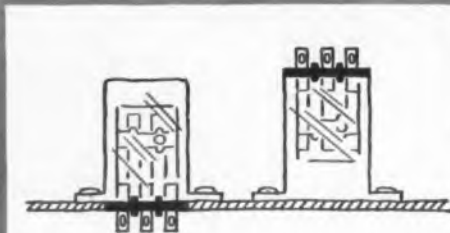
Oryx Co., Dept. ED, 13804 Ventura Blvd., Sherman Oaks, Calif.
P&A: \$14.95; stock.

Accuracy Is Our Policy

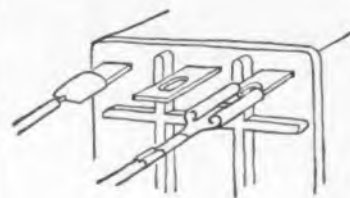
The New Literature release which appeared on p 205 of the Sept. 27 issue of ELECTRONIC DESIGN described catalog No. 62 offered by Alpha Wire Corp., 200 Varick St., New York 14, N. Y.

ELECTRONIC DESIGN • October 25, 1961

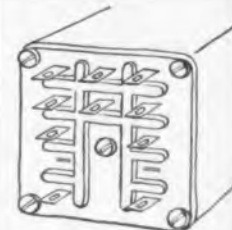
FRESH IDEAS IN RELAYS...



CHOICE of below-chassis or above-chassis connecting in plastic enclosures.



MULTI-USE terminals allow soldering, insertion in printed circuit board, and use of AMP Style 110 push-on terminals.



ALL TERMINALS on one panel... permits insertion in printed circuit board.

SPECIFICATIONS

CONTACTS: Integral with terminals; up to 3PDT; 5 amp, 115 VAC or 32 VDC. Stationary contacts, fine silver inlay material; movable, solid fine silver.

COILS: Up to 230 VAC at 60 cps or 115 VDC.

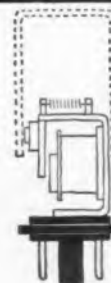
ENCLOSURES: Clear plastic.

TERMINAL PANELS: Barrier type or octal plug.

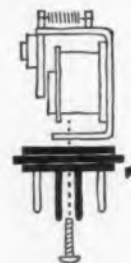
LATCHING RELAY: Available enclosed in clear plastic with plug-in mounting; or unenclosed.



OCTAL PLUG relays up to DPDT have recessed pin bases... meet UL spacing requirements to 150 V.



ALL ENCLOSED relays mount solidly on base... not on covers.



INTEGRAL plug-in base up to DPDT avoids wiring between contact terminals and pins.

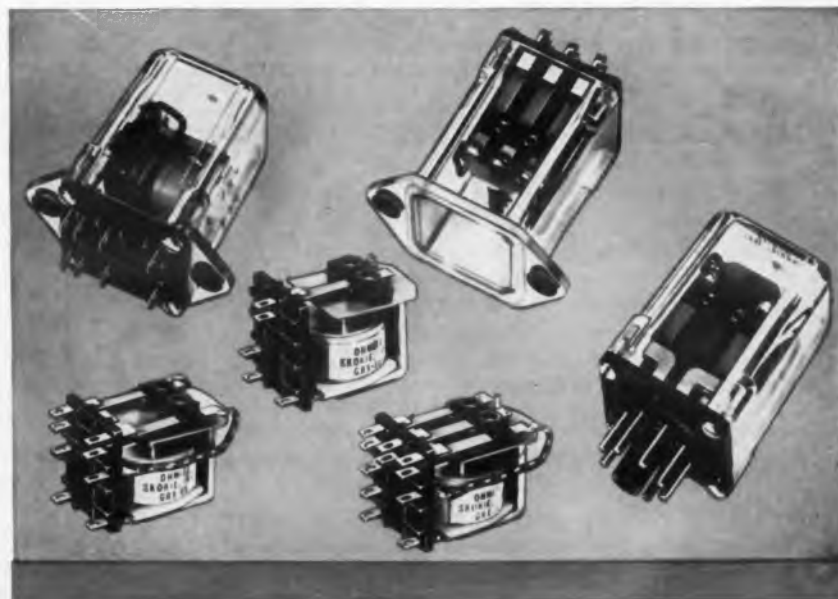
OHMITE'S New "GR" Series

Stocked for Immediate Delivery From Distributors or Factory...
WRITE FOR BULLETIN 166



OHMITE MANUFACTURING COMPANY
3643 Howard Street
Skokie, Illinois

Rheostats • Power Resistors
Precision Resistors
Variable Transformers
Tantalum Capacitors • Tap Switches
Micromodules • Relays
R.F. Chokes • Germanium Diodes



CIRCLE 58 ON READER-SERVICE CARD



...and now for a spot of welding!

Still at it? Trying to improve potentiometer reliability by building 'em yourself? Well, you're on the right track about one thing — welding's a sure way to eliminate a lot of operational headaches — like gassing contamination of contact metals at high temperature, from organic solder flux. No chance of "cold joints", either, to increase circuit resistance. No soldered connections to come loose under vibration and shock. Welding is the way to reliability!

But why set the wife's drapes afire to get a reliable, all-welded pot? Utilizing welding techniques, Ace produces reliable potentiometers operable at temperatures exceeding 150°C. and able to withstand 50 G's at 2000 cycles. All this, plus extremely low contact resistance and longer rated life. All taps, end connections, resistance elements, contact assemblies and terminal leads are specially prepared beforehand — then welded with pure nickel or palladium silver. So, for built-in reliability through sounder construction techniques, see your ACErep!

This 2" AIA Acepot® (shown 1/2-scale) incorporates all these exclusive welding construction features, for superior reliability.



ACE ELECTRONICS ASSOCIATES, INC.
99 Dover Street, Somerville 44, Mass.
SOMerset 6-5130 TAx SMVL 181 West. Union WUX

Acepot® Acepot™ Acepot® Acepot® Reg. Appl. for
CIRCLE 59 ON READER-SERVICE CARD

NEW PRODUCTS

UHF Preamplifier

564



Low-noise figures are characteristic of these tow-stage preamplifiers for channels 14 through 83. GE type 7077 and GL-2699 planar type tubes are used exclusively. All models, PRU-J through M, have grounded-grid, high-Q resonant-cavity circuits. Power source must be 117 v, 50-60 cps, 20 w. Single-stage models with weatherproof enclosures are also available.

Community Engineering Corp., Dept. ED,
234 E. College Ave., State College, Pa.

Digital Modules

630

Designed for 2 mc operation. The DC2M series consists of miniaturized, encapsulated, digital modules, 1.6 x 0.8 x 0.5 in., fully transistorized and assembled through welding techniques. The DC2C series is a family of system-designed digital circuit cards 2-3/4 x 5-1/2 in. Each card mounts two to four DC2M modules.

Control Logic, Inc., Dept. ED, Natick Industrial Centre, Mass.

Copper-Clad Laminate

460

Designed for printed circuitry, grade G-10R has a hot peel strength of 2 to 4 lb per in. of width, and from 9 to 11 lb per in. of width at room temperature. This material is available in sheets of 36 x 36 in. and 36 x 48 in. with the usual copper foil thicknesses.

Synthane Corp., Dept. ED, Oaks, Pa.

Key Switch

464



Rotary selector key operated ac switch, has 45 or 90 deg indexing, providing a positive feel during rotation. Standard features include one or two wafers and 2 to 12 positions. Units have either screw or 1/4-in. spade terminals.

Cutler-Hammer, Dept. ED, 315 N. 12 St., Milwaukee 1, Wis.

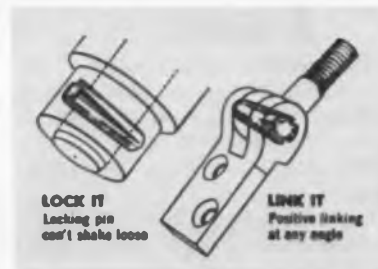


To join two parts as one...

THE SOLID GROOV-PIN

Every one of the Groov-Pins shown here was designed with your pin problems in mind. Designed to withstand the rigors of constant shock and vibration without loosening...to drive easily into a simple drilled hole...for faster hand or production feeding, including hopper feed...for a permanent connection that stands up to vibration fatigue as only a solid pin can.

Groov-Pins are made to meet your requirements, too. Standard sizes run from 1/32 to 1/2", specials to fit your needs at standard prices over 5,000 pieces. Send for illustrated catalog, free samples.



No matter what your pin problem,
there's a Groov-Pin to solve it for you.

GROOV-PIN
CORPORATION

1148 Hendricks Causeway
Ridgfield, New Jersey
Whitney 5-6780



CIRCLE 60 ON READER-SERVICE CARD
ELECTRONIC DESIGN • October 25, 1961



Microminiature 4pdt relay, model JH-12, has standard contact configurations for 2-, 4- and 6-pole relays. Rated at 2-amp non-inductive at 29 v dc or 115 v ac, the hermetically sealed relay operates at temperatures from -65 to +125 C. Plug-in, printed circuit and hook-type solder terminals are available. Operate time is 10 msec; release time is 8 msec; weight is 1.4 oz max.

Allied Control Co., Inc., Dept. ED, 2 East End Ave., New York 21, N. Y.

Dice Sorter

470

An automatic dice sorter, the Auto-Sorter TK-500 can gage and sort 2,400 to 3,200 dice per hr to an accuracy of 0.000040 in. Dice are sorted into 10 categories ranging in size from 0.000050 to 0.00020 in. including "rejects" and "reinspects". Automatic controls, counters and shut-offs are standard equipment.

Techni-Rite Electronics, Inc., Dept. ED, 71 Centerville Road, Warwick, R. I.
Price: \$10,500.

Power Supplies

355

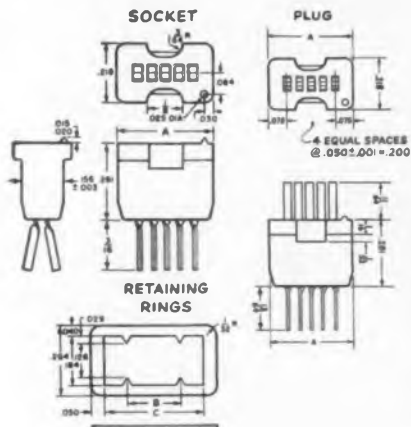


Two series offered. The T series, consisting of seven models, has outputs of 0.8 to 30 v at 50 to 200 ma with line and load regulation of $\pm 0.5\%$ and ripple of 0.1%. The M series, consisting of 12 models, has outputs of 9 to 40 v at 500 to 700 ma with line regulation of $\pm 0.1\%$.

Acopian Technical Co., Dept. ED, 927 Spruce St., Easton, Pa.
P&A: \$60 and \$80; stock.

CIRCLE 61 ON READER-SERVICE CARD ➤

NEW FROM CINCH.



DIMENSIONS

No. of Contacts	A	B	C
3	.350 ± .003	.194	.360
4	.350 ± .003	.194	.360
5	.350 ± .003	.194	.360
6	.400 ± .003	.244	.410
7	.450 ± .003	.294	.460

NOMENCLATURE

PLUG	RECEPTACLE	RETAINING RINGS
3 contacts 204-92-03-047	131-13-12-095	441-00-11-082(105)
4 contacts 204-92-04-048	131-14-12-096	441-00-11-082(105)
5 contacts 204-92-05-049	131-15-12-097	441-00-11-082(105)
6 contacts 204-92-06-050	131-16-12-098	441-00-11-083(105)
7 contacts 204-92-07-046	131-17-12-099	441-00-11-084(105)

Low-Cost SUBMINIATURE PLUGS and SOCKETS

for low-current circuits



ACTUAL SIZE

for interconnecting low current circuits where miniaturization is important... electrical ratings conform to EIA standards

Molded of low-loss, mica filled phenolic insulation (type MFE per MIL-4-14E) with beryllium copper contacts, .00003 Min. Sel-rex gold plated. Available also, with glass-filled Dialyl Phthalate insulation (type SDG per MIL-M-18794).

May be swaged into metal chassis, cemented into Bakelite chassis, mounted with retaining ring or potted.

ELECTRICAL RATINGS

Maximum Rated Voltage AC-RMS
Contact to contact 300 volts
Contact to ground 500 volts

Capacitance
Measured from one contact to all other conducting parts 1.5 m.m.f. (Max.)

Insulation loss factor
Maximum 0.50 Dry

Insulation Resistance
Measured from one contact to all other conducting parts 50,000 Megohms (Min.)
Contact Resistance @ 50 Ohms (Max.)

Safe Operating Temperature
Maximum 80 C

Initial Insertion and Extraction Force

3 contact (Max.)	6 lbs.
4 contact (Max.)	7 lbs.
5 contact (Max.)	8 lbs.
6 contact (Max.)	9 lbs.
7 contact (Max.)	10 lbs.

Individual Contact Retention Force
Minimum Gauge Weight 1/2 ounce

WRITE FOR FULL INFORMATION TODAY! Complete engineering data and detailed specifications on this line of low cost plugs and sockets is available. Yours for the asking, or phone NE 2-2000.



Cinch
ELECTRONIC
COMPONENTS

CINCH MANUFACTURING COMPANY

1026 South Homan Avenue, Chicago 24, Illinois

Division of United-Carr Fastener Corporation, Boston, Massachusetts

Centrally located plants at Chicago, Illinois; Shelbyville, Indiana; City of Industry, California, and St. Louis, Missouri



THIS IS A 32 YEAR RELAY

*1 cycle per second rate



FOR

- Business Machines
- Machine Tools
- Military Applications
- Cross Points
- Proximity Switches
- Counting and Scanners
- Flip-flop
- "Explosive" Environments
- Railway Signaling
- Traffic Controls
- Food Processing
- Chemical Processing
- Annunciators



Switching rates
up to 1,000 cps.



A new concept
of reliability.



High speed operation.



High resistance to
shock and vibration.

Long life of the Hathaway Drireed Miniature Relay Form A is typical of the quality built into all our relays...and we have a relay for all your applications—routine or specialized.

Contact rating: 10,000,000 operations at 100 milliamperes, 115 V 60 cps resistive, 10,000,000 operations at 125 milliamperes, 28 vdc resistive. 1,000,000,000 operations dry circuit. **Vibration:** 20 G's to 2,000 cps, energized or non-energized with no fault operation. **Shock:** 50 G's for 11 milliseconds. **Operate time-typical:** 600 microseconds, including bounce, for 28 vdc unit at nominal voltage. **Closed contact resistance:** .04 to 0.12 ohms initially. **Breakdown voltage between contacts:** 250 volts rms, 60 cps. **Natural contact frequency:** 2,700 to 3,200 cps. **Weight:** 5 grams. **Volume:** 0.110 cubic inches. **Noise:** Useable in the low micro-volt region. **Special circuits available upon request.**

COIL SPECIFICATIONS AT 25° C. 130 Milliwatts

NUMBER CATALOG	NOMINAL VOLTAGE
AM06	6
AM12	12
AM28	28

Contact your local representative
or distributor for prices and additional information.



HATHAWAY DENVER

5804 EAST JEWELL AVE.
DENVER 22, COLORADO SKYline 6-8301

A division of Hathaway Instruments, Inc.

CIRCLE 63 ON READER-SERVICE CARD

NEW PRODUCTS

Block Tape Readers

378



Modular design block tape readers are developed for use where panel space is at a premium. One or more of the reader-subassemblies may be combined with a single control unit to make up a tape reader for 80-, 96-, or 120-bit frames. The 410 series is an 80-bit unit; the 412, a 96-bit unit and the 415, a 120-bit unit. Combined with the 400 series control unit, they make up the TP-450, TP-452 and the TP-455 tape programmers, respectively.

Electronic Engineering Co. of California, Dept. ED, 1601 E. Chestnut Ave., Santa Ana, Calif.

P&A: from \$1,625 to \$2,145; 45 days.

Control System

649

Model 1710 has been modified to include closed-loop capability by adding two new units, the 1711 data converter, model 2, and the 1712 multiplexer and terminal unit.

International Business Machines, Corp., Data Processing Div., Dept. ED, 112 E. Post Road, White Plains, N. Y.

P&A: \$125,000 to \$250,000; early 1962.

Sampling Oscilloscope

394



Calibrated, high resolution measurement of nsec pulse phenomena is possible with sampling oscilloscope model 185B. Conventional controls, direct reading and a standard 5-in. mono-accelerator crt are features of the unit. With model 187B plug-in dual trace amplifier, the unit has a pass-band from dc to 1-Gc, can be synchronized up to 1-Gc and permits full screen presentation of signals from 0.3 nsec to 100 μ sec.

Hewlett-Packard Co., Dept. ED, 1501 Page Mill Road, Palo Alto, Calif.

P&A: model 185B, \$2,300, model 187B, \$1,000; 4 months.

CIRCLE 62 ON READER-SERVICE CARD ▶

**MOVING
AIR
IS
CHILD'S
PLAY**

**CONTROLLING
IT
TAKES
AN
EXPERT**



In years of specializing in air moving and cooling, at times we have been undersold, outmaneuvered and outtalked. But we've seldom been outdesigned or outperformed. Sooner or later most air moving problems come to Torrington. Brochure 102 proves why it should be sooner.

TORRINGTON
MANUFACTURING COMPANY
TORRINGTON ■ CONNECTICUT



Coming Soon . . .



Improved—Easier to Use

1961 Edition—Revised and Updated

Lists and Describes 8700 Recent Electronic Products

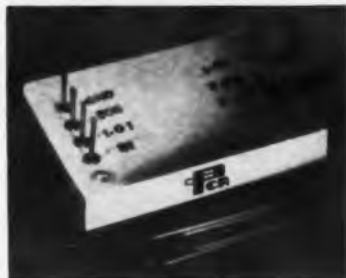
The new EDC makes it easier than ever before to locate and obtain information about recently released electronic products. Improvements suggested by readers include:

- *Simplified code and reference numbers, for new products.*
- *Bold category heads on each page make it easier to find products listed in the locator.*
- *Improved cross references.*
- *An entirely new section—"Index to New Products by Manufacturer." Use it to scan a given company's new product activity.*

EDC is Electronic Design's 27th Issue.

Constant Delay Lines

399



Packaged in hermetically sealed cases, series PCDL lumped constant delay lines are designed for application on printed-circuit cards. Case height is 0.4 in. max; width is 1.4 in.; length may be varied as required. Time delay to rise time ratios of 5 to 1 have a delay line length of 1.6 in.; ratios of 25 to 1 can be obtained with a length of 5.6 in. Rating is 500 v dc; tolerances can be maintained through a temperature range of -55 to +125 C.

PCA Electronics, Inc., Dept. ED, 16799 Schoenborn St., Sepulveda, Calif.

P&A: from \$20 to \$150 each; 30 days.

Epoxy Shells

420



Non-burning epoxy shells can be furnished in a wide range of sizes. Square and rectangular shapes can be molded on special order. Shells of silicone, diallyl phthalate and phenolic can also be supplied.

Cycle Products Co., Inc., Dept. ED, 123 Central Ave., Newark 2, N. J.

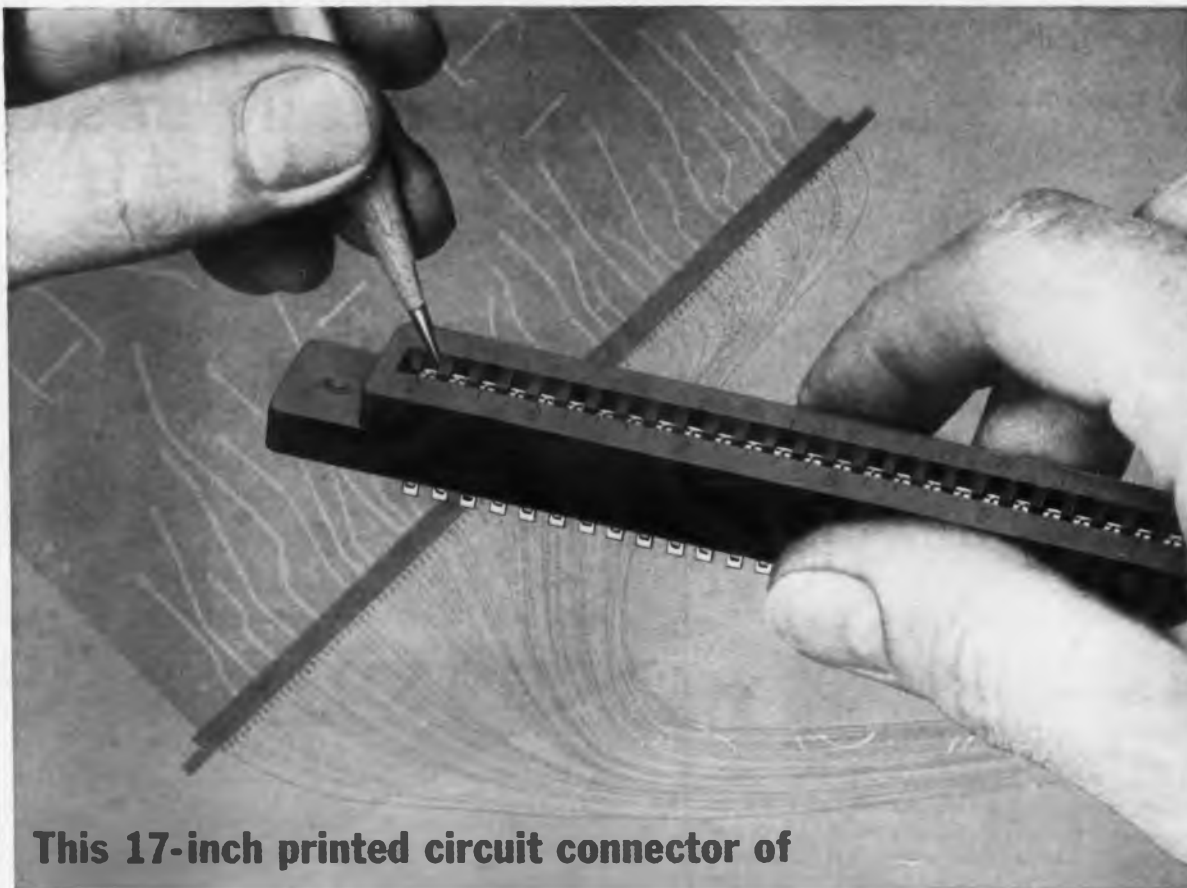
Logic Plug-in

416



A 200-kc clock driver circuit for digital systems, the CD-1 logic plug-in can also be used for driving medium-power indicator lamps or relays. It contains six independent circuits, each able to handle 450 ma at 50% duty cycle. Dimensions are 4-3/8 x 3-3/4 in.

Computer Logic Corp., Dept. ED, 11800 W. Olympic Blvd., Los Angeles 64, Calif.



This 17-inch printed circuit connector of

DAPON® M OPERATES AT 450° F... DIALLYL ISOPHTHALATE STOPS WARPAGE AND MISALIGNMENT

Dimensional stability of compounds based on DAPON M keeps this connector straight and true: contacts are always accurately positioned.

This long connector is home base for hundreds of terminals. By molding it of thermosetting compound based on DAPON M, Viking Industries Inc. solved a number of design problems . . .

DAPON M gives the connector outstanding electrical and mechanical qualities. The resin permits 450°F continuous operating temperatures, has excellent dimensional stability and resistance to moisture. Its electrical resistance (measured in millions of megohms) remains unaffected by weeks of exposure to 100% relative humidity.

The material is easily molded. It has good hot strength, the piece is strong when cured. Neither cooling jigs nor multiple ejector pins are needed in removing the connector from the mold. Fast cycles are possible. The resin's high flex, tensile, and compressive strengths result in rugged moldings with high insert holding power and dependable performance.

DAPON M is recommended for use wherever:

- high operating temperatures are encountered
- top electrical qualities are a must
- better strengths are desired
- molding conditions pose a problem.

FREE LITERATURE

SEND COUPON FOR NEW 32-PAGE BROCHURE AND THE NAMES OF COMPOUNDERS OF DAPON RESINS



Putting Ideas to Work
FOOD MACHINERY AND CHEMICAL CORPORATION
Dapon Department
Room 145B, 161 East 42nd St., N. Y. 17, N. Y.

Please send new brochure: "DAPON MOLDING MATERIALS"

Name _____ Title _____

Company _____

Address _____

NEW PRODUCTS

Toroid-Coil Winder

421



For small coils. The toroid-coil winder has a 7.5-in. diam bobbin of narrow cross-section allowing a large number of turns to be wound on a single coil. The large diameter is also practical for stacked coils used in dual-coil magnetic amplifiers.

Controlomag Laboratories, Dept. ED, Box 16, Ottsville, Pa.

Price: \$940.

Auto-Collimator

425

Precision angle measuring system, model 700, provides the capability of automatically and continuously measuring angular deviation between the axis of a transmitted and reflected light beam. Features of the system are: automatic acquisition of light source within a ± 0.5 deg field-of-view in both elevation and azimuth axes; continuous angle readout information in both azimuth and elevation axes up to ± 1.0 deg of arc; angle resolution of ± 2 sec.

Automation Laboratories, Inc., Dept. ED, 179 Liberty Ave., Mineola, L. I., N. Y.

Miniature Chopper

398



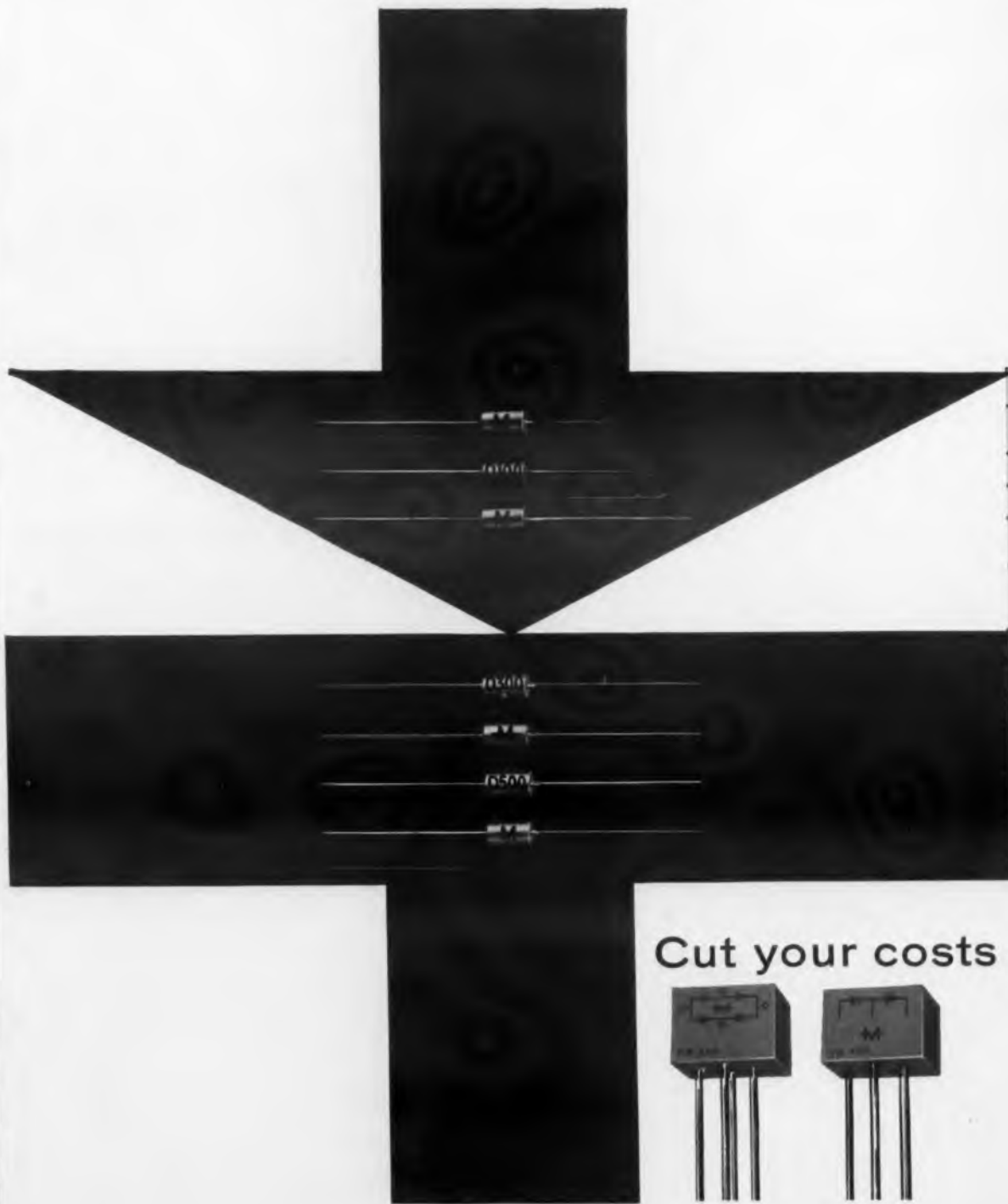
Starting voltage of less than 3 v is required at any frequency within a specified range for this miniature 60-cps chopper. It is designed for operational dc amplifiers in computer applications. Nominal drive frequency and voltage are 60 ± 5 cps at 6.3 v, aperiodic from 10 to 100 cps. Phase lag is 20 ± 5 deg at 60 cps and 25 C.

Oak Manufacturing Co., Dept. ED, Crystal Lake, Ill.

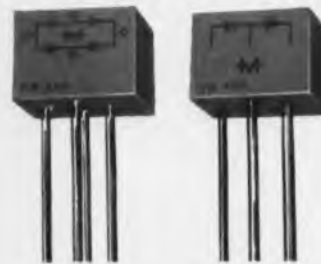
Price: \$22.85 each.

New from Mallory

Hermetically sealed 125°C silicon



Cut your costs



rectifiers at economical prices

For the first time, you can now get a glass-to-metal sealed silicon rectifier capable of 125°C operation . . . at a cost substantially lower than that of "top hat" types. It's the new Mallory Type D rectifier. It brings you a combination of small size, premium performance and down-to-earth economy which opens broad design opportunities in home instruments and commercial and industrial products.

New performance. Take a look at the specifications for three typical ratings. Compare forward drop, leakage current and ambient temperature ratings against any other

rectifier in this price range. Peak reverse voltage ratings from 50 to 600 volts are available.

New miniaturization. Only 0.240" in diameter and 0.405" long, the Type D is ideal for high density packaging. It can be supplied with an insulating sleeve.

New reliability. The Type D is the result of over four years of Mallory research in semiconductor development and production. Our unique cell construction and manufacturing techniques, coupled with the most exacting quality control, assure exceptionally high level of product quality delivered to your plant.

Our engineers are well qualified to help you utilize the new characteristics of Mallory silicon rectifiers in your present or planned circuits. Write today for data and for a consultation.

Mallory Semiconductor Company
Du Quoin, Illinois

P. R. MALLORY & CO. Inc.
MALLORY

with Mallory packaged rectifier circuits

You can reduce prime component costs, and make important added savings in stocking, handling, wiring and assembly costs with Mallory rectifier circuits.

In a single compact package, encapsulated in moisture-impervious resin, you get a complete full wave or doubler circuit . . . ready to mount on a chassis or printed circuit, ideally suited for automated assembly, with cold case for maximum mounting flexibility. The same basic rectifier elements are used as in the Type D sealed rectifier . . . high in reliability,

premium in performance. Type VB doubler circuits come as a 3-terminal package with 400 and 600 PRV ratings, delivering .5 ampere at 100°C and .75 ampere at 50°C ambient. Type FW full wave rectifiers are 4-terminal packages; rated 200, 400 or 600 volts; 1.0 ampere at 100°C, 1.5 amperes at 50°C. Full wave center tap circuits with positive or negative polarity can be supplied.

Write for our new Technical Data Bulletins: No. 11-8 on the Type FW, and 11-9 on the Type VB.

CIRCLE 65 ON READER-SERVICE CARD

DC Amplifier

400

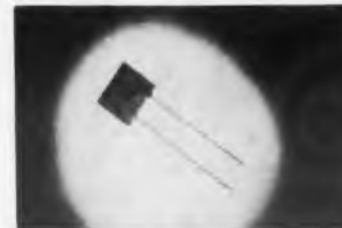


Model 4001 is a compact and rugged dc amplifier designed to amplify low level signals from dc to 5 kc. The unit occupies 3.15 cu-in. and weighs less than 5 oz. Linearity is $\pm 0.3\%$; gain stability $\pm 0.25\%$ for 24 hr; frequency response is ± 0.1 db to 500 cps, ± 1.0 db to 500 cps.

P M Electronics, Inc., Dept. ED, 5221 University Ave., San Diego 5, Calif.
P&A: \$985 each; 60 days.

Transistor-Plate Capacitor

413



Range is 0.005 to 0.1 μ f; wvdc is 50. The transistor-plate capacitor measures from 0.28 to 0.7 in. sq. The additional area and thick ceramic section resulting from the square design provide for improved reliability and temperature-capacitance characteristics. Coating is durez phenolic, wax impregnation.

Aerovox Corp., Dept. ED, Myrtle Beach, S. C.

Drafting Instrument

415



Applies tape to charts, printed-circuit masters and other graphic illustration. The Quick Line Tape pen provides straight, curved or irregular lines from 1/32 to 3/16 in. wide. A wheel assembly feeds, applies and burnishes tape.

W. H. Brady Co., Dept. ED, 789 W. Glendale Ave., Milwaukee 9, Wis.



MAKE YOUR CIRCUIT COUNT TO TEN



OAK DECADE SWITCH SECTIONS have been designed to fill a need in those applications where reliable decade counting is required—computers, process controls, L/C/R decade boxes, lab equipment, and other devices having read-in or read-out functions.

Although the decade counting function can be designed into almost any Oak low-power rotary switch, Type A, F, and H switches are particularly well-adapted to this purpose. Oak engineers have developed a special rotor blade design for these

switch types to be used in resistance/capacitance/inductance decade boxes. It is a single section switch that not only saves space but also makes maximum use of a minimum number of components.

If yours is an application that calls for a counting function, inquire about Oak Decade Switch Sections. Because of the special nature of these switches, however, please submit details of use or number of functions required to the Oak Applications Engineering department for specific recommendations.

Creative Engineering • Quality Components



OAK MANUFACTURING CO.

CRYSTAL LAKE, ILLINOIS • Telephone: Crystal Lake, 459-5000

Plants in Crystal Lake, Illinois • Elkhorn, Wisconsin

SUBSIDIARIES: OAK ELECTRONICS CORPORATION, Quiver City, Calif. • M-COY ELECTRONICS CO., Mt. Holly Springs, Pa.

ROTARY AND PUSHBUTTON SWITCHES • TELEVISION AND FM TUNERS • VIBRATORS
APPLIANCE CONTROLS • ROTARY SOLENOIDS • CHOPPERS • CONTROL ASSEMBLIES

CIRCLE 66 ON READER-SERVICE CARD

NEW PRODUCTS

Potentiometer-Switch

419



Step-driven potentiometer-switch series 720 combines a 15/16-in. diam variable resistor, on-off switch and a bi-directional stepping device. For manual or remote control, it can be used in TV and radio applications. Operating pulse is 25 ma for 75 msec. Coil resistance is 5,400 ohms. Switch rating is 3 amp, 125 v ac.

CTS Corp., Dept. ED, 619 N. Michigan Ave., Chicago 11, Ill.

P&A: \$3.60; 2 to 4 weeks.

Insulated Terminals

506

Melamine and diallyl phthalate insulated terminals are offered in standoff and feed-through types. A total of 48 sizes offer terminal sizes from 0.047 to 0.070 in., insulator lengths of 3/16 to 17/32 in., shank lengths of 0.156 to 0.344 in. Single and double turret, pin and split terminal types are available.

Cambridge Thermionic Corp., Dept. ED, 445 Concord Ave., Cambridge 38, Mass.

P&A: \$0.12; stock.

Oscilloscope

409



Two-channel, direct writing oscilloscope model 296 accepts any of the 350 series pre-amplifiers including phase-sensitivity demodulator, carrier and frequency deviation types. The oscilloscope has a basic sensitivity of 0.1 v per mm, frequency response to 125 cps within 3 db at 10 mm, peak to peak; non-linearity of 0.5% max and input impedance of 25 K from each lead to ground.

Sanborn Co., Industrial Div., Dept. ED, 175 Wyman St., Waltham 54, Mass.

Flash-Mount Transducer 509

For hydrophones, the flash-mount transducer assembly has a receiving sensitivity of -85 db vs 1 v per μ -bar and a transmitting sensitivity of +85 db. Resonant frequency is 195 kc \pm 10%; impedance at resonance is about 300 ohms; total capacitance is 2,000 pf \pm 15%. Transmitting capacity is 50 w at 10% duty cycle.

Erie Resistor Corp., Dept. ED, 644 W. 12th St., Erie, Pa.

P&A: \$6.50 to \$10; 3 to 4 weeks.

Rectifier Tester 408



Silicon control rectifier tester includes all necessary attachments for complete operation. A sweep supply, gate supply and divider for horizontal and vertical are included. The unit will test forward leakage, reverse leakage, gate voltage and gate current. Specifications are: variable sweep supply, 0 to 500 v; variable gating, 0 to 7 v; vertical output, 50 mv per ma; horizontal output, 1-v out for every 5-v across the unit under test.

Power Sources, Inc., Dept. ED, Northwest Industrial Park, Burlington, Mass.

Price: \$165, including all attachments.

Powdered Epoxy Foams 510

Three types, designated Eccofoam EFF-4, 10 and 15, weigh 4, 10 and 14 lb per cu ft. Other specs are: compressive strength: 100, 400 and 700 psi; dielectric constant from 10^2 to 10^{10} cps, 1.08, 1.15 and 1.28; dissipation factor from 10^2 to 10^{10} cps, 0.003, 0.006 and 0.01.

Emerson & Cuming, Inc., Dept. ED, Canton, Mass.

Price: \$3.00 per lb.

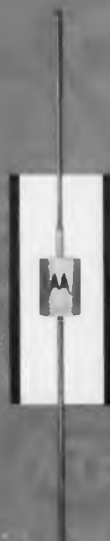
Voltage Variable Capacitors 516

Cover 47 to 6.5 pf in ten types: PC122, PC-114, PC129, PC128, PC113, PC126, PC124, PC115 and PC141. Q values range from 50 to 125; working voltages, from 25 to 100 v. Uses include frequency multipliers, parametric amplifiers, electronic tuners.

Pacific Semiconductors, Inc., Dept. ED, 12955 Chadron Ave., Hawthorne, Calif.

P&A: \$5 to \$7; stock.

now for military and industrial applications...



NEW MOTOROLA 1N3189-91 RECTIFIERS

DELIVER 1 AMP AT 100°C

designed to meet requirements of MIL-S-19500/155 (Navy)

Motorola's new 1N3189 flangeless series consists of three silicon rectifiers, each capable of carrying 1 AMP at 100°C. Available in voltages of 200, 400, and 600 PIV, these quality units offer superior stability, and can be employed in military designs where commercially available MIL-STD-701B "Guidance" types are acceptable.

Especially suited for printed circuit applications, these new flangeless rectifiers do not require heat-sinks and are easier and more economical to install than the bulkier studs. Yet, they operate in the stud-like 1 AMP region instead of the milliamp region usually associated with such subminiature axial-lead devices.

Whether you require rectifiers for military or industrial applications, look to Motorola for the best silicon devices at the best prices. Ask about our other devices to MIL "Preferred" and "Guidance" type specifications.

FOR MORE COMPLETE TECHNICAL INFORMATION contact your Motorola Semiconductor district office, or call or write: Motorola Semiconductor Products Inc., Technical Information Department, 5005 East McDowell Road, Phoenix 8, Arizona.

NEW MOTOROLA FLANGELESS RECTIFIERS

MAXIMUM RATINGS	TYPE NO.	RATING	UNITS
Peak Inverse Voltage — PIV	1N3189	200	volts
DC or Recurrent	1N3190	400	volts
	1N3191	600	volts
Average Half-Wave Rectified Forward Current @ Ambient Temp.	All Types	0.5	Amps
	All Types	1.0	Amps
ELECTRICAL CHARACTERISTICS		AMBIENT TEMPERATURE	
ALL TYPES		25°C	150°C
Maximum forward voltage drop at 750 mA continuous DC	1.0	—	volts
Maximum forward voltage drop, full cycle average at maximum rated current & voltage	—	0.5	volts
Maximum reverse current at maximum rated DC voltage	0.005	0.500	mA
Maximum full cycle average reverse current at maximum rated voltage & current as half-wave rectifier with resistive load	—	0.2	mA
Operating & Storage Temperature Range		-65°C to +175°C	

MOTOROLA DISTRICT OFFICES: Belmont, Mass. / Burlingame, Calif. / Chicago / Clifton, N. J. / Dallas / Dayton / Detroit / Glenside, Pa. / Hollywood / Minneapolis / Orlando, Fla. / Phoenix / Silver Spring, Md. / Syracuse / Toronto, Canada.

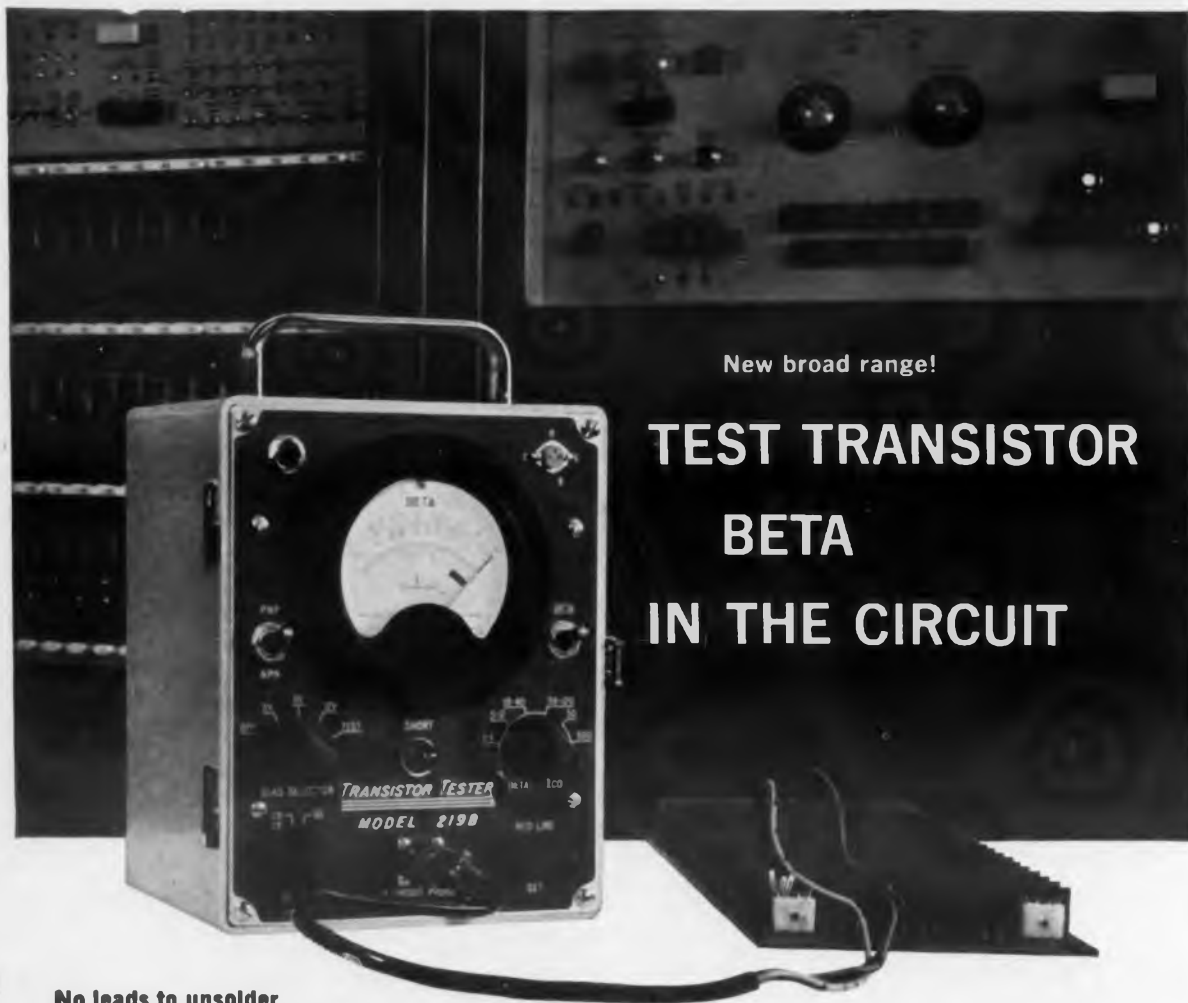


MOTOROLA
Semiconductor Products Inc.

A DIVISION OF MOTOROLA INC.

5005 EAST McDOWELL ROAD • PHOENIX 8, ARIZONA

CIRCLE 67 ON READER-SERVICE CARD



New broad range!

TEST TRANSISTOR BETA IN THE CIRCUIT

**No leads to unsolder
Four overlapping Beta Ranges • High meter resolution
Direct reading with test circuit power off**

New Sierra 219B 4-range Transistor Tester reads Beta directly in the circuit; also measures I_{c0} , Beta out of circuit.

Less downtime and less danger of damage to transistors under test with this new Sierra instrument—battery-operated, light weight, portable, easy to use.

Maintenance, quality control, incoming inspection and production testing are just a few of the applications where you save time and money by testing transistors, even complete assemblies, without unsoldering leads. Model 219B reads Beta in the circuit, 1 to 120. I_{c0} is measured on a straightforward basis; collector potentials of 3, 6 or 12 vdc may be selected. All controls are on the front panel . . . an instrument of convenience, speed, accuracy.

Write or phone today for information and demonstration.

sierra SIERRA ELECTRONIC CORPORATION
A Division of Philco Corporation
6919K BOHANNON DRIVE • DAVENPORT 6-2060 • MENLO PARK, CALIF., U.S.A.

Sales representatives in all principal areas.
Canada: Atlas Instrument Corporation, Ltd., Montreal, Ottawa, Toronto, Vancouver.
Export: Frazar & Hansen, Ltd., San Francisco.

CIRCLE 69 ON READER-SERVICE CARD

SPECIFICATIONS

Test ranges	
Beta	1-4, 3-12, 10-40, 30-120*
I_{c0}	0-50, 0-500 ua
Accuracy	
In circuit:	±20% for external loads over 500 ohms. Improved accuracy above 500 ohms, usable readings below 500 ohms.
Out of circuit:	±10%
Power:	Internal battery, mercury or zinc-carbon type, 600 hrs. av. life; output indicated on front-panel meter.
Operating Temperature:	32 to 149° F
Size:	9" high, 7½" wide, 6½" deep, weight, 10¼ lb., including batteries.
Price:	\$335.00.
	*Beta readings to 300 may be approximated.

NEW PRODUCTS

Servo Preamplifier

410



High-temperature servo preamplifier model 51-100 provides a gain-impedance product of 3.6×10^6 and has a nominal gain of 1,200 at 3-K input impedance. Maximum undistorted output is 2 v rms across a 10-K load. It can be used to extend input impedance or gain of other amplifiers.

Servo Development Corp., Dept. ED, 2 Willis Court, Hicksville, L. I., N. Y.

Analog Computer

411



Iterative analog computer series 3200 uses components matched to within 0.01%. Nominal size is 50 amplifiers. Amplifiers have 20- μ v drift and 500- μ v noise. Inverter bandwidth is 1 mc. Design is completely modular. Pushbuttons select compute, hold, reset, automatic recycle, slave, audible overload indication and automatic-hold modes of operation.

Systron-Donner Corp., Donner Scientific Div., Dept. ED, Concord, Calif.

Wire Marker

417



Automatic wire marker, called the Marker-matic was designed for marking wires with pressure-sensitive bands but can be used to mark any tubular object. The machine uses markers which are supplied in continuous coil form; each coil contains up to 5,000 individual marks.

W. H. Brady Co., Dept. ED, 727 W. Glendale, Milwaukee 9, Wis.

6919

● **FROM:** Bendix Eclipse-Pioneer

● **SUBJECT:** Aerospace gyros, synchros

SIX LIGHT, RUGGED BENDIX GYRO TYPES MEET BROAD AEROSPACE NEEDS. With the Bendix gyro line, you enjoy a *double* benefit. First, *the line is unusually versatile*—includes models for a wide range of applications, such as radar stabilization systems, aircraft and missile guidance and control systems, bombing and navigational systems, and many others. Second, *high quality of manufacture is consistently combined with such advantages as light weight, proved accuracy, reliability, and ruggedness.*



Top: vertical; rate; and directional gyros. Bottom: free-cageable; two-gyro, three-axis (contains both vertical and directional units in a single package); and free-uncageable.

BENDIX GYROS FEATURE: Electrolytic switches for precise erection, long life • 1000-hour operating life • Two-gyro, three-axis control erection rate of 1.3°/min.—with normal erection rate of 2°/min. and fast erection up to 120°/min. for other models.

Eclipse-Pioneer Division

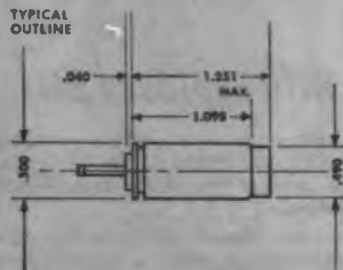
TETERBORO, N. J.



BENDIX AUTOSYN SYNCHROS FOR MINIATURIZED CIRCUITRY

Where dependability plus size and weight reduction are essential for aerospace applications, these size 5 Autosyn® Synchros can meet your needs exactly. They're available as transmitters, control transformers, and differentials. See typical characteristics below. Further, more comprehensive data available on request.

TYPICAL OUTLINE



TYPICAL CHARACTERISTICS

Operating temperature range -55°C. to 95°C.
Rotor moment of inertia 0.25 gm cm²
Weight.....0.8 oz.
Accuracy.....± 15 minutes

Manufacturers of

GYROS • ROTATING COMPONENTS
RADAR DEVICES • INSTRUMENTATION
PACKAGED COMPONENTS

DISTRICT OFFICES: Burbank and San Francisco, Calif.; Seattle, Wash.; Dayton, Ohio; and Washington, D. C. Export Sales & Service: Bendix International, 205 E. 42nd St., New York 17, N. Y.

NEW PRODUCTS

Solenoid Magnets

513

High field strength. Model HF-26 solenoid magnet has typical specifications of 52 kilogauss at 240 kw with a 2-in. bore, and over 95 kilogauss for a 1-in. bore at 500 kw. Bore length is 6 in. Magnet is suitable for use at both depressed and elevated temperatures.

Harvey-Wells Corp., Dept. ED, P. O. Box 189, Framingham, Mass.

Transient Sensing Relay

496



Solid-state. transient sensing relay has a continuous output of 12 to 28 v dc. Upon receiving a transient pulse of 100 μsec or longer duration, the output is changed to a pulse of 0.5 sec ON; 0.5 sec OFF, for a period of 10 sec and then returns to a continuous output. The output circuit is rated at 500 ma, continuous load. Recycle time is 15 msec.

Accutronics, Inc., Dept. ED, 403 N. Foothill Road, Beverly Hills, Calif.

P&A: \$90 each; two weeks.

Transistor Test Set

434

A dynamic oscilloscope display of Beta (grounded emitter current gain) as a function of collector current is displayed in the T3A-1 transistor test instrument. A complete plot of Beta vs I_c from 0 to 500 ma peak current at fixed frequencies of 1-kc and 10-kc. Accuracy is 5% exclusive of oscilloscope error.

Orbitec Corp., Dept. ED, 512 30th St., Newport Beach, Calif.

Price: \$1,125.

Casting Compound

429

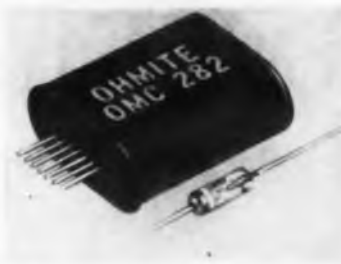
A flexible flame-out system, casting compound C9-5041 with hardener H4-3656, is especially designed for encapsulating transformers that are required to meet MIL-T-27A, Class S, Grades 2 and 5. Shelf life is 6 months; pot life at 25 C is 2 to 3 days; cure is 16 hr at 100 C.

Hysol Corp., Dept. ED, Olean, N. Y.

P&A: \$2.50 for sample; immediate.

Matched Diode Package

479



For use as a ring modulator, demonstrator or discriminator in ssb equipment, this matched diode quad package has a temperature range of -65 to $+90$ C. The four gold-bonded, hermetically-sealed-in-glass germanium diodes are matched in pairs and then the pairs are matched to pairs to obtain a carefully balanced assembly. The package measures $0.325 \times 0.700 \times 0.730$ in. with a 7-pin in-line single-ended plug termination.

Ohmite Manufacturing Corp., Dept. ED, 3640 Howard St., Skokie, Ill.
Availability: 10 day delivery.

Cable Assembly

475



Designed to mate with a jack even if it is recessed below the surface of the panel, the 10BF10 cable assembly has molded, 3-conductor phone plugs at both ends of a 36-in. shielded cable. Built-in cable clamps eliminate strain on the plug terminals.

Switchcraft, Inc., Dept. ED, 5555 N. Elston Ave., Chicago 30, Ill.

Diode Clip

473



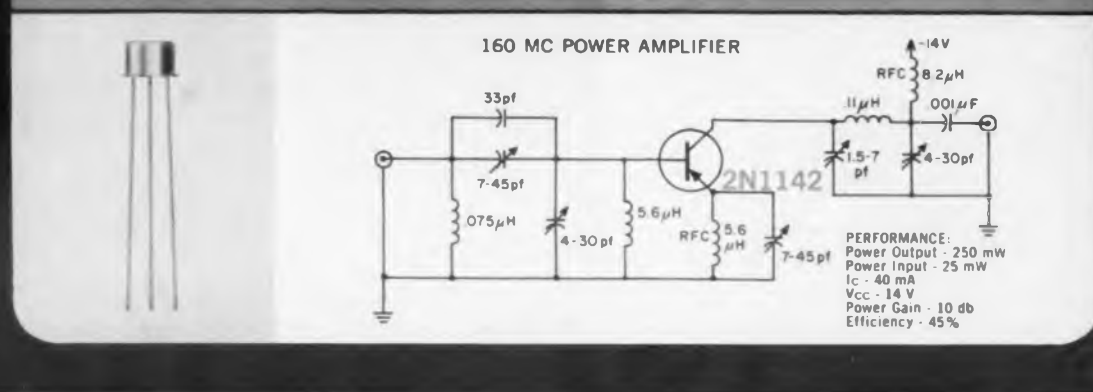
Test components are automatically located in the Daymarc diode clip when dropped in by hand. Four contacts reliably permit error-free measurements. Diodes and components with magnetic leads including glass resistors, capacitors, etc. can be rapidly handled even with bent leads.

Teradyne, Inc., Dept. ED, 87 Summer St., Boston, Mass.

P&A: \$65; from stock.

LOOK WHAT ONE MOTOROLA 2N1142 GERMANIUM EPITAXIAL MESA DOES IN THIS CIRCUIT!!

PROVIDES 250 mW @ 160 mc WITH
10 db POWER GAIN AND 45% EFFICIENCY



The latest devices to join Motorola's epitaxial mesa family are four new PNP germanium transistors, the 2N1141-2-3 and the 2N1195. These new Motorola communication amplifiers provide very high power gain and low R-F noise in the VHF-UHF frequency ranges. They not only make ideal drivers for 160 mc power mesas (Motorola 2N1692) in transmitter output stages, but they also solve critical design problems in frequency multipliers, R-F and I-F amplifiers, mixers, and oscillators.

In addition to higher power gain and lower R-F noise, the new epitaxial units also offer typically:

$$V_{CE(sat)} = .185 \text{ V @ } I_c = 50 \text{ mA;}$$

$$100 \text{ mc } h_{FE} = 18 \text{ db.}$$



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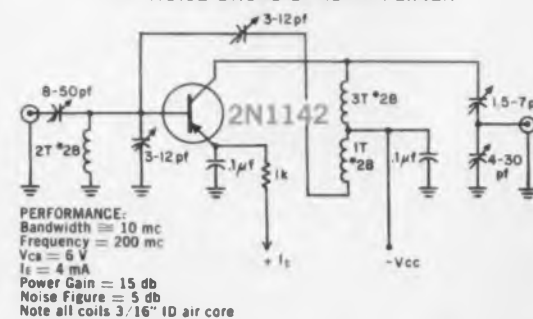
Belmont, Mass. / Burlingame, Calif. / Chicago / Clifton, N. J. / Dallas
Dayton / Detroit / Glenside, Pa. / Hollywood / Minneapolis / Orlando,
Fla. / Phoenix / Silver Spring, Md. / Syracuse / Toronto, Canada.

LOW NOISE 200 MC AMPLIFIER

5 db noise figure at 15 db power gain

And, this new Motorola 2N1141 series offers performance breakthroughs in the communication field for low-noise R-F circuits and broad-band high-frequency amplifiers. In front-end applications the low noise of this series provides new extended receiver range. A typical low noise, broad-band amplifier circuit is shown below.

LOW NOISE BROAD-BAND AMPLIFIER



For more complete specifications, contact your Motorola district office, or write: Motorola Semiconductor Products, Inc., Technical Information Department, 5005 East McDowell Road, Phoenix 8, Arizona

CIRCLE 72 ON READER-SERVICE CARD

NEW PRODUCTS

Magnetic Clutch

414



Nylon-gear magnetic clutch model MC541 is for multiple clutch-potentiometer assemblies. It has a minimum torque of 6 oz-in. and exerts no drag on potentiometer when de-energized. Coil voltages are from 6 to 110 v dc. It is 1 in. in diameter and 1 in. long.

Altair Research & Manufacturing Co., Dept. ED, Box 106, Baldwin Park, Calif.
P&A: \$15; stock.

Stack Switch

474



A miniature stack switch, the Tini-Stack consists of a "pile-up" of various miniature springs, insulators, etc., with a max length of contact spring 1-3/4 in.; 3/16-in. mounting centers and 5/32-in.-wide switch parts. Springs are tempered nickel silver, contacts are welded. It is rated at 3 amp, 300 w, ac non-inductive load.

Switchcraft, Inc., Dept. ED, 5555 N. Elston Ave., Chicago 30, Ill.

DC Power Supply

401



Adjustable response time permits compensation for voltage-time differences between model MRST28-300 static dc power supply and the load inverter. Static line or load regulation is 0.1% and dynamic load regulation is ± 6 v; ripple is 1% rms. Measurements are 22 x 36 x 24 in.

Perkin Electronics Corp., Dept. ED, 345 Kansas St., El Segundo, Calif.

SILICONE NEWS from Dow Corning

For protection of value



New casting resin—Sylgard® 182— is tough, flexible and repairable

Visual inspection . . . environmental protection . . . ease of processing . . . simplicity of repairs — these and other features make Sylgard 182 an important new tool when engineering for value.

Tough yet flexible, this solventless silicone casting resin cushions against shock and vibration from -70 to 225 C . . . assures constant dielectric strength in any environment . . . resists the effects of ozone, voltage stress, heat aging and thermal cycling.

Processing is simplified since Sylgard 182 and its curing agent are not toxic to the skin . . . nor do they give off toxic fumes or heat during blending or curing. Curing time can be controlled by the external heat applied — from as little as 15 minutes at 225 C to 72 hours at 25 C.

Deep sections cure thoroughly. There are no solvent fumes to be trapped . . . and visibility is excellent. Applied as a fluid, Sylgard 182 resin flows readily around intricate shapes . . . cures even in deep sections without damage from internal stresses or exothermic heating.

Repairability is assured when circuits are embedded in Sylgard 182. Defective components can be removed and replaced after cutting away the cured resin with a sharp knife. New resin, poured over the repaired area, adheres to the existing encapsulant restoring the entire unit to its original condition.

CIRCLE 770 ON READER-SERVICE CARD

Dow Corning is your best source for a broad line of silicone fluids, gels, elastomers and rigid forms for potting, filling, embedding and encapsulating.



Dow Corning

ELECTRONIC DESIGN • October 25, 1961

-- specify these silicones

Visually inspect... instrument check and replace faulty parts with ease

Dielectric Gel permits both visual and instrument inspection of potted circuits and components. Poured as a liquid, Dielectric Gel fills all voids, then sets up as a transparent, heat-stable, resilient mass. No significant stresses or exothermic heating develops during cure. Even the most delicate electronic components are safe. Instrument probes can be inserted and withdrawn repeatedly without damaging the outstanding dielectric properties of this Dow Corning silicone potting material.

Circuit Repair is easy to accomplish. Simply cut away the gel surrounding a defective component with knife or scissors. After the circuit is repaired, simply pour new gel into the repaired area to restore original high quality protection.

CIRCLE 771 ON READER-SERVICE CARD



Deep section... rugged protection with repairable Silastic® RTV

Silastic RTV, Dow Corning's fluid silicone rubber that vulcanizes at room temperature, is available in several variations. Select the best one suited for your application or processing requirements. All have excellent dielectric properties, low water absorption, stability under extreme temperatures, resistance to thermal cycling and aging. The newest Silastic RTV cures in thick sections in 24 hours at 77 F. Variations in thickness have no significant effect on curing rate or material uniformity.

Vulcanized Patch. Defective parts embedded or encapsulated in Silastic RTV... even where thick sections are used... can be replaced. The cured Silastic RTV is cut away with a knife, the component replaced, and new Silastic RTV applied to the repair area. The fresh material bonds to the original, restoring the encapsulant's integrity.

CIRCLE 772 ON READER-SERVICE CARD



Free 12-page manual, "Silicones for the Electronic Engineer".
Write Dept. 4022, Dow Corning Corporation, Midland, Michigan.

CIRCLE 770, 771, 772 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 25, 1961

Cable Connector

472



An adapter device for interconnecting flat conductor cable with conventional round wire simplifies the introduction of the new flat cable to existing electrical and electronic equipment wiring systems. The connector makes the use of flat conductor cable practical for low-voltage control wiring, intercom systems and remote control wiring.

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

Interval Timer

471



Push-button interval timers, series 6200, have universal 4- or 3-stud mounting. Dial frame is available with interchangeable dial faces to provide up to four possible variations. A wide choice of time cycles is available with versatility in load circuit wiring.

Vocaline Co. of America, Inc., Bristol Motors Div., Dept. ED, Old Saybrook, Conn.

Vibrating Feeder

480



For semiconductor dice, wafers and other small parts down to fine powders, this vibrating feeder measures 3-in. in diam and 2-3/8 in. high. Escapements are machined directly into the plastic bowl to eliminate the necessity for gravity chutes. The unit may be built right into work stations.

The Minumus Co., Dept. ED, 1582 Manning Ave., Los Angeles 24, Calif.

P&A: \$160; immediate.

83



**NEW
DVM ENDS
MONTHLY**

RECALIBRATIONS

New EAI Series 5001 Transistorized Digital Voltmeter will maintain full accuracy without recalibration for more than six months. Accuracy specifications have significance only when supported by such stability. This unique digital voltmeter automatically seeks out the correct range for readings of 100 microvolts to 1199.9 volts. In addition to automatic range changing and 20% over-range, it provides floating input, accuracy of 0.01% full scale plus one digit, full time high input impedance up to 1000 megohms and an average of 200 readings per second. In all, the EAI Series 5001 is an outstanding instrument for laboratory, production and system use. Write for full information today to Dept. ED 10.

EAI

Career Opportunity for Engineers — Graduate or advanced degrees in EE, Physics, Math — call or write Gordon Strout, Director-Personnel

ELECTRONIC ASSOCIATES, INC. Long Branch, New Jersey

Leader in Analogics Analog/Digital Computers Data Reduction Process Control Instruments Computation Service

CIRCLE 74 ON READER-SERVICE CARD

NEW PRODUCTS

Oscillograph Recorder

478



A continuous oscillograph recorder conversion for standard oscilloscopes, the Mark II system is for simultaneous viewing and direct recording of oscilloscope traces. The unit uses a direct-printing method on a photo-sensitive material. It weighs 12 lb, is self contained and can be attached to any conventional oscilloscope.

Par Products Corp., Dept. ED, 602 Colorado Ave., Santa Monica, Calif.

Pre-Detection Receiver

508

For 900, 450 or 225-kc recording. The pre-detection receiver provides a means of collecting telemetry data for recording prior to demodulation. Playback from magnetic-tape recorder may be fed through the receiver and demodulated. Selection of seven if bandwidths is by means of plug-in bandpass filters.

Dynatronics, Inc., Dept. ED, P. O. Box 2566, Orlando, Fla.

Availability: 90 days.

Switching Transistor

403

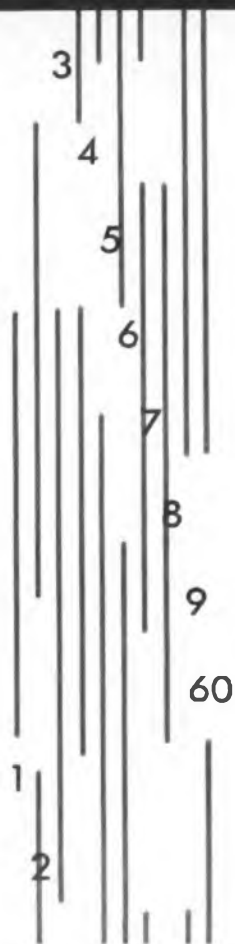


A maximum rise time of 10 nsec and a maximum storage time constant to 18 nsec are features of the 2N976 madt switching transistor. The units are packaged in TO-18 cases and have a minimum gain-bandwidth product of 600 mc and a power dissipation rating of 100 mw.

Philco Corp., Lansdale Div., Dept. ED, Lansdale, Pa.

P&A: \$5.78 each in 100 to 999 quantities; immediately.

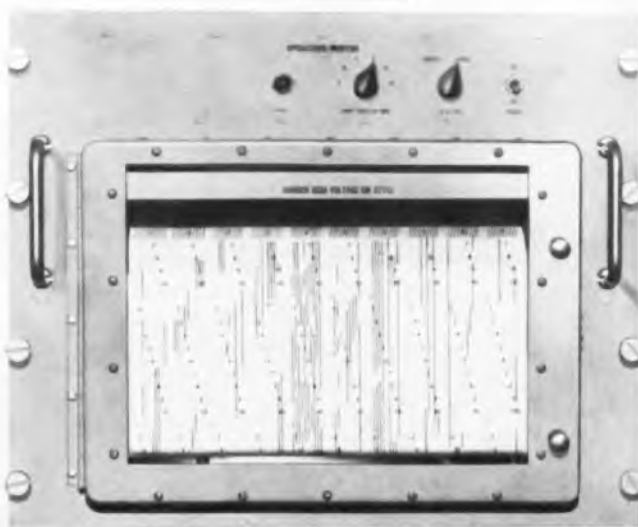
verify
events
permanently
in
milliseconds



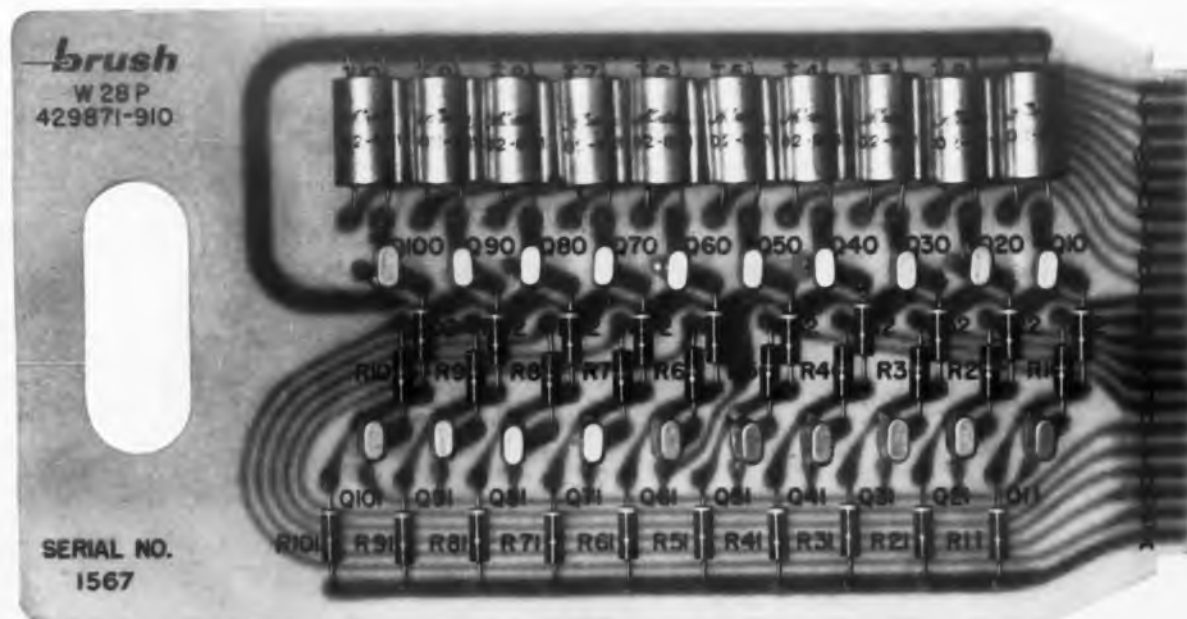
Brush Operations Monitors' response to signals is virtually instantaneous—less than 4 milliseconds. Multiple high-speed events are clearly defined from start to stop, on a common time base—and at rates up to 500 per second. Portable 30 channel or rack-mounting 100 channel models record sharp reproducible traces with fixed-stylus electric writing that provides the utmost in reliability. "Built-in" transistor switching to eliminate relays is optional. No direct writing recording system can match the capabilities of Brush Operations Monitors for industrial and military analysis and control. Write for complete specifications and application data.

brush INSTRUMENTS

DIVISION OF
CLEVITE
CORPORATION
37TH AND PERKINS CLEVELAND 14, OHIO



compact
transistor switching
for
millisecond
monitoring



The new Brush Trans-Switcher eliminates relays—greatly simplifies your problems of operations monitoring. Designed to take full advantage of the fast response and high resolution of Brush Operations Monitors, this compact, solid-state switching unit accepts up to 100 different "on-off" signals in a broad range of pulse shapes and amplitudes. Interchangeable, plug-in decade boards are designed to accept different voltage ranges and modes of operation. Avoid the "black box" approach—specify the *standard* Brush Trans-Switcher for the ultimate in precise, reliable monitoring. Write for complete details.

brush INSTRUMENTS
DIVISION OF
CLEVITE CORPORATION
37TH AND PERKINS CLEVELAND 14, OHIO



Solderless Terminals

501



A complete range of heavy-duty and large wire range terminals has been added to the firm's solderless terminal and connector line. Terminals are available in the 16 to 14 wire range in stud sizes 3 through 1/2-in. in the ring tongue, spade tongue, and flanged spade types. All terminals have brazed barrels.

Waldom Electronics, Inc., Dept. ED, 4625 W. 53rd St., Chicago, Ill.

Microminiature Relays

482



For dry circuit to high level switching, the 100N series of 6pdt relays conform to and exceed the test specifications of MIL-R-5757D. They feature bifurcated contact construction for longer life and greater reliability.

Iron Fireman Manufacturing Co., Electronics Div., Dept. ED, 2838 S.E. 9th Ave., Portland 2, Ore.

VLF Bridge

502



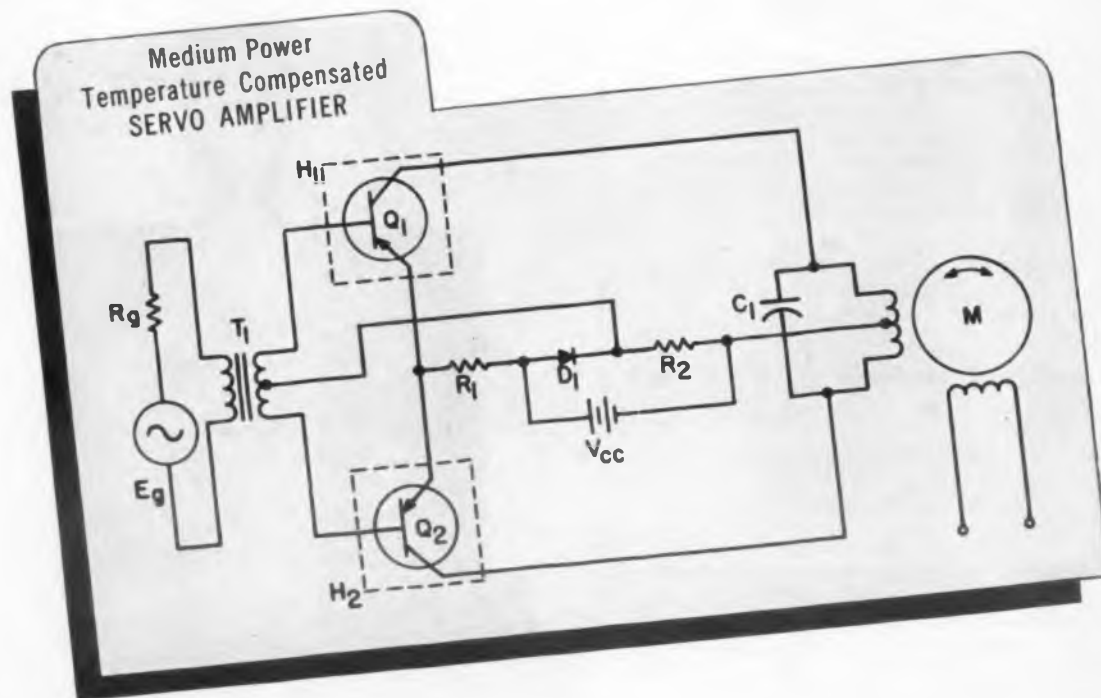
Completely transistorized, high sensitivity, low noise vlf mutual inductance bridge is for measurement of the susceptibilities of paramagnetic materials at cryogenic temperatures. It has its own power supply, signal generator and a built-in null-detecting oscilloscope. It can be tuned to 17 or 155 cps; sensitivity is $2 \times 10^{-4} \mu\text{h}$ with reproducibility better than one part in 1,000.

Cryotronics, Inc. Dept. ED, 191 Mill Lane, Mountainside, N. J.

CIRCUIT IDEA FILE

New Transistor Applications

Looking for simplicity in a servo amplifier?



This Class B push-pull servo amplifier using Honeywell's medium power transistors features:

- Temperature compensation—the germanium diode compensates for the transistor emitter diode temperature characteristic.
- Negligible crossover distortion—the same diode applies a slight forward bias so that the transistors are operating Class AB.

- Medium power—rated at 6 watts output into a size 15 servo motor.
- Simplicity—permits a package size limited only by the heat dissipators.

Honeywell's medium power transistors are packaged in a compact case for ease of mounting and versatility of wiring. For specifications and additional information, send the coupon below to: Honeywell, Dept. ED-10-251, Minneapolis 8, Minnesota.

COMPONENTS

Q₁, Q₂—Honeywell 2N 1658
 R₁—5 ohms—R₂—1000 ohms
 C₁— $25\mu\text{f}$ —D₁—1N 91 or equivalent
 V_{cc}—28 VDC—M—Size 15 servo motor
 T₁—UTC SSO-14 or equivalent
 E_g—400 cycle generator with R_g—1500 ohms
 H₁, H₂—5" x 5" x 1/16" aluminum plates

Honeywell

H First in Control
 SINCE 1885

Sales and Service offices in all principal cities of the world.

KINDLY CHECK ONE OR BOTH OF THE FOLLOWING:

Please send me your 2N 1658 and 2N 1659 specification sheets which include notes on the above servo amplifier.

Please have a Honeywell field engineer call on me at my convenience.

NAME _____

ADDRESS _____

COMPANY _____

CITY _____ STATE _____

CIRCLE 77 ON READER-SERVICE CARD

NEW PRODUCTS

Current Booster Amplifier

402



All solid-state, the P5 current booster amplifier is designed to be used as a follower with operational amplifiers to increase the available output current to as high as ± 20 ma at ± 10 v. Amplifier gain is 0.99 typically; max input signal is ± 12 v with minimum input impedance of approximately 50 K. The unit operates as a class AB amplifier.

Philbrick Researches, Inc., Dept. ED, 127 Clarendon St., Boston, Mass.
P&A: \$48 each; from stock.

Strain Gage Transducer

491



Unbonded strain gage pressure transducer, model 2521 has a hysteresis and linearity combined of less than $\pm 0.25\%$. Pressure ranges are 0-5 to 0-5,000 psia; zero balance is $\pm 1\%$ of full scale output; weight is 5 oz; thermal zero shift is $\pm 0.005\%$ F, size is 7/8 in. diam x 3 in.

Bourns, Inc., Dept. ED, 6135 Magnolia Ave., Riverside, Calif.

Price: upon request.

Micro Manipulators

490



Type CP VI micro-manipulator is equipped with three combination microscope coarse and fine adjustments. It is sufficiently stable to be used at magnifications of 500X or more. Various types of instrument holders, attachments, special bases and micro-injection equipment are available as accessories.

Brinkmann Instruments, Inc., Dept. ED, 115 Cutter Mill Road, Great Neck, L. I., N. Y.



NEW FROM BENDIX® 42 RECTIFIERS 3-6-12 AMP SERIES

New Bendix® silicon rectifiers offer lower current leakage for greater circuit stability—as low as 10 microamps at 600 volts. They're 'Dynamically Tested', an exclusive Bendix quality control process that individually tests each unit to assure uniform reliability. The result: dependable, versatile units that offer a wide range of voltage capabilities (50 to 600 volts PRV). Designs conform to JEDEC DO-4 outlines—with welded case and glass-to-metal hermetic seal between case and anode lead. Ideally suited for applications including magnetic amplifiers, DC blocking units, and power rectification. Write Bendix Semiconductor Division for information.

MAXIMUM RATINGS

Type Number	Forward Current Adc	Peak Reverse Voltage Vdc	Reverse Current at PRV		Forward Drop at 25°C Vdc
			@ 150°C	@ 25°C	
1N1124-1N1128	3 @ 50°C	200-600	—	10 μ Adc	1.1 @ 6 Adc
1N1199-1N1206	12 @ 150°C	50-600	10.0 mAdc	—	1.25 @ 12 Adc
1N1341-1N1348	6 @ 150°C	50-600	10.0	—	1.15 @ 6 Adc
1N1581-1N1587	3 @ 150°C	50-600	0.5	—	1.5 @ 6 Adc
1N1612-1N1616	5 @ 150°C	50-600	1.0	—	1.5 @ 10 Adc
1N2491-1N2497	6 @ 150°C	50-600	2.0	—	1.1 @ 6 Adc
B-443-B-449	12 @ 150°C	50-600	2.0	—	1.2 @ 12 Adc

Bendix Semiconductor Division

HOLMDEL, N. J.



Main Office: South Street, Holmdel, N. J.—Ph: SH 7-5400 • New England Office: 114 Waltham, Lexington, Mass.—Ph: VO 2-7650 • Detroit Office: 12950 West 8 Mile Road, Detroit 37, Mich.—Ph: JO 6-1420 • Midwest Office: 21565 York Rd., Elmhurst, Ill.—Ph: BR 9-5050 • West Coast Office: 117 E. Providence Ave., Burbank, Calif.—Ph: VI 9-3961 • Canadian Agents: Computing Devices of Canada, P.O. Box 508, Ottawa 4, Ont. • Export Office: Bendix International, 205 E. 42nd Street, New York 17, N. Y. Stocking Distributor: Contact nearest sales office for name of local distributor.

CIRCLE 78 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 25, 1961

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999
FACTORY PRICES APPLY!

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 331 Luckie St., N.W.—JACKSON 4-8477

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BIRMINGHAM, ALA.
 Ack Semiconductors, Inc.
 3101 Fourth Ave.—FAIRFAX 2-0588

BOSTON, MASS.
 Cramer Electronics
 811 Boylston St.—COPLEY 7-4700

BUFFALO, N. Y.
 Summit Distributors
 916 Main St.—TT 4-3450

CHICAGO, ILL.
 Newark Electronics
 223 W. Madison St.—STATE 2-2944

DETROIT, MICH.
 Rissi Electronic Supply
 14405 Wyoming Ave.—TEXAS 4-8420

GLENDALE, CALIF.
 R. V. Weatherford Co.
 6921 San Fernando Rd.
 Victoria 9-2741

LOS ANGELES, CALIF.
 Radio Product Sales
 1501 S. Hill St.—RICHMOND 8-1271

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NEW YORK, N. Y.
 Milgray—New York
 136 Liberty St.—RECTOR 2-4400

Milo Electronics
 530 Canal St.—BEEKMAN 3-2980

Terminal—Hudson
 236 W. 17th St.—CHELSEA 3-5200

OAKLAND, CALIF.
 Elmar Electronics
 140 11th St.—HILGATE 4-7011

PHILADELPHIA, PA.
 Radio Electric Serv. Co.
 701 Arch St.—WALNUT 5-5840

SEATTLE, WASH.
 Seattle Radio Supply, Inc.
 2117 Second Ave.—MAIN 4-2341

WASHINGTON, D. C.
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 2345 Sherman Way, N.W.
 HUDSON 3-5200

Bendix Semiconductor Division



NOLADEL, N. J.

CIRCLE 79 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 25, 1961

Induction Fan Motor

500



Open frame, high slip induction fan motor, model 35YH73 has an output nominally rated at 1/12 hp at 11,000 rpm. Size is 2-5/8 in. in diam by 2-1/2 in. long. Weight is 1.7 lb; duty is continuous with air through motor. Operation is from sea level to 60,000 ft.

Western Gear Corp., Electro Products Div., Dept. ED, 132 Colorado St., Pasadena, Calif.

Pressure Transducer

424



Wide-range pressure transducer series HPT-10 covers 0 to 100 and 0 to 10,000 psia or psig full scale. Static accuracy is $\pm 1.5\%$ on most ranges. Resolution is 0.22% to 0.33%. Suitable for military environments, it withstands temperatures from -55 to $+100$ C.

DeJur-Amsco Corp., Instrument Sales Div., Dept. ED, 45-01 Northern Blvd., Long Island City 1, N. Y.

Heat Sink

497



All aluminum heat sink is designed for soldering of fine wires on electronic components. Tapered jaws give easy gripping action for fine, delicate wires and the model 349 heat sink may be used as a tweezer or a clamp. It measures 3-1/2 in. long.

X-Acto, Inc., Dept. ED, 48-41 Van Dam St., Long Island City, N. Y.

Price: \$0.20.

DRAFTING
TRENDS



Appearance is not a good indicator of drafting film workability or reproduction quality—see test offer below.

In drafting films,
it's the coating
that counts

Film Similarities

All drafting films share one common characteristic—every major brand employs a polyester base. This polyester material may vary somewhat in grade (from clear to milky) or in gauge (from .002 to .007). However, its properties remain so nearly identical that no appreciable difference in print-back speed can be noted by exposing diazo material through the uncoated film. Accordingly, all polyester films have these unique features: dimensional stability, transparency, flexibility, moisture-resistance and tear strength.

Coating Differences

These advantages mean nothing to the engineer, draftsman or architect until a surface receptive to pencil and ink is put on the film. Post applies three distinct micro-coatings to its polyester film, baking these elements and the film at such high temperatures that they are literally fused. This process also "pre-shrinks" the material, endowing

Polytex with slightly greater dimensional stability.

More Drafting Latitude

The net result of the exclusive Post coating process is the most durable drafting film surface available—a surface on which, if circumstances demand, you can use the hardest grade of pencil without destroying the coating. Some pencils work better than others, of course. Plastic-based pencils are best of all when permanence or washability are considered.

Test Offer

To convince you, regardless of previous or present drafting film experience, that Post Polytex offers a superior coating with outstanding erasability, pencil and ink adhesion, a free Polytex test kit is yours without obligation. We'll mail an 8 1/2 x 11 drafting film sample, plus a vinyl eraser and drafting pencil assortment, packed in a Post Pocket Protector. Write for it on your letterhead today. Frederick Post Company, 3644 N. Avondale Avenue, Chicago 18, Ill.



SENSITIZED PAPERS & CLOTHS • TRACING & DRAWING MEDIUMS • DRAWING INSTRUMENTS & SLIDE RULES
 ENGINEERING EQUIPMENT & DRAFTING SUPPLIES • FIELD EQUIPMENT & DRAFTING FURNITURE

CIRCLE 80 ON READER-SERVICE CARD

You can put
1/2 TON
on this slide



New Heavy-Duty Slide from Chassis-Trak

Now you can rack-mount your heaviest electronic gear, yet keep it readily accessible for checking and servicing. A new heavy-duty Circulating Ball Slide, developed by Chassis-Trak, will easily support equipment in the 1000 lb. range, even under extreme shock and vibration conditions. Secret of the slide's strength is its Circulating Ball design (see phantom view above). Weight is distributed evenly over the balls which rotate in the direction of the pull, resulting in easy sliding action.

The new Circulating Ball Slide is permanently dry-lubricated with Poxylube 75, a bonded molybdenum disulfide film which assures smooth operation for the life of the slide. Easily assembled with standard hardware, the slide is available in lengths from 16" to 24" in two-inch increments and in lengths up to 60" in six-inch increments. Each track is only 1 1/2" wide and 3" high, requiring much less chassis space than other slides in this heavy-duty range.

Get full details on the new CB Slide today.



for further information contact:

525 South Webster Ave., Indianapolis, Indiana

CIRCLE 81 ON READER-SERVICE CARD

NEW PRODUCTS

Cabinet Ovens

487



Suitable for batch production, these standard cabinet ovens have heating capacities from 150 to 500 F. Sizes range from 2 x 2-1/2 x 2-1/2 ft to 3 x 4 x 2-1/2 ft interior dimensions. Accessories include recording controller, powered exhaust system, fresh air filter chamber, and extra shelves.

De Vilbiss Co., Dept. ED, Toledo 1, Ohio.

Cooling Unit

484



Cooling at any current up to 17 amp is provided by the F-3DC Frigistor. Operating voltage is 0.3 volts. It will pump 4.25 w min across a temperature difference of 0 C; at zero w load it will provide a temperature difference of 65 C or more. The unit is intended for use with stud-mounted diodes and transistors.

General Thermoelectric Corp., Dept. ED, P. O. Box 253, Princeton, N. J.

Modular Power Supplies

407



Modular, transistor regulated power supplies are designed for laboratory and prototype work. They may be operated at full ratings without heat sink at up to 35 C ambient temperature. The mounting base temperature is 65 C. Units are available in a full line of specifications ranging from 4.5-6.0 v to 45-55 v.

Power Sources, Inc., Dept. ED, Northwest Industrial Park, Burlington, Mass.

Availability: from stock.

CLEAN

Electronic, Electrical,
Mechanical Components
and Contacts with
NO Film or Residue

Cobehn

HIGH-VELOCITY
SPRAY-CLEAN TECHNIQUE



APPLICATIONS

Electronic Components & Assemblies: Diodes, Transistors, Slip-Ring Commutators, Crystals, Vacuum Tube Components, Sub-Miniature Assemblies.

Meter & Instrument Components: Instrument Bearings, Jewel Bearings & Pivots, Gear Trains, Lapped Surfaces.

Electrical Contacts: Relays, Vibrators, Voltage Regulators, Sensitive Switches.

FEATURES

No film, residue, or corrosive effect to damage surface, fire and explosion hazard nil, non-polar, non-ionic, an all around safe operation.

For specific information about your critical cleaning problems, send product information and production requirements.

Cobehn Inc.
226 Passaic Avenue
Caldwell, N. J. CApital 6-6675

CIRCLE 82 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 25, 1961

AC Relay

367



Occupies less than 1 cu in. and weighs 1.25 oz. For general-purpose use, series 5300 ac relay is rated at 3 amp, 115 v, resistive. It has 1 form C, cross-bar contacts arranged for spdt operation. Coil voltage is 220 v, 60 cps. It withstands 95% humidity, high shock and vibration.

Federal Pacific Electric Co., Cornell-Dubilier Electronics, Dept. ED, Fuquay Springs, N. C.
Availability: 1 to 4 weeks.

Pressure-Sensitive Tape 388

Polyvinyl fluoride film is available with a pressure-sensitive silicone polymer adhesive on one side. Called Temp-R-Tape PVF, the tape offers weatherability, toughness and chemical resistance as well as good electrical characteristics. Samples are 1-in., 5-yd rolls.

The Connecticut Hard Rubber Co., Dept. ED, 407 East St., New Haven, Conn.

P&A: sample rolls, \$5.

Precision Brake

379



A solenoid-operated, precision-built brake for sub-fractional hp electric motors is for use in stopping overtravel of motors used in computer mechanisms and tape transports. Braking torque is 2 to 4 in.-lb for shafts up to 3/8 in. Parts are cadmium plated, stainless or bronze. Without load the motor is stopped in less than 20 deg.

Midwest Automatic, Inc., Dept. ED, 510 Third St., Des Moines, Iowa.

CIRCLE 83 ON READER-SERVICE CARD ►



UNUSUAL CAREER OPPORTUNITIES FOR QUALIFIED SCIENTISTS AND ENGINEERS ... REGARDLESS OF RACE, CREED, COLOR OR NATIONAL ORIGIN ... WRITE AVCO/ELECTRONICS AND ORDNANCE TODAY.

Avco // **ELECTRONICS
AND ORDNANCE**
DIVISION

Avco and... satellite signal selection

Space vehicles are constantly exposed to many signals as they orbit the earth. Electronic interference, false messages... these are but two of the problems they contend with.

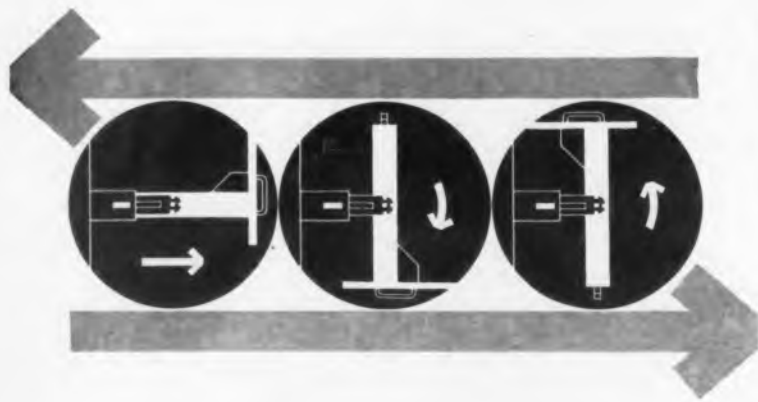
To receive correct commands, a new coder-decoder has been developed by Avco's Electronics and Ordnance Division working with NASA. Built around a single-conversion concept, the Avco unit ignores stray signals, shuns radio noise and interference. Today it is operating in Explorer XI, now orbiting the earth.

Miniaturized to save weight and space, this uniquely selective radio device will pull in only proper information, feed it to the decoder, and actuate the correct on-off controls and other satellite equipment as ordered.

Communications capabilities are among the many contributions of the Electronics and Ordnance Division's experienced engineering talent and skill. For more information on this new satellite receiver-decoder, or answers to your own communications problems, write: Director of Marketing, Communications Operation, Electronics and Ordnance Division, Avco Corporation, Cincinnati 15, Ohio.

New Avco receiver-decoder withstands extreme vibration, shock. 6.3" in diameter, only 3.5 lbs.





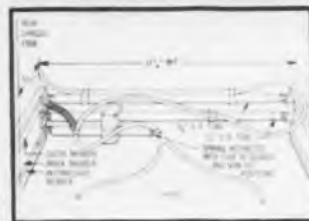
The Ins and Outs of System Packaging

Development of the common cabinet drawer was as important a contribution to storage as the wheel to mobility. Use of ball-bearings appreciably improves the action of both. Advanced drawer design has been applied by Jonathan to electronic chassis storage in the form of close tolerance, extruded aluminum ball-bearing slides for precision packaging. Now chassis are instantly accessible for maintenance and replacement. Gear of any weight may be accommodated without restriction of length and travel, and with tilting and locking features.

First Precision-Designed Cable Carrier

The new Power-Track Cable Carrier facilitates servicing rack-mounted electronic chassis without disconnecting the power source. It is the first cable carrier with uniform telescopic action in the carrier and the slides. Telescopic supporting arms are mounted to opposing sides of 3 member Jonathan Thinline telescoping chassis slides, forming a carrier along which the cable is supported. This transfers cable weight to the strong, smooth-running arms and ball-bearing slides, effectively preventing damaging vibration and shock.

The telescoping action allows full drawer extension and 90° tilting up and down. Since the cables are unable to sag or bind, there is no longer risk to other stored electronic chassis. Cable is compactly stored in minimum depth. The carrier system meets all applicable military standards.



Write for new 16 page descriptive brochure.

JONATHAN
MANUFACTURING COMPANY



720 East Walnut Avenue
Fullerton, California

Eastern District Offices
1209 Teaneck Road
Teaneck, New Jersey

CIRCLE 84 ON READER-SERVICE CARD

NEW PRODUCTS

DC Power Supplies

489



Both constant voltage and constant current output are available with dc power supplies known as Digital Set series. The six models cover the ranges of 100 and 1,000 v dc at currents of 100 ma and 1 amp. Repeatability accuracy is 0.01% and absolute accuracy is 0.05%. Ripple is below 0.002%.

Duncan Electric Co., Davenport Manufacturing Div., Dept. ED, 2530 N. Elston Ave., Chicago 47, Ill.

Blower Motors

498



Split-phase 1/2- and 3/4-hp motors come in 115 or 115/230 v models. They are designed for belt-drive blowers and fans. Motors start at less than full-load torque and smoothly accelerate to full performance.

Westinghouse Electric Corp., Industrial Motor Dept., Dept. ED, P. O. Box 566, Lima, Ohio.

Lamp Holder

499



Midget groove lamp holder, series WE 700, provides the space requirement necessary for the Midget Groove lamp. Unit comes with a standard 6-in. length of 0.22 gage 0.025 wall PVC wire and the housing is made of 0.010 anealed spring steel.

Webster Electronics Co., Inc., Dept. ED, 237 Lafayette St., New York 12, N. Y.

TELEMETRY BY TELE-DYNAMICS

NEW... **1**-watt

Transistorized FM Transmitter



If you've a need for light—17 ounces—extremely compact—20 cu. in.—215 to 260 MC telemetry transmitters, specify Tele-Dynamics' Type 1053A.

Providing one-watt true FM output, the 1053A employs dependable silicon transistors for high efficiency and offers better than 0.01% frequency stability. The 1053A will operate reliably at any altitude and under any environment. Pressurized o-ring sealed aluminum case keeps out water vapor, salt spray, sand and dust.

This unit, representative of Tele-Dynamics' latest creative effort in the complete telemetry field, is capable of being combined into various custom systems and is low in cost.

For detailed technical bulletins, call the American Bosch Arma marketing offices in Washington, Dayton, Dallas or Los Angeles. Or write or call Tele-Dynamics Division, American Bosch Arma Corporation, 5000 Parkside Avenue, Philadelphia 31, Pa. Telephone TRinity 8-3000. 8502

TELE-DYNAMICS
DIVISION

AMERICAN BOSCH ARMA
CORPORATION

5000 Parkside Ave., Philadelphia 31, Pa.

CIRCLE 85 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 25, 1961

Circuit Package

405



A flat, rectangular enclosure, suitable for multi-element components, thin film and solid-state circuits, the 2-D enclosure has a true glass-to-metal hermetic seal. The number of leads and package dimensions can be varied to conform to a particular miniaturization approach, such as printed circuit, micro-module, and welded mounting techniques.

Philco Corp., Lansdale Div., Dept. ED, Lansdale, Pa.

Force Washers

481

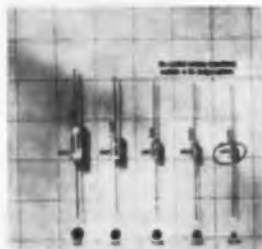


Temperature-compensated force washers are actually miniature load cells. They approximate the shape of regular bolt washers and come in standard bolt sizes ranging from 3/16 to 1 in. in diam. Temperature compensation is better than 0.5 micro-in. per in. per deg F over a range from 50 to 250 F.

Lockheed Electronics Co., Dept. ED, 6201 E. Randolph St., Los Angeles 22, Calif.
Availability: from stock.

Subminiature Inductor

397



Smaller by 20% than the companies Wee-Ductor, the Wee-Wee Ductor is a high inductance rf inductor in a range of 0.10 to 1,000 μ h. The units are encapsulated, non-flammable, rf-shielded and designed to meet MIL-C-15305B. Volume is 0.0042 cu-in.; weight is 0.38 g; diameter is 0.125 in.

Nytronics, Inc., Dept. ED, 550 Springfield Ave., Berkely Heights, N. J.




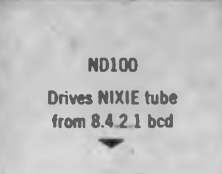




DIGITAL CIRCUIT MODULES



Militarized and industrial types including flip-flops, clock drivers, AND gates, and shift registers. Mounting cases for 72 or 250 modules offering easy access to cards and wiring. Send for Bulletin SP 120.

pb Packard Bell Computer

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 <p>MC250 Holds 250 modules and power supply</p>	 <p>TF101M Militarized flip-flop card. Meets MIL-E-5400C and MIL-E-16400C</p>	 <p>MT1 Dynamic and d-c module tester</p>
 <p>ND100 Drives NIXIE tube from 8.4.2.1 bcd</p>	 <p>pb</p>	 <p>MC72S 72 card case and power supply</p>
 <p>SR1 Shift Register</p>	 <p>TD2 Operates four lamps or relays</p>	

CIRCLE 86 ON READER-SERVICE CARD



New advanced coil forms
and Internal PERMA-TORQ®

RELIABILITY... locked in and guaranteed

Working on the problems plaguing electronic systems design, CAMBION® engineers developed a new device to keep coils and coil forms in proper adjustment.

This exclusive development is the CAMBION internal PERMA-TORQ, a miniaturized, constant tensioning unit located completely within the CAMBION ceramic coil form. Allowing tuning cores to be locked while still tunable, it considerably reduces harmonics, provides increased stability and decreases oscillation in high gain IF strips. Reliability under all conditions keynotes the performance.

New Internal PERMA-TORQ is available in coil forms with the normal yellow, red, green and white slugs — (range: 0.2-300 MC) and with purple slugs (range: 2-40 MC) and blue slugs (range: 40-300 MC). Mechanically, PERMA-TORQ is very easy to adjust. Only a special tuning tool is needed.

CAMBION makes more than 1500 coil forms with varying collar-and-terminal arrangements — including ceramic, phenolic and shielded forms for conventional and printed circuits. All are guaranteed to meet your specifications.

The broad CAMBION line includes plugs and jacks, solder terminals, insulated terminals, terminal boards, capacitors, shielded coils, coil forms, panel hardware, digital computer components. For a catalog, for design assistance or for both, write to Cambridge Thermionic Corporation, 457 Concord Ave., Cambridge 38, Massachusetts. In Europe contact Maitland Engineering, Ltd., 50 Heaton Moor Rd., Stockport, England, or Uni-Office, N.V., P.O. Box 1122 Rotterdam, The Netherlands.

CAMBRIDGE THERMIONIC CORPORATION
CAMBION®
The guaranteed electronic components

CIRCLE 87 ON READER-SERVICE CARD

NEW PRODUCTS

Telemetry Discriminators

495



Containing their own power supplies, these two telemetry discriminators are less than 2-in. wide. Model A-135 bandpass filter characteristics are equal to, or less than, 3 db over pass band and attenuation is equal to, or greater than, 20 db at the adjacent edges of a signal band. Model A-136 characteristics are identical except that attenuation is 30 db or greater at adjacent band edges.

Airpax Electronics, Inc., Deeco Div., Dept. ED, Van Nuys, Calif.

Price: A-135, \$400; A-136, \$650.

Microdiodes

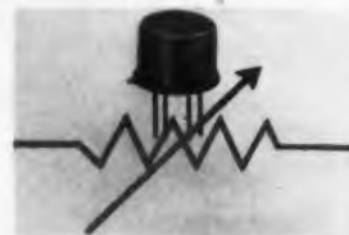
430

Power dissipation is 0.3 w at 25 C with average rectified current up to 0.2 amp at 25 C and 0.060 amp at 150 C for this new line of microdiodes. Elimination of surface failure mechanisms has been verified by complete absence of reverse characteristic degradation during tests which include storage at 200 C and operating life at twice maximum ratings.

MicroSemiconductor Corp., Dept. ED, 11250 Playa Court, Culver City, Calif.

Control Circuit

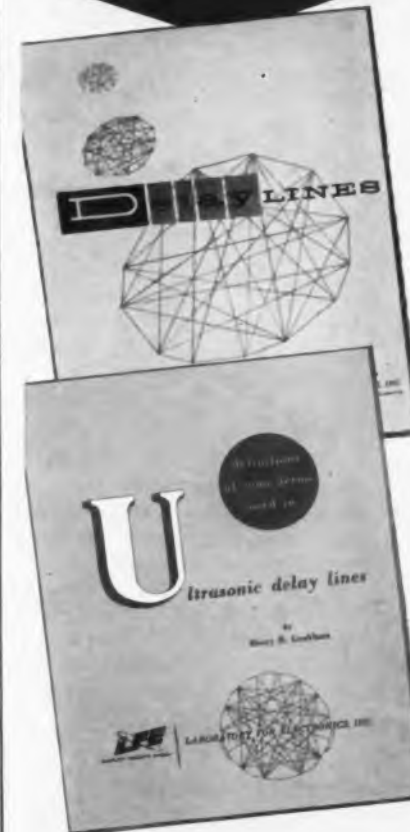
476



A silent potentiometer, sealed in a transistor case, the CK1114 is designed for either switch, relay or potentiometer application in circuits requiring minimal space and power. It can be driven with 25 mw at 1 v. When illuminated by this power, the photosensitive cell changes resistance value from 3×10^8 to 460 ohms. Designed to withstand up to 60 v dc across its terminals, the signal circuit will dissipate up to 50 mw.

Raytheon Co., Industrial Components Div., Dept. ED, 55 Chapel St., Newton 55, Mass.
P&A: \$8.75, 1 to 9; immediate.

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Computer Products Division
1079 COMMONWEALTH AVENUE
BOSTON, MASSACHUSETTS

CIRCLE 88 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 25, 1961

Interrogation Switch 373



Designed to exceed MIL-S-6807A, the series 2000 missile interrogation switch features any degree of indexing. Power handling capabilities are up to 5 amp, 115 v ac; 3 amp, 28 v dc resistive and 2 amp, 28 v dc inductive. They are rated to make, break and carry. They can be incorporated into a gear-driven gang installation to provide a switch assembly of 12 positions with a total of 96 poles.

Janco Corp., Dept. ED, 3111 Winona Ave., Burbank, Calif.
P&A: \$100 and up; 4 weeks.

Printed-Circuit Kit 389

Two grid boards measuring 3 x 5 in. are supplied in this printed-circuit board kit. Also included are: an etching tray, etchant, ball-point resist pen and resist tape.

Cramer Electronics, Inc., Dept. ED, 811 Boylston St., Boston, Mass.

Price: \$8.95.

Crossbar Switch 386



Single-pole double-throw crossbar switch includes five form C gold contacts per crosspoint and up to 120 crosspoints. Within each hold group the "makes" and the "breaks" each have common contact strips for the crosspoints. Dielectric strength is to 750 v ac and 1,000 v dc. Insulation resistance is greater than 10^5 meg at 25 C with 40 to 50% relative humidity.

North Electric Co., Dept. ED, Galion, Ohio.

P&A: \$640 each in 1 to 9 lots; six weeks.

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CIRCUPAKS

NEW IDEA! MODULAR CIRCUIT PACKAGES MAKE ENCAPSULATION EASY

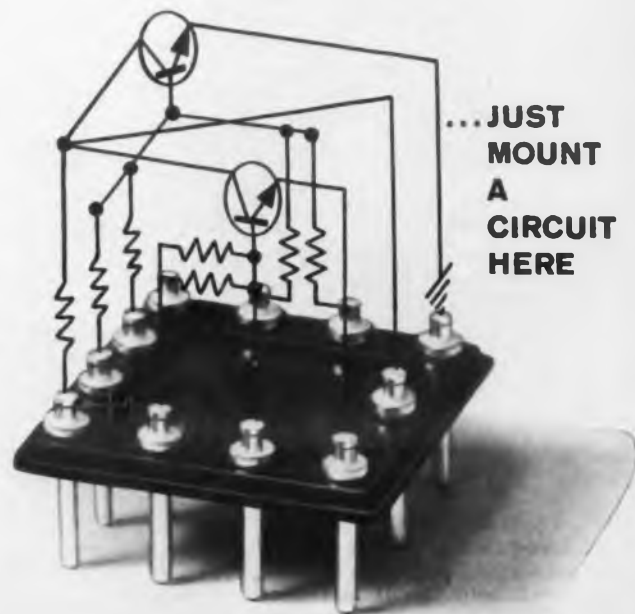
CIRCUPAKS are miniature cubes and cylinders, machine-molded of non-burning epoxy. Each has two parts: a header with gold-flashed pins secured in place; a snap-fit case with a hole in the top to be easily filled with encapsulation compound. The case and header fit together precisely . . . no other seal is needed during the curing period.

CIRCUPAKS eliminate waste, mess and special molding equipment. When filled and cured each becomes a one-piece, environmentally sealed module that fully protects delicate circuitry. Now quantity production can be automated. Eight different shapes and sizes (square, rectangular and cylindrical) comprise a standard line with "off the shelf" availability. One circuit or one thousand can be encapsulated with equal ease when standard CIRCUPAKS are used. Write for literature or order sample kit.

U.S. DIELECTRIC INC.

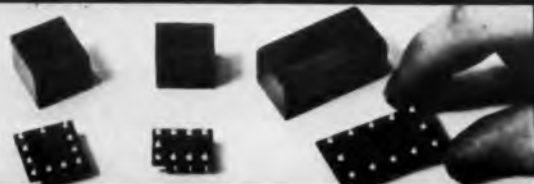
Dept. 11

181 GREENWOOD STREET,
WORCESTER, MASSACHUSETTS



SEND FOR SAMPLE KIT

A special kit for experimental work is ready. The three sample sizes shown at left, plus a convenient package of epoxy resin will be sent to you for five dollars (\$5). Send check or money order to U. S. Dielectric Inc. at above address.



NEW PRODUCTS

Transistor Tester 370



Power transistor tester model 1885 tests transistors to 50-amp I_C , power diodes to 5-amp forward current and Zener diodes to 150-ma leakage current. It measures these parameters: I_{CBO} , I_{CEO} , I_{EBO} , dc beta, input impedance, Z_{in} , output impedance H_{oe} , gm in μ mhos and mho. Alpha, collector voltages and V_{CC} can also be determined.

Hickok Electrical Instrument Co., Dept. ED, 10525 DuPont Ave., Cleveland 8, Ohio.

Sliding Desk Top 390

Formica sliding desk top provides a smooth surface for writing, servicing or inspection. It occupies 1-3/4 in. of panel space, fitting flush with panels. Usable surface is 11 x 16-7/8 in. It fits standard 19-in. racks or cabinets.

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

Circuit Breaker 371



Three-pole miniature circuit breaker model 1526 has a single push-pull actuator. It is for use on 400 cps, 115 or 200 v systems, particularly in aircraft or electronics industries. Ratings available are 1 to 5 amp in steps of 0.5 amp. It meets MIL-C-5809C.

Mechanical Products, Inc., Dept. ED, Jackson, Mich.

SEMICONDUCTOR NEWS: FROM WESTINGHOUSE AT YOUNGWOOD



Westinghouse announces new 70-amp ratings in "Rock-Top" Tristor[®] controlled rectifiers

Highest rated flag type in the industry. Type 809 Tristor controlled rectifier series, in both flag terminal and flexible lead types, now immediately available in production quantities at 70-amp ratings! Exclusive Westinghouse "Rock-Top" construction offers superior electrical and mechanical characteristics for greater performance reliability under all operating conditions. Provides positive protection against arcing at highest voltages. Exclusive new flag terminal design has lower weight . . . requires less headroom. Outstanding parameters include: ■ 600 nano-second switching time ■ efficiencies in excess of 98% ■ minimum noise level ■ peak reverse voltages to 480 volts ■ ideal parameters for high-speed static switch functions.

Industrial, commercial, and military applications include: high-frequency power generation; variable frequency controls; pulse generation; ignitron firing; welding control. Tristors also replace thyratrons, contactors, magnetic amplifiers, relays.

For more information, or technical assistance, contact your nearest Westinghouse representative, or write: Westinghouse Electric Corporation, Semiconductor Department, Youngwood, Penna. *You can be sure...if it's Westinghouse.* SC-1046

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NEWARK ELECTRONICS, CO.
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Westinghouse



Electromagnet

376



An iron-bound air-core solenoid, the Magnion UFS-3 is a 12-kilogauss electromagnet for uses such as Zeeman effect, magneto-optics, Faraday effect and magnetic materials research. The complete solenoid weighs less than 100 lb with poles and it measures 8 x 8 x 8 in.

Magnion, Inc., Dept. ED, 195 Albany St., Cambridge 39, Mass.

Multi-Turn Potentiometer

368



For use to 150 C, the PM305 10-turn potentiometer with molded body, measures 3/8 in. in diameter and weighs 5 g. Rotation is 3,600 +20 or -0 deg with active coil length of 8 in. Torque is 0.5 oz-in. Resistance range is 50 to 100,000 ohms; resistance tolerance is ±3%.

General Controls Co., Aircraft/Electronic Controls Div., Dept. ED, 1320 S. Flower St., Burbank, Calif.


High-Resolution Camera

357



Vidicon camera type V-945 has a 700-line horizontal resolution and a 650-line vertical resolution at 15 ft-c. A useable picture is delivered with as little as 1 ft-c reflected light. The camera withstands 120 F operating temperature. Controls can be remote.

American Microwave and Television Corp., Dept. ED, 61 Renato Court, Redwood City, Calif.



SAVE SPACE WITH THIN, EXTRA-STRONG ELECTRICAL TAPES OF MYLAR®

Here's a pressure-sensitive tape that packs great strength into thinner gauges (20,000 psi for 1 mil). Tape of Mylar* polyester film saves space because manufacturers can use thinner gauges with no loss in performance... at lower cost per linear foot.

Want more? "Mylar" also provides —flexibility for snug wraps—high dielectric strength (4,000 v/mf)—dimensional stability at high humidities —moisture and chemical resistance —resistance to temperatures from -60°C to 150°C. And "Mylar" lasts and lasts because there's no plasticizer to dry out with age.

Insulation of "Mylar" gives motors 50 to 100% longer service-free life. Gives capacitors longer-lasting stability, greater reliability. In a wide variety of electrical applications, the advantages of "Mylar" can improve the performance, lower costs. Evaluate "Mylar" for your product. Write for free booklet (SC) detailing properties. Du Pont Co., Film Dept., Wilmington 98, Delaware.



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... THROUGH CHEMISTRY



*Registered Du Pont trademark.
†ASTM D-149

CIRCLE 91 ON READER-SERVICE CARD

NEW PRODUCTS

Decade Capacitors

503

Heat-treated polystyrene decade capacitors are housed in aluminum cabinets. Type 1419-B has capacitance values up to 1.11 μ f in steps of 0.0001 μ f, accurate to 1%. Type 1424-A decade provides standard capacitance values from zero to 10 μ f. The 1- μ f sections are accurate to 0.25%; both 2- and 3-terminal connections are provided.

General Radio Co., Dept. ED, West Concord, Mass.

Price: 1419-B, \$262; 1424-A, \$325.

Reversing Counters

494



Designed to count "up" or "down", model 3300 reversing counters are totally solid-state. They count at rates up to 200,000 counts per second. Three to six digit readout capacities can be supplied. Optional features are dual input channels with A + B and A - B anticoincidence functions, accumulate-count gate control and automatic reset gate and display control.

Beckman Instruments, Inc., Dept. ED, 2200 Wright Ave., Richmond, Calif.

P&A: \$1,495 (5 digits); 90 days.

Telemetry Receiver

426

Completely modular, model TMR-6 136-mc telemetry receiver has plug-in rf heads, if amplifiers, demodulators and pre-detection recording converters. Frequency range is 136 to 137 mc; noise figure is 3.5 db; rf bandwidth is 2 mc; image rejection is greater than 65 db.

Defense Electronics, Inc., Dept. ED, 5451-B Randolph Road, Rockville, Md.

P&A: \$1,410; 30 to 60 days.

High Capacity Switches

431

Type M switches have a 22-amp steady state current capacity. Maximum differential travel is 0.001 in. and minimum overtravel is 0.005 in. They handle up to 35-amp inrush currents from solenoids and motors. Operating force is 7 to 10 oz; release force is 4 oz min; break distance is 0.010 in. min.

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

P&A: \$2 each, 1 to 9; immediate.

CIRCLE 92 ON READER-SERVICE CARD >



CLEVITE TRANSISTOR
WALTHAM MASSACHUSETTS

RELIABILITY

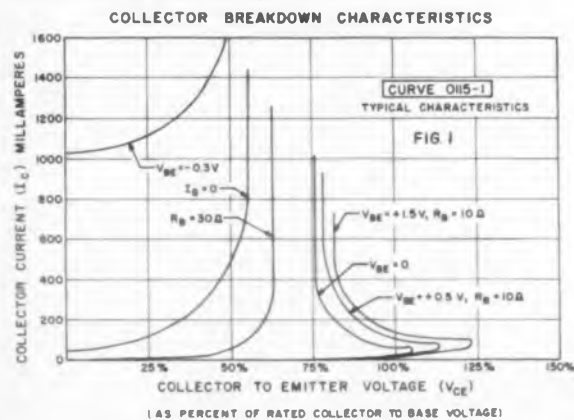
VOLUME...

How Siegler built ultra-reliability into its new 3 KVA Inverter

by **RAYMOND F. KEEGAN**
Commercial Engineer, Clevite Transistor

Magnetic Amplifiers Division of The Siegler Corporation has announced the development of a 3 KVA Static Inverter featuring high conversion efficiency, precision voltage regulation, synchronized phase locking, short circuit protection with automatic recovery, and reliable high performance operation in the presence of transient line voltages. The unit is designed for minimum space-weight requirements and meets with Mil Specs MIL-E-5400 and 5272.

Developed to convert nominal 28 VDC to regulated 200 V 400 CPS 3 phase, the unit is designed for military reliability in aircraft, missiles, space vehicles, ground guidance and detection systems.

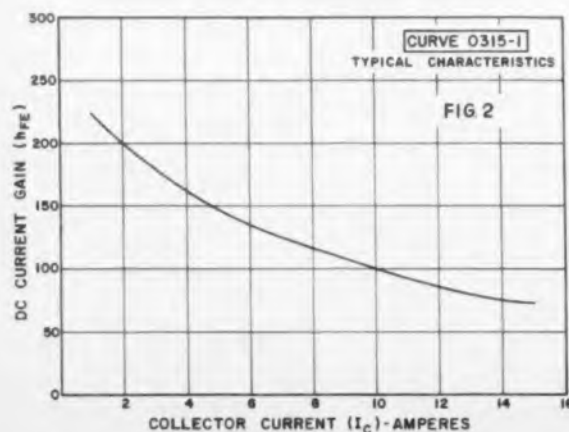


DESIGN CONSIDERATIONS

Because of the need for highly stabilized output voltages at high current levels, power transistors capable of handling these currents with uniform gain characteristics over a wide operating range were required (Fig. 1). Guaranteed gain spread and low saturation voltage were important factors.

Since aircraft power sources are subject to transient voltages which may damage transistor junctions, extra consideration was given to the selection of power transistors with known collector to emitter voltage capabilities.

CURRENT GAIN VS COLLECTOR CURRENT



The ability of Clevite 2N1146B power transistors to meet the requirements of the design caused Siegler to select them for the high power output and driver stages of the system. Clevite's 2N1146 series of transistors has specified minimum values of collector to emitter voltage under shorted and open base conditions both measured at high values of collector current to preclude the possibility of secondary breakdown caused by high local current densities (Fig. 2). Collector to base junction leakage current is specified as a maximum value at two voltages at room temperature and at the shorted base collector to emitter voltage at the maximum rated junction temperature.

The Clevite 2N1146 series of high current power transistors is conservatively rated for use in applications

Electrical Characteristics	Symbol	Measurement Conditions	2N1146B		
			Min	Mode	Max
DC Current Gain	h_{FE}	$I_C = 5A$ $V_{CE} = -2.0V$	60	100	150
Base Input Voltage	V_{EB}	$I_C = 15A$ $V_{CE} = -2.0V$	1.0	2.0	
Collector to Emitter Saturation Voltage	$V_{CE(SAT)}$	$I_C = 15A$ $I_B = 1.0A$	0.5	1.0	
Thermal Resistance	R_{θ}				0.8
Collector to Base Breakdown Voltage	BV_{CBO}	$I_{CBO} = 15mA$	80		
Emitter to Base Breakdown Voltage	BV_{EBO}	$I_{EBO} = 10mA$	30		
Collector to Emitter Sustain Voltage	$V_{CES(SUS)}$	$I_C = 500mA$ Swept to 750mA Shorted Base $V_{EB} = 0$	60		
Collector to Emitter Sustain Voltage	$V_{CEO(SUS)}$	$I_C = 1500mA$ Open Base $I_B = 0$	40		
Collector Cutoff Current	I_{CBO}	95°C	60 Vdc		4.0
Collector Cutoff Current	I_{CBO}	25°C	20 Vdc 30 Vdc 40 Vdc 50 Vdc	2.0	4.0

requiring a combination of high current gain at high operating currents and high collector to emitter breakdown voltages.

For more complete information write for Bulletin B221-1A

CT CLEVITE TRANSISTOR
Waltham, Massachusetts



Silicon epitaxial star planar transistor combines the advantages of epitaxial growth and surface passivation with a star geometry for efficient operation in circuits from dc to 100 mc. Specifications are: frequency range, dc to 100 mc; switching speed at 0.5 amp, 10 nsec; collector saturation voltage, 0.5 v at 0.5 amp; power dissipation, 3 w; gain-bandwidth product, 400 mc.

Motorola Semiconductor Products Inc., Dept. ED, 5005 E. McDowell Road, Phoenix 8, Ariz.

Pneumatic Receiver 391

Strip-scale indicating receiver, designated series 654, is a pneumatic receiver and can be used as a single unit or gang assembled for horizontal or vertical mounting. Range is 3 to 15 psi. Model OBH654 is a single-pointer unit; model 00BH654, dual-pointer.

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

DC To DC Converter 375



Solid-state dc to dc converter is designed for airborne, ground or shipboard computer applications. It may be operated continuously within confined areas restricted to convection cooling. The multiple output 40-w converter furnishes $\pm 3\%$ regulated $+15$ and -15 v dc and $\pm 5\%$ regulated $+6$ and -6 v dc output voltages. Efficiency is 65% at 28 v dc input and full load.

Magnetic Research Corp., Dept. ED, 3160 W. El Segundo Blvd., Hawthorne, Calif.

CIRCLE 93 ON READER-SERVICE CARD ▶

◀ CIRCLE 92 ON READER-SERVICE CARD

get
all
the facts
about
readouts

readout fact finder

ANOTHER ELECTRONIC CONTRIBUTION BY
Burroughs Corporation
ELECTRONIC COMPONENTS DIVISION
PLAINFIELD, NEW JERSEY

This 14-page factual report compares the six major types of in-line readout devices from the standpoint of viewing distance, viewing angle, speed and method of operation, size, weight, power, cost, reliability and life.

Write for the Readout Fact Finder today. Learn where NIXIE® Indicator Tubes stand in relation to other visual displays in this unique comparative study.

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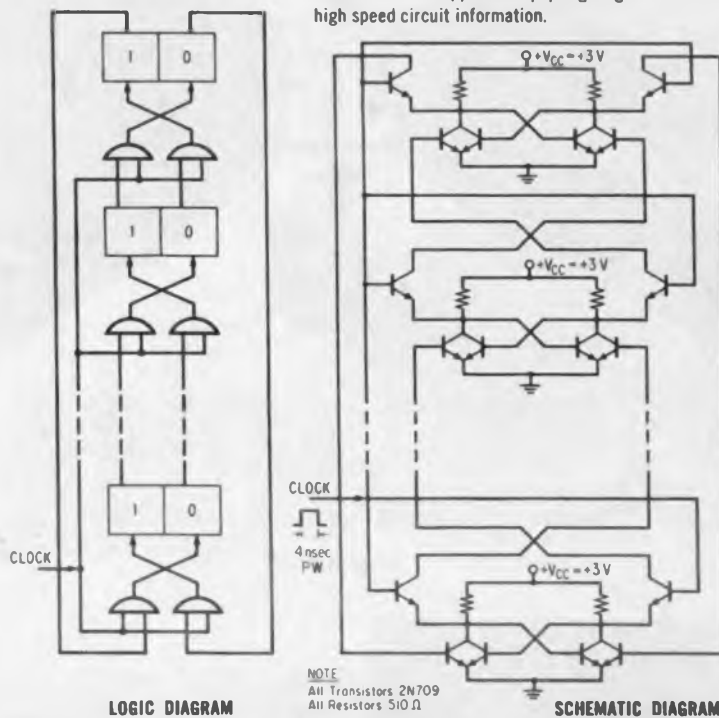
SIMPLIFIED/LOW COST
150 mc SWITCHING

MADE POSSIBLE BY FAIRCHILD SILICON PLANAR 2N709

CIRCUITS

A 2N709 Application: 150 mc FIVE-STAGE DECIMAL COUNTER

Write for APP-43 application paper giving more high speed circuit information.



PERFORMANCE CHARACTERISTICS

Typical propagation time of 2.5 nsec per stage. Combined turn-on and turn-off time of 5.0 nsec. Excellent gain-bandwidth (typically 800 mc) at high currents and low voltages.

FAIRCHILD PLANAR RELIABILITY

Reliability is inherent to the Fairchild Planar process because of the integral oxide surface. All junctions are completely protected against contamination from the start of manufacture, guaranteeing parameter stability and uniformity.

INITIAL AND OVERALL SAVINGS

The 2N709 is available NOW, at prices practical for the breadboard budget as well as quantity production. Additional savings result because UHF circuits can be designed with the 2N709 and require fewer component types as well as a much smaller total number of components.

THE 2N709:

ELIMINATES NEED FOR NON-SATURATING AND/OR TUNNEL DIODE CIRCUITS

SOLVES DESIGN AND ASSEMBLY PROBLEMS FOR APPLICATIONS SUCH AS:

- DIGITAL COMPUTER LOGIC CIRCUITS WITH BIT RATES OF 50 TO 100 mc
- BINARY AND DECIMAL COUNTER AND DECODER CIRCUITS WITH BIT RATES OF 100 TO 300 mc

FAIRCHILD

SEMICONDUCTOR

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A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

Astromics *Variable Reluctance*
PRESSURE TRANSDUCERS
total system solution

FOR RECORDING
A DC system with Voltage Amplifier, Oscillator, Feedback Amplifier, and Demodulator will custom...

FOR CONTROL - 400 cycle unit containing input transformer and Feedback Amplifier.
write for Fact Sheet on **NEW ASTROMICS VERNATOR—PRESSURE REGULATOR**

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666 West Harvard Street, Glendale 4, California

CIRCLE 95 ON READER-SERVICE CARD



“ELECTRONIC DESIGN EDITING IMPROVES COMMUNICATION...”

... writes Vincent Rocco, Project Engineer, Reeves Instrument Corporation, and author of a recent article in *Electronic Design*.

*“I was particularly impressed with the format used in the art exposition. The contrasting colors did much to simplify the interpretation of the various graphs. I considered *Electronic Design* for publication of my article because of its large circulation and its unique method of presentation.”*

Photo shows Mr. Rocco evaluating the performance of the Standard Electronics Product Line of Reeves Instrument Corp.

If you have design information to share, why not do so in the industry's best read magazine, *Electronic Design*. To begin, send an outline of your article to Edward E. Grazda, Editor, *Electronic Design*, 850 Third Ave., New York 22, N. Y. Your efforts will benefit the entire industry.

NEW PRODUCTS

DC Power Supply

477



A silicon rectifier-type dc power supply, model MRST28-200 has dynamic regulation of ± 6 v for instantaneous load changes of full load magnitude. Ripple is 1% rms; dc output is 24-32 v at 200 amp. Magnetic amplifier and transistor regulators maintain static regulation tolerance of 0.1%. Response time is adjustable between 20 and 200 msec.

Perkin Electronics Corp., Dept. ED, 345 Kansas St., El Segundo, Calif.

Nickel-Cadmium Battery

520



Rated at 8 w-hr, this nickel-cadmium battery can deliver 8 amp. Nominal-load voltage is 5 v. Battery is rechargeable. Unit is made to power a cordless electric drill.

Gould-National Batteries, Inc., Dept. ED, E-1200 First National Bank Building, St. Paul 1, Minn.

Ultrasonic Cleaner

518



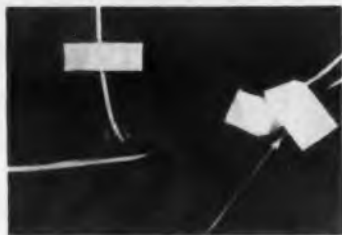
Producing a 200-kc sinusoidal output, the series 751 ultrasonic cleaner has a focussing device which can achieve cavitation within the liquid cleaner medium rather than at the transducer surface. Operation below the cavitation level is recommended. A wide range of detergents can be used with the cleaner. Unit is thermostatically controlled.

B. M. Harrison Electronics, Inc., Dept. ED, 80 Winchester St., Newton Highlands, 61, Mass.

P&A: \$695 to \$795; immediate.

Wire-Harness Fastener

517



Flexible fastening material for wire harnesses is called Velcro. One material contains small nylon hooks which cling to the nylon loops on another material. The materials separate when pulled apart. They do not use adhesive. The material can be used many times and is said to have a long life.

The Hartwell Corp., Dept. ED, 9035 Venice Blvd., Los Angeles 34, Calif.

Silicon Controlled Rectifier

524



Capable of blocking 500 v, the type C50E silicon controlled rectifier is of hard solder construction. Transients up to 600 v are handled. Average forward current rating is 110 amp dc, 70 amp at 180-deg conduction angle. One-cycle surge current rating is 1,000 amp. The unit is available as an inverter with specified turn-off times.

General Electric Co., Dept. ED, W. Genesee St., Auburn, N. Y.

Availability: from stock.

Transfer Relay

525



For switching up to 17 kv ac or dc, the RVS-1 transfer relay is spdt, normally closed, and is designed for long life. Coil is normally 28 v dc; 117-v ac coils can also be furnished. Maximum current at 17 kv is 0.25 amp; at 5 kv, 1.5 amp. Pull-in time is 20 msec.

Resistron Laboratories, Inc., Dept. ED, Drawer 2, 2908 Nebraska Ave., Santa Monica, Calif.

P&A: \$34.50; stock.



INLAND

first with solid state 100-watt d-c amplifier

Inland's new Model 579.35 d-c amplifier has a high power output of 100 watts when used with low impedance loads requiring direct current. And this completely transistorized amplifier is packaged in a hermetically sealed can only 2½" x 3¾" x 2½".

Designed for use with d-c torquers, in one typical application Model 579.35 provides 65 db power gain between the output of a d-c driver stage and the input terminals of a permanent magnet torque motor. This amplifier has these outstanding performance characteristics:

- The d-c output has magnitude and polarity proportional to the input signal.
- All amplifier circuits use a combination of silicon and germanium transistors (all-silicon models also available).
- Amplifier null and gain are stable and independent of temperature.

Inland also makes a complete line of rotary amplifiers for matched use with Inland's distinctive pancake shape d-c torquers.

A brochure on this new high-power amplifier is available. For your copy and complete data on Inland torquers and amplifiers, write Dept. 3-10.

TYPICAL SPECIFICATIONS

Maximum Power Output, watts (6 ohm load)	100
Power Gain	4,000,000
Current Gain	200,000
Voltage Gain	15
Frequency Response	DC to 1000 cps
Input Impedance, ohms	50,000
Dimensions, inches	2½ wide 3¾ long 2½ high

Operating Temperature Range in °C minus 50° to plus 50°

INLAND MOTOR



INLAND MOTOR CORPORATION OF VIRGINIA A SUBSIDIARY OF KOLLMORGEN CORP., NORTHAMPTON, MASS.
CIRCLE 96 ON READER-SERVICE CARD

Phil
Greenstein
can
show
you...



how North Atlantic's Phase Angle Voltmeters solve tough ac measurement problems ... in the lab or in the field.

Designed for critical tasks in circuit development, production and testing, North Atlantic's Phase Angle Voltmeters provide direct reading of phase angle, nulls, total, quadrature and in-phase voltages—with proven dependability even under field conditions. Your North Atlantic engineering representative can quickly demonstrate how they simplify ac measurement jobs from missile checkout to alignment of analog computers—from phasing servo motors to zeroing precision synchros and transducers.

Shown below are condensed specifications for single-frequency Model VM-202. Other models include high sensitivity, three-frequency and broadband types.

Voltage Range.....	1 mv to 300 v f.s., 12 ranges
Voltage Accuracy.....	±2% f.s.
Phase Accuracy.....	dial: ±1°; meter: ±3% of F.S. degrees
Signal Frequency.....	1 Freq., 30 cps—10 kc
Input Impedance.....	10 megohms
Reference Input.....	100 K, 0.25 v min.
Meter scale.....	3-0-3, 10-0-10 linear
Phase Angle Dial.....	4 scales, 90° (elec.) apart
Nulling Sensitivity.....	2 microvolts (phase sensitive)
Harmonic Rejection.....	55db (with filters)
Dimensions.....	5¼" h. x 19" w. x 7¾" d.

The North Atlantic man in your area has full data on standard and special models for laboratory, production and ground support. Call today for his name, or request Bulletin VM-202.



NORTH ATLANTIC industries, inc.
TERMINAL DRIVE, PLAINVIEW, L. I., NEW YORK • OVerbrook 1-8600

CIRCLE 97 ON READER-SERVICE CARD

NEW PRODUCTS

Size 11 Servo Motor

523



Viscous-damped servo motor operates at 57.5 or 115 v, 400 cps power. Designated type R180-001, the motor operates where high damping or low time constants are required. Stall torque is 0.6 in.-oz. No-load speed is 1,700 rpm. Power input is 3.5 w. Unit weighs 6 oz.

Kearfott Div., General Precision, Inc., Dept. ED, 1150 McBride Ave., Little Falls, N. J.

Pulse Counter

514

Single and dual-channel 1-mc pulse counters, one or two seven-decade counting units in a standard logic bay. Counts are displayed on front panels in neon-lighted decimal digits. The 8-4-2-1 binary-coded decimal count in each scaler is available at the front panel on four parallel lines where they can perform logic functions.

Harvey-Wells Electronics, Inc., Dept. ED, 14 Huron Drive, Natick, Mass.

P&A: \$2,100 (dual channel); 2 weeks.

Magnetic Hold Switch

537



With build-in solenoid. The magnetic hold switch can be released remotely. Having dpdt design, the switch has ratings of 28 v dc at 24 amp, inrush, 4 amp resistive, 2.5 amp at sea level (sealed) and 2 amp at 65,000 ft. (unsealed) inductive.

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

P&A: \$51.95; stock.

Versatility TO SAVE YOU MONEY

PANEL MOUNTING ALL-ANGLE BLOWERS

One multi-purpose model in stock will eliminate procurement of several single-purpose units to satisfy variable requirements. Large cooling capacity.



Twin scrolls can be rotated and set to angle of choice through 230° for accurate air flow control.

Use for supply or exhaust—or one port for supply, the other exhaust.



MODEL AAB-8¼

Mount as standard 8¼", 7" or 3½" panels. Blower unit of 3½" model is recessed to allow extra usable chassis or storage space.



MODEL AAB-3½

- MIL quality heavy duty construction and finish or finish to Customer specs
- Easy maintenance without removal from cabinet
- Cushion mounted for quiet operation
- Cleanable filter
- Motor bearings permanently lubricated

Ask for complete data—our Bulletin D-1000

ONE SOURCE . . .

for VENTILATED RELAY RACK CABINETS,
CONTROL CONSOLES, BLOWERS, CHASSIS,
CHASSIS-TRAK, RELATED COMPONENTS

ORegon 8-7827

WESTERN DEVICES, INC.

600 W. FLORENCE AVE., INGLEWOOD 1, CALIF.

CIRCLE 98 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 25, 1961

Pressure Transducer 363



Static error is $\pm 1\%$. Model 426 pressure transducer has ranges of 0 to 5 to 0 to 200 psia or psig. Nominal resolution is 0.3 at 10,000 ohms. It is for experimental, industrial and military ground applications in telemetry and control. It withstands vibration to 10 g.

Bourns, Inc., Dept. ED, 6135 Magnolia Ave., Riverside, Calif.

Analog Computers 392

For industrial process control. The PC-12 analog computers are assembled from modular components designed to meet process environments of high humidity, corrosive atmosphere and temperature extremes. The components are permanently programmed to meet specific applications.

Electronic Associates, Inc., Dept. ED, Long Branch, N. J.
Availability: assembled from stock components.

FM Transmitter 354



Rated at 250 w, the 830B-1 fm transmitter includes self-contained multiplexing equipment and FCC approved stereo-multiplex system. The transmitter is pushbutton operated; all rf circuits are tuned from the front panel. The power supply uses silicon rectifiers. The unit may also be used as an exciter for a 5,000-w installation.

Collins Radio Co., Dept. ED, P. O. Box 1891, Dallas 21, Tex.

CIRCLE 99 ON READER-SERVICE CARD >

MACH 5... MACH 10...

and Beyond



STEVENS *Certified* THERMOSTATS

Up where the "wild blue yonder" becomes inky black, you can't afford to gamble on precise, reliable temperature control. And that's the natural domain of Stevens thermostats. They are compact and lightweight... withstand high G's... are utterly reliable even under wide temperature swings. For Stevens Thermostats are a product of creative engineering... coupled with the most stringent environmental testing and quality control programs in the industry. If space is your dimension, take the measure of Stevens thermostats *first*.

STEVENS *manufacturing company, inc.*
P. O. Box 1007 • Mansfield, Ohio

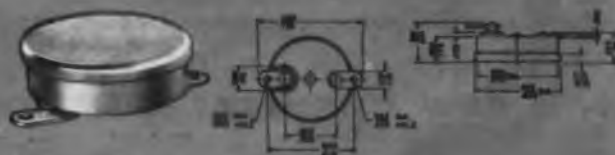


THERMOSTATS

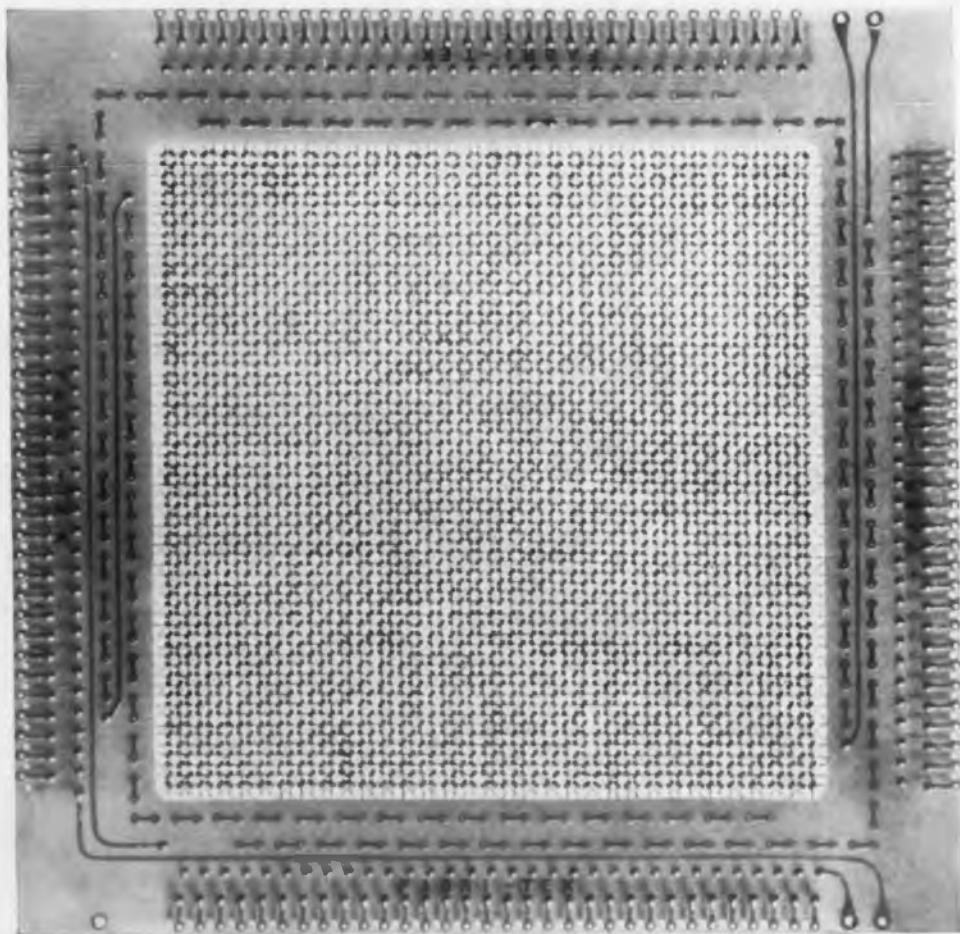
Type MX shown;
other Certified disc types available

2° to 6°F Differential Standard
1° to 4°F Differential Special

**Maximum spread of 6°F*
including differential and tolerance



*6°F is difference between maximum open and minimum close



Memory unit fabricated by Fabri-Tek, Incorporated, Minneapolis, Minnesota;
Unit frame base material laminated by Mica Corporation, Culver City, California.

DOW EPOXY CAPABILITY SOLVES COMPUTER MAKER'S PROBLEM

This precision memory unit is the heart of a new computer. Long-term, dependable operation calls for the utmost in dimensional stability in the memory unit's laminated frame, to maintain the highly critical spacing of the wire-and-core grid assembly.

The problem: which material will provide the best possible combination of needed properties . . . dimensional stability, physical strength, resistance to heat, good electrical characteristics plus a self-extinguishing factor? The solution: a brominated Dow epoxy resin.

Because of Dow's unique basic position in epoxy resins, Dow offers manufacturers an unusual capability in supplying materials to fill the most demanding requirements. An

example is the self-extinguishing Dow epoxy resin chosen for this application.

Dow offers a wide range of "controlled property" epoxy resins—to meet the exacting needs of today's complex electronic circuitry. Among these materials are Dow brominated epoxies, unusual resins with excellent self-extinguishing properties . . . flexible epoxy resins . . . epoxy novolac resins for high temperature use . . . and specially refined epoxies for the most critical applications.

For information on Dow epoxy resins for many varied applications, including the unusual, write us in Midland, C/O Coatings Sales Department 1955BC10-25.

THE DOW CHEMICAL COMPANY

DOW

Midland, Michigan

CIRCLE 100 ON READER-SERVICE CARD

NEW PRODUCTS

Angle Sensing Instrument

519



Less than 1-sec rotation is detected by the Refractosyn angle sensor. The device reflects light from a mirror attached to the device being measured. The angle of reflection is indicated on a meter. Device is all solid state.

H H Controls Co., Dept. ED, 7 Leroy Drive, Burlington, Mass.

Camera System

528



High-resolution, closed-circuit TV camera system is enclosed in an epoxy impregnated fiberglass container. It can be used under conditions far above normal for acoustic shock, vibration and altitude, humidity, temperature and explosions.

Packard Bell Electronics, Dept. ED, 1920 S. Figueroa St., Los Angeles 7, Calif.
Availability: 30 days.

Precision Decade Capacitor

522



Capacitances from 100 pf to 1.111 μ f are provided in steps of 100 pf by the type 1423-A decade capacitor. Silver-mica capacitors are used. Each scale is accurate to $\pm 0.05\%$. In-line readout is provided. Terminal capacitance can be adjusted. Stability is better than $\pm 0.01\%$ per year.

General Radio Co., Dept. ED, West Concord, Mass.

Price: \$695.

USE CANNON PLUGS?



Aercon, Inc., your Cannon CAPS Distributor is the only source for off the shelf delivery of Cannon DPX2 plugs.

In addition, Aercon gives special service on

CANNON

Audio Plugs
Miniature D's
Co-axial Plugs
DPD and DPD2's
DPA, DPX and MC
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KPT
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Aercon has equipment in operation to assemble MS, DPD and K series from a large stock of components. Get a wide selection and faster service from Aercon!

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2137 Ludlow Street
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Phone LO 8-5105
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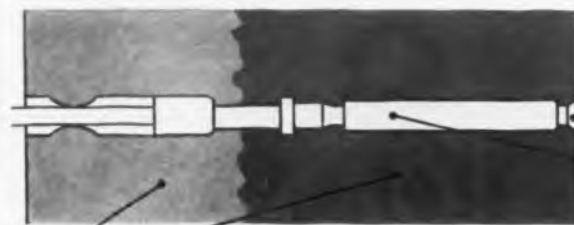


NEW CANNON KPT/KSP MINIATURE DESIGNED TO MIL-C-26482

Quick disconnect plugs for aircraft, missiles, and all applications requiring miniature plugs. Our standard solder-pot versions, including hermetic seals, are completely interchangeable with all bayonet-lock plugs designed to MIL-C-26482!

*Solder pot version now available from
Cannon CAPS Distributors*

ALSO KPT/KSP PLUGS WITH CRIMP SNAP-IN CONTACTS AND TWO SHORE INSULATOR.



Maximum lead-in chamfer for positive alignment.

MIL-C-26636 contacts (plating gold over silver)

Two shore resilient insulators molded out of two different hardness materials (polychloroprene) into a homogenous piece. The rear portion of the insulator is the softer in order that the conductors can be sealed properly, and the front portion is the harder to retain the snap-in contacts. The two shore insulator insures a continuous moisture and pressure

seal from front to back to provide superior electrical performance at high altitudes. This method of sealing and contact retention offers the industry a most reliable crimp series meeting the requirements of MIL-C-26482. Write for catalog KPT/KSP-1 to:

**CANNON
PLUGS**

CANNON ELECTRIC COMPANY, 3208 Humboldt St., Los Angeles 31, Calif.

CIRCLE 102 ON READER-SERVICE CARD

CIRCLE 101 ON READER-SERVICE CARD
ELECTRONIC DESIGN • October 25, 1961

105

NEW PRODUCTS

AC-DC Signal Generators

521



For use as sensing elements in transducers and servo systems, these ac-dc signal generators have rotary or linear outputs. Units have infinite resolution, low reaction torque, and low impedance. Devices do not use slip-rings or brushes.

Giannini Controls Corp., Dept. ED, 1600 S. Mountain Ave., Duarte, Calif.

Safe-Arm Devices

533



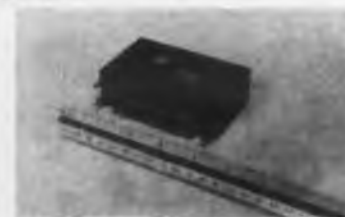
Withstands 50,000 psi. Hermetically sealed, high-pressure safe-arm devices are capable of ignition and actuation as well as high order detonation. They operate under normal squib applications. Operating on 28-v dc, they require no auxiliary electronic equipment or special wiring.

Ordnance Associates, Inc., Dept. ED, 855 El Centro St., South Pasadena, Calif.

Price: \$50 to \$75.

Multicoders

546



For multichannel telemetry uses, two multicoders are offered for sampling rates of dc to 50,000 channels per sec. Linearity is less than 0.1%, cross-talk is less than 0.1%. They can be used with transducers where source impedance is up to 100,000 ohms for operation with less than 2% error.

General Devices, Inc., Dept. ED, Princeton, N. J.

Mallory miniature tantalum capacitors



from the industry's widest selection...

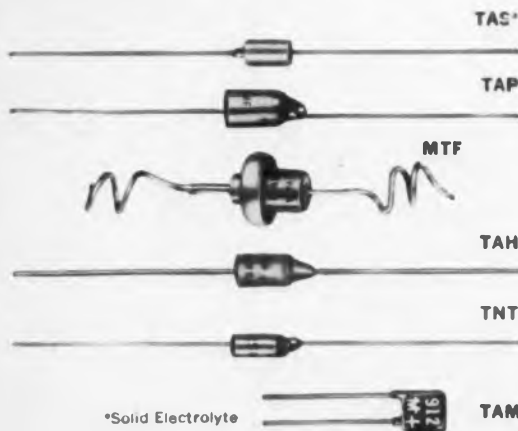
- miniature high-temperature types (to 150°C)
- smallest metal-case type made
- encapsulated type for printed circuits
- liquid and solid electrolytes

... seven miniature types in all—with the sintered pellet anode pioneered by Mallory.

And six other types—including foil, high temperature, high capacitance.

Write today for our complete catalog on all 13 types... and for a consultation with a Mallory capacitor specialist. Mallory Capacitor Company, Indianapolis 6, Indiana.

for the squeeze on space



Complete line of aluminum and tantalum electrolytics, motor start and run capacitors



CIRCLE 103 ON READER-SERVICE CARD

**Mallory Tantalum Capacitors
Stocked by these distributors**

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Rucker Electronic Products

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Cramer Electronics, Inc.
DeMambro Radio Supply Co.
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East Coast Radio

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Wackid Radio-TV Lab.

Palo Alto, Calif.
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Philadelphia, Pa.
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Philadelphia Electronics

Pittsburgh, Pa.
Radio Parts Co.

St. Louis, Mo.
Olive Electronics

Seattle, Wash.
F. B. Connelly Co.

Tampa, Florida
Thurow Distributors, Inc.

Toronto, Ont.
Alpha Aracon Radio Co.
Electro Sonic Supply
Wholesale Radio & Electronics

Tucson, Ariz.
Standard Radio Parts

Tulsa, Okla.
Engineering Supply Co.

Washington, D.C.
Capitol Radio Wholesalers
Electronic Industrial Sales

White Plains, N.Y.
Westchester Electronic Supply Co., Inc.

Winston-Salem, N.C.
Dalton-Hege Radio

P. R. MALLORY & CO. INC.
MALLORY

DC Wideband Amplifier

423



Gain is 10 to 10,000 with fixed gains of 10, 20, 50, 100, 200, 500 and 1,000. Model 1010 dc wideband amplifier has an input impedance of 100 meg shunted by 0.001 μ f and a source impedance of 5 K max. Drift is less than 2 μ v in 500 hr. Design provides full magnetic and electrostatic shielding.

Cubic Corp., Dept. ED, 5575 Kearny Villa Road, San Diego 11, Calif.

Price: \$650.

Transistor Header

542



Microminiature block design of the hermetically sealed transistor header permits the use of transistors 0.93 in. high in a header 0.040 in. high. Miniaturization is achieved by replacing the glass beads, in the transistor head, in which conductors are embedded, with a recessed well of glass.

Hermetic Seal Corp., Dept. ED, North Arlington, N. J.

Solenoid Actuators

543



Explosion-proof solenoid actuators are for use with the firm's series CC pilot-operated air valves. They are suitable for Class 1, Group D and Class 2, Groups F and G applications. They are offered for both momentary and maintained contact, air-control valves.

Hannifin Co., Dept. ED, 501 S. Wolf Road, Des Plaines, Ill.

Data loss due to drop-outs is eliminated in FM predetection recording-reproducing by Mincom's new, exclusive Tracklok[®]

This is because, for the first time in the field of instrumentation, the Tracklok makes possible redundant FM data recording at the carrier level. In any desired FM or PM-type carrier system, data loss is eliminated by a 99% skew reduction; existing skew of $\pm 0.3 \mu\text{s}$ for example, is effectively reduced to $\pm 0.003 \mu\text{s}$, a reduction of 100 to 1.



Shown here with the Mincom Series CM-100 1.5-mc Instrumentation Recorder/Reproducer, a standard auxiliary rack houses (from the top down) an oscilloscope monitor unit, the new Tracklok, and a demodulator.



Completely Compatible: The new Tracklok is designed to improve the predetection performance of Mincom's 1-mc Series CM-100 Instrumentation Recorder/Reproducer (which now, on special order, performs to 1.5 mc at 120 ips). Tracklok can be incorporated into all existing Series CM-100 systems, since it is compatible with CM-100 or any comparable recorder-reproducer in the standard IF carrier frequencies.

TRACKLOK[®]

Reliable Simplicity: The same reliability that has been typical of Mincom's instrumentation systems for years has been built into Tracklok.

NEW PRODUCTS

Time Pulse Generator

406



Completely solid-state digital time pulse generator model PTG 901-3 provides BCD and PDM coded time pulses for use in time correlation of data processing as well as to trigger and/or control events in a system. Standard timing stability is 2 parts in 10^7 per day. The unit provides BCD output both parallel and serial concurrently.

Power Instruments Corp., Dept. ED, 235 Oregon St., El Segundo, Calif.
Availability: 4 to 6 weeks.

Analog-to-Digital Converter

545

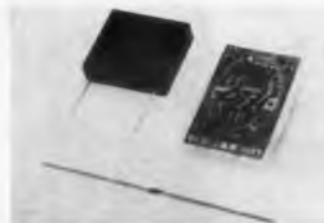


Accuracy is 0.5%. The rack-mounted analog-to-digital converter provides an output of eight binary bits or two binary-coded-decimal bits in 8-4-2-1 code. Conversion time is 0.5 μsec . Power supply is self-contained in the unit.

General Data Corp., Dept. ED, 11602 Ninth St., Garden Grove, Calif.
Price: \$1,250.

Micro Diode

539



Reverse leakage is 25 $\text{m}\mu\text{a}$ or less at 80% V_{r} . Model MC100 micro diode, rated at 1,000 v, provides conductances of higher than 200 ma at +1 v and up to 200 ma avg rectified current. They are single junction units, capable of being connected in series. Applications are in power supplies for radar, photo multipliers, radiation detection and video systems.

MicroSemiconductor Corp., Dept. ED, 11250 Playa Court, Culver City, Calif.
P&A: \$7; stock.

MINCOM DIVISION **3M** MINNESOTA MINING & MANUFACTURING CO.

2049 SO. BARRINGTON AVE., LOS ANGELES 25, CALIFORNIA • 529 PENN BLDG., 425 13th ST. N.W., WASHINGTON 4, D. C.

CIRCLE 104 ON READER-SERVICE CARD

ELECTRON TUBE NEWS from SYLVANIA

NEW!

4 Gold Brand Tubes for Communications

GB-6688A

Strap Frame Grid Pentode, Gm of 16,500 ...

GB-6922

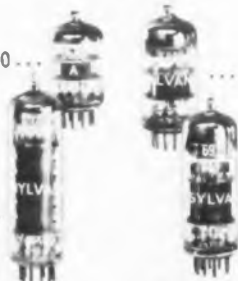
... Strap Frame Grid Dual Triode, Gm of 12,500

GB-6360

operation to 200MC, 12W output ...

GB-6939

... operation to 500MC, 5W output



What does the "GB" (Gold Brand) prefix mean to your application? Just this—assurance of designed-in tube reliability capable of withstanding severe environmental stresses. Look at a few of the tests Gold Brand tubes undergo: shock tests of 500g, vibrational fatigue tests of 2.5g for 96 hours at 50cps frequency, bulb temperatures of 225°C.

GB-6360—9-pin twin tetrode for use as a Class C amplifier and oscillator, frequency multiplier and modulator at frequencies to 200MC. Plate dissipation for both sections is 14W, ICAS. As an AF power amplifier and modulator in Class AB₁ push-pull service, GB-6360 will deliver 12W output (CCS) with total distortion of 2.5%.

GB-6688A—9-pin, high Gm, sharp cutoff pentode featuring Sylvania Strap Frame Grid. It's designed for use as broadband IF amplifier in communications and instrumentation equipment. Gm is 16,500 μ mhos, Ib is 13mA. Short, sturdy mount structure plus rugged grid design significantly enhances reliability.

GB-6922—9-pin sharp cutoff twin triode, utilizing Strap Frame Grids, designed for use as a multivibrator, cathode follower, VHF amplifier and VHF cascade amplifier. GB-6922 features relatively low heater input power of 6.3V @ 300 mA, Gm of 12,500 μ mhos, Ib of 15mA. It provides superior performance under long periods of time under cutoff conditions.

GB-6939—9-pin twin tetrode using a frame grid with extremely fine diameter wires rigidly brazed to flat side rods. Designed for operation to 500MC, it is capable of delivering 5W (CCS) when used in Class C telegraphy service and 1.8W (CCS) when used in a Class C tripler service with a plate voltage of 180V.

If your application demands premium performance and reliability, specify Sylvania Gold Brand Tubes. Your Sylvania Sales Engineer will be pleased to tell you more. For data on specific types, write Electronic Tubes Division, Sylvania Electric Products Inc., 1100 Main St., Buffalo 9, N. Y.

MICROWAVE DEVICE NEWS from SYLVANIA

NEW!

Unique tuner design of

X-Band Tunable Magnetron

improves airborne radar performance



Provides: linear tuning; precision tuning; low thermal drift; freedom from vibrational resonance; rugged, reliable structure!

Sylvania-7692A is a highly stable pulsed magnetron offering 220KW peak power output over the 8550 to 9650MC range. It combines a remarkable *new tuner design* with *proven dispenser type cathode* in a rugged package capable of withstanding heavy shock and excessive temperatures. (Tests to date indicate 300°C capabilities.)

Inductive Post Tuner, a Sylvania design, provides linear tuning, simplifying local oscillator tracking, eliminating associated compensating equipment of coupled cavity designs. Features include: a single bellows that tunes all posts simultaneously—secure and precise alignment of tuning posts by means of a guide ring that also serves as an effective heat sink—free tuning post length restricted to 0.200 inches, eliminating electrical and mechanical resonances at very high frequencies—electrically and thermally grounding the tuning posts for very low thermal drift.

Reliable dispenser type cathode, incorporated in Sylvania-7692A, features low heater power requirements, therefore low cathode temperatures, high stability, outstanding life. Cathode memory is of extremely short duration—abrupt switches in pulse length do not detract from cathode performance or life. Too, the molybdenum cathode support is virtually unyielding to vibrational stresses, exhibits very low heat loss, permitting zero heater voltage operation at rated operating current.

Vacuum firing up to 1000°C of individual parts prior to assembly effectively de-gasses elements, contributing to reliability and the exceptional starting stability of approximately 0.05% average missing pulse count.

Additional X-band, tunable types from Sylvania include: 7006, 210KW peak power output; M-4164, 220KW peak power output; 7692, 220KW peak power output. Presently under development are significant refinements to the 7692A, including a hydraulically tuned version.

In short, the intensive magnetron development program underway at Sylvania deserves your close investigation. Contact your Sylvania Sales Engineer for up-to-the-minute information. For tech data on specific types, write Electronic Tubes Division, Sylvania Electric Products Inc., 1100 Main St., Buffalo 9, N. Y.

TYPICAL OPERATION — SYLVANIA-7692A

Duty cycle	0.001	
Pulse width	1.0	μsec
Rate of rise of voltage	200	KV/μsec
Avg. anode voltage	27.5	mAdc
Peak anode voltage	22.0	KV
Avg. power output	220*	W
Pulling factor	12	MC
Pushing factor	0.25	MC/A

*Min. power output—200W

SYLVANIA

SUBSIDIARY OF

GENERAL TELEPHONE & ELECTRONICS



P-1127

Time Code Generator 650



IRIG formats A, B, C, and D, in addition to parallel code output, and 1- and 10-pps synchronizing pulses are supplied by the EECO 811 time code generator. Frequency stability of the unit is one part in 10^8 per day under laboratory temperature conditions or 3 parts in 10^8 per day over wider temperature limits.

Electronic Engineering Co. of California, Dept. ED, 1601 E. Chestnut Ave., Santa Ana, Calif. P&A: \$9,750; 60 to 90 days.

Computer Tape 387

In heavy duty type due to coating applied to polyester film. Computape magnetic computer tape is designed for high-density, high-resolution recording. Binders have been selected to assure non-aging characteristics. The tape withstands continual exposure to varying climatic conditions.

Computron Inc., Dept. ED, 122 Calvary St., Waltham, Mass.

Power Supply 385



Constant voltage and/or constant current power supply model CVC-300-6 has automatic electronic changeover for forming and aging electrolytic capacitors. Operating with constant voltage the unit has an output range of 2 to 300 v and 0 to 6 amp. Its regulation is $\pm 0.1\%$ for both line and load. At constant current, the output range is 0 to 300 v and 0.3 to 6 amp. Line regulation is $\pm 0.1\%$; load regulation is $\pm 0.1\%$.

NJE Corp., Dept. ED, 20 Bortright Ave., Kenilworth, N. J. Price: \$3,780.

RCA Combines Two Major Advances in a Single Tube



New **NOVAR**
Design

New **RCA**
DARK HEATER

in RCA-6BH3, 17BH3, and 22BH3 half-wave vacuum rectifiers for TV damper service

Design your new TV horizontal-deflection damper circuits around one of these new novar rectifiers, and you'll get better performance at less cost, thanks to economical novar design and the revolutionary RCA Dark Heater.

High performance, low-cost novar construction—These BH3 types are stellar members of RCA's new novar line of large, all-glass, integral-base receiving tubes that outperform at less cost other high-dissipation receiving tubes of any base configuration and T9 or T12 envelope. BH3's are rated to withstand a maximum peak-inverse plate voltage of 5500 volts; they can supply maximum peak plate current of 1100 ma and maximum dc plate current of 180 ma.

These tubes embody the advantages of novar design, the only all-glass, integral-base receiving tube design featuring:

Larger internal lead diameter—for strong cage support and high thermal conductivity for highly effective heat dissipation.

Wider pin spacing (0.172")—minimizes chance of voltage breakdown; hence greater reliability.

Pin length of 0.335"—for firm retention of tube in socket.

Pin-circle diameter of 0.687"—allows use of both T9 and T12 envelope.

RCA Dark Heater—additional assurance of high reliability.

REVOLUTIONARY RCA DARK HEATER—Each of these tubes features the new RCA Dark Heater... one of the most significant contributions to tube technology in years. The Dark Heater operates at greatly reduced temperature, as much as 350°K below the 1500 to 1700°K of conventional heaters. The required cathode temperature is reached with the heater operating at approximately 1350°K. Result: longer heater life; reduced chance of heater failure; heater-current stability on life; reduced ac H-K leakage and hum; improved mechanical stability; greater safety factor in established H-K voltage ratings.

For additional information on novar types, see your RCA Field Representative or write Commercial Engineering, Section J-18-DE-2 RCA Electron Tube Division, Harrison, N. J.



The Most Trusted Name in Electronics

RCA ELECTRON TUBE DIVISION 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: 6801 E. Washington Boulevard, Los Angeles 22, California, RAymond 3-8361.

GENERAL ELECTRIC Fused Quartz



FUSED QUARTZ COMPONENTS FABRICATED of high purity—in stock in a wide variety of crucibles, boats, test tubes and furnace tubes.

GENERAL ELECTRIC MANUFACTURES AND STOCKS A COMPLETE RANGE OF:

- Standard Taper Joints
- Double Bore Tubing
- Combustion Tubes
- Capillary Tubing
- Ball and Socket Joints
- Laboratory Quartzware
- Precision Bore Tubing

FREE BROCHURE ON G-E FUSED QUARTZ. Newly published 40-page brochure is yours for the asking. Contains latest information on physical properties and transmission characteris-

tics plus complete prices. For your free copy of this illustrated booklet, or requests for engineering assistance, write the G-E Willoughby Quartz Plant (see "Midwestern" address below).

GENERAL ELECTRIC DISTRICT SALES OFFICES

New England
50 Industrial Place
Newton Upper Falls, Mass.
DEcatur 2-6200

Eastern
744 Broad St.
Newark 2, N. J.
MARket 3-3953

Midwestern
Euclid Ave. & Campbell Rd.
Dept. ED-110, Willoughby, O.
WHitehall 2-9300

Western
2747 S. Malt Ave.
Los Angeles 22, Calif.
RAYmond 3-2541

Progress Is Our Most Important Product

GENERAL ELECTRIC

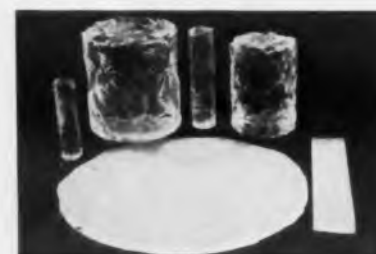
CIRCLE 107 ON READER-SERVICE CARD



CLEAR TUBING AND ROD—Can be secured from stock in a complete range of sizes—special sizes also available to meet your exact specifications.



TRANSLUCENT TUBING AND ROD—In stock for immediate delivery in a wide range of sizes. Available in random or cut lengths to fit your requirements.



INGOTS, PLATES AND DISCS—Rough-cut or ground and polished in diameters up to 18½". Lenses, windows, prisms supplied in a wide range of sizes—or finished to your needs.

NEW PRODUCTS

Circuit Breakers

554



Three-phase, overcurrent circuit breakers are offered in two types: manual reset, rated at 100 ma to 6 amp at 440 v; automatic reset, 100 ma to 10 amp at 440 v. They are enclosed in bakelite housings. Applications include motor protection.

E-T-A Products Co. of America, Dept. ED, 6284 N. Cicero Ave., Chicago 46, Ill.

Price: \$3.10 and \$3.80.

General-Purpose Relay

551



Comes in 1-, 2- and 3-pole, double-throw, 2-amp contact arrangements and a variety of coil ratings. The general-purpose relay has an operating power of 1.5 w dc or 2 to 3 va ac. Dimensions are 1.183 x 1.811 x 1.343 in. and weight is 2 oz. max.

Elgin National Watch Co., Electronics Div., Dept. ED, 2435 N. Naomi St., Burbank, Calif.
Availability: stock.

Semiconductor Housings

561



For 350 C use. The high-alumina semiconductor housings have a ceramic-metal bond to maintain high-vacuum tightness at high temperatures. Long creepage paths in a compact design are possible. Sizes are from 1/4-in. ID.

Cermaseal, Inc., Dept. ED, New Lebanon Center, N.Y.

**AVAILABLE
FROM STOCK!**

**C. I. C.
PRECISION FILM POTS**

You can have any of these precision film pots on their way to you within hours. No need to wait for "custom" pots.

LINEAR SINGLE TURN FILM POTENTIOMETERS

Diameter	Resistance	Linearity
1/2"	1K	± .5%
	10K	± .5%
	50K	± .5%
7/8"	1K	± .5%
	10K	± .5%
	50K	± .5%
1-3 32"	1K	± .25%
	10K	± .25%
	50K	± .25%
2"	1K	± .25%
	10K	± .25%
	50K	± .25%
3"	1K	± .25%
	10K	± .25%
	50K	± .25%

SINE-COSINE SINGLE TURN FILM POTENTIOMETERS

Diameter	Resistance	Conformity
1-3 32"	10K	± .75%
	20K	± .75%
2"	10K	± .25%
	20K	± .25%
3"	10K	± .15%
	20K	± .15%

LINEAR MOTION FILM POTENTIOMETERS

Size	Resistance	Stroke	Linearity
1" Sq.	10K	1" Stroke	± .5%
		2" Stroke	± .5%
	20K	1" Stroke	± .25%
		2" Stroke	± .25%
	10K	3" Stroke	± .1%
		20K	3" Stroke

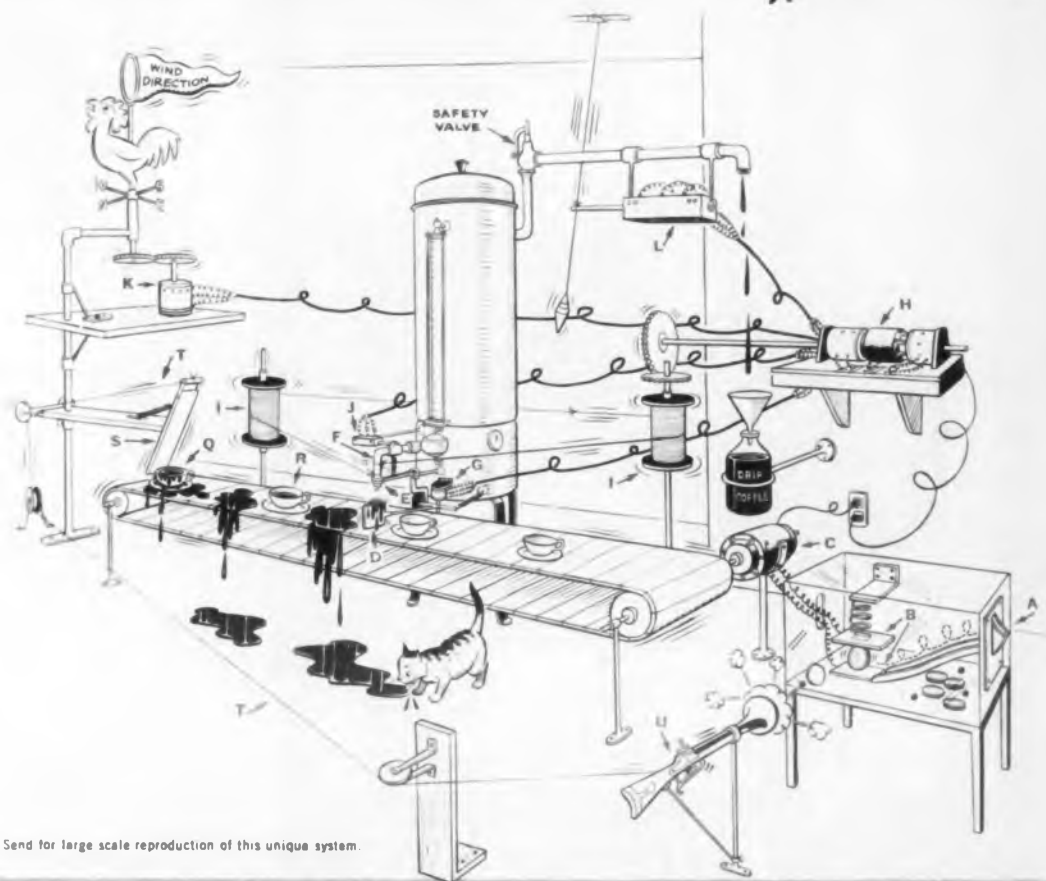
WRITE OR CALL IN YOUR ORDER! POTENTIOMETERS WILL BE IN YOUR PLANT WITHIN 24 HOURS!



COMPUTER INSTRUMENTS CORPORATION
92 MADISON AVE., HEMPSTEAD, L. I., N. Y.

CIRCLE 108 ON READER-SERVICE CARD
ELECTRONIC DESIGN • October 25, 1961

Here's One Way to Automate Coffee-Pots With ^{Some} Servo Pots...



Send for large scale reproduction of this unique system.

Place dime into coin slot (A). Coin rolls down ramp into position between spring-loaded metal contacts (B). Contact starts motor (C) and coffee-conveyor-belt proceeds to carry cup into position below spout. As coffee cup pushes actuator blade (D), plug (E) is lowered from spout (F) and coffee starts flowing. Wire-wound pot (G), indicating cup position, sends signal to high gain servo-amplifier (H) and precision drive system (I), causing spout to move toward cup. Wire-wound spout-indicator-pot (J) feeds signal back to amplifier in effort to follow movement of cup. In order to compensate for wind direction and angle of building, wire-wound windage-pot (K) and vertical-sensor-pot (L) send additional aiming signals to servo-motor amplifier. Due to poor linearity, high noise, poor resolution and high starting torque —

typical of wire-wound pots — servo-system is unstable and inaccurate. Coffee misses cup, spills over belt onto floor, where coffee-loving pussy cat (Cafe au lait colored, of course) attempts to keep floor clean. Note that cup (Q) is overflowing, while cup (R) is only half-full. As cup (Q) reaches end of belt, paddle (S) is pushed forward causing string (T) to pull trigger of early 18th century solid-propellant missile launcher (U). Missile dislodges coin, thereby stopping entire system. (Which isn't a bad idea, considering the price of coffee!)

Men who know coffee and servo-systems best* all agree that the above system works perfectly, everytime, by replacing wire-wound with C. I. C. film potentiometers.

*Every major aircraft and missile manufacturer uses C. I. C. precision film potentiometers.

BUT THE BEST WAY YET...

Whether aiming missiles or coffee, use C. I. C. Precision Film Potentiometers . . . only C. I. C. film pots have infinite resolution, linearity to .01%, low starting torque and microvolt operational noise.



C.I.C. first in film pots

COMPUTER INSTRUMENTS CORPORATION

92 MADISON AVENUE • HEMPSTEAD, L. I., NEW YORK
CIRCLE 109 ON READER-SERVICE CARD

PRECISELY RIGHT



METAL STUD

Precisely machined to closer than .001" tolerance and plated under the most tightly controlled conditions. Photomicrography shows accuracy of plating, resulting in better soldering, and lower contact resistance.



DIMENSIONAL ACCURACY

Teflon body machined on precision lathes to tolerances of .001" maximum. This accuracy assures uniformly high holding strength when installed in chassis.

VIRGIN TEFLON

Only fresh, uncontaminated virgin Teflon is used in Sealectro Press-Fit terminals assuring optimum electrical, mechanical, thermal, and chemical properties.

...by the **MILLIONS**

These Press-Fit terminals are used in the production of all electronic and instrumentation equipment. They are available in sizes from 1/16" to 1/2" diameter and are used in the millions of Sealectro Press-Fit terminals used in the critical military and commercial equipment used in every single case with Sealectro.

PRESS-FIT
TEFLON TERMINALS

Sealectro Press-Fit terminals are available in sizes from 1/16" to 1/2" diameter and are used in the millions of Sealectro Press-Fit terminals used in the critical military and commercial equipment used in every single case with Sealectro.

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NEW PRODUCTS

Power Supply

526



Welding energy of 20 to 225 w-sec, permitting 50 to 120 spot-welds per min, is provided by model 225B power supply. It accumulates energy within 0.5 to 1 sec after each weld and discharges it in a pulse of a few milliseconds. It stores and discharges the same amount of power for each weld, regardless of line fluctuations.

Raytheon Co., Commercial Apparatus & Systems Div., Dept. ED, 225 Crescent St., Waltham 54, Mass.

P&A: \$1,244; stock.

Temperature Cycling Chamber

504

For testing airborne instruments, this temperature cycling chamber produces rapid temperature changes between -100 and 300 F. Using a double-compartment principle, the device moves samples from one compartment to another on a conveyor belt. Speed of temperature change is adjustable down to less than one minute.

General Testing Laboratories, Dept. ED, 40-50 Commercial Ave., Moonachie, N. J.

DC Amplifier

559



Differential dc amplifier model 2640, for amplifying strain-gage and thermocouple signals in the presence of common-mode signals, has a common-mode rejection of greater than 120 db at 60 cps for 1,000-ohms ground line unbalance. Linearity is better than $\pm 0.3\%$ from dc to 1 kc, better than $\pm 0.1\%$ from dc to 300 cps.

Dynamics Instrumentation Co., Dept. ED, 583 Monterey Pass Road, Monterey Park, Calif.
Price: \$885.



NEW

SUBMINIATURE COAXIAL RF CONNECTORS

SMALLEST, LIGHTEST, MATCHED IMPEDANCE SUBMINIATURE CONNECTORS AVAILABLE

MICON, new as a company, old in experience, makes available the industry's most extensive line of uniquely* designed bulkhead, chassis, line and printed wiring board connectors of the 50 ohm screw-on type, snap-on type and crimp-on type.

The following are MICON'S exclusive features:

• 1000 volt minimum flashover at 70,000 feet

• Cable pullout resistance — 30 pounds minimum

• No rubber or plastic boots — all metal-to-metal contact

• Connector can be disassembled and reassembled without spare parts

• Coupling nut pullout resistance — 100 pounds minimum

• Extended temperature range of -100°F to +300°F

• VSWR at 2 KMC — less than 1.1
• VSWR at 10 KMC — less than 1.5

MICON Evaluation Kit Available On Request

*Patent Pending



MICON ELECTRONICS, INC.

ROOSEVELT FIELD,
GARDEN CITY, L. I., NEW YORK
a wholly owned subsidiary of Metalcraft, Inc.

CIRCLE 110 ON READER-SERVICE CARD

DESIGNED TO MEET THE
CHALLENGE OF ENVIRONMENT



Connectors

A well-developed sonar system is standard equipment for the Porpoise... That, plus speed, maneuverability, and intelligence, rates him highly adaptable for underwater existence.

An equally well-adapted man-made combination is the Polaris Missile and its subsurface, nuclear-powered launching pad. The Polaris program adds extra-reliability with Anton Series WM-20 Connectors by Lionel... These rugged, dependable devices afford the utmost in reliability and construction, the maximum in quality, design, materials and workmanship... as proven by Polaris.

- Die-Cast housings
- Diallyl Phthalate moldings
- Five sizes, 34 to 104 contact range
- Also available to accept #16 wire
- Extended insertion/withdrawal life
- Meet applicable MIL Specs

(Special materials and modifications to meet specific requirements)



Delivery time slashed for Anton "special" connectors! New Lionel tooling practices provide rapid delivery of "specials" for unusual applications... within 6-8 weeks* of order date!

*"Standard" catalog units are in-stock items.

Write Dept. 110A-W for Series WM-20 Technical Literature.



LIONEL
Electronic Laboratories

FORMERLY ANTON ELECTRONIC LABORATORIES
1226 Flushing Ave., Brooklyn 37, N.Y.

CIRCLE 112 ON READER-SERVICE CARD

Load Cell

555



For machine tools and materials handling processes, the Force Control Cell is actuated by deflections as small as 0.001 in. It is offered in 16 models with capacities of 500 to 500,000 lb of force. Units sustain up to four times rated capacity. Accuracy is within 3%; repeatability, 1%.

Force Controls Co., Dept. ED, 424 W. Eighth Mile Road, Ferndale, Mich.

Price: \$450 to \$750.

DC-DC Transducer

563



Variable-reluctance pressure transducer model 2302, for direct operation from unregulated 28-v dc and missile power supplies, has pressure ranges of 5 to 5,000 psi. Output is up to 5 v dc, terminal-based linearity is $\pm 0.5\%$, frequency response is flat to 700 cps, thermal zero shift is $\pm 0.003\%$ per deg F.

Bourns, Inc., Dept. ED, 6135 Magnolia Ave., Riverside, Calif.

Trimmer Capacitors

547



Rated at 1,000 wvdc, glass trimmer capacitors have ranges of 1 to 4.5, 8.5, 12, 18 or 30 pf. For use from -55 to $+125$ C, they have a temperature coefficient of 400 ± 100 ppm per deg C or 0 ± 100 ppm. Insulation resistance is 1-K min. They have been life tested for 250 hr at 1,500 v dc.

Erie Resistor Corp., Dept. ED, 644 W. 12th St., Erie, Pa.

P&A: \$1.30 up; 3 to 4 weeks.

CIRCLE 113 ON READER-SERVICE CARD ▶

At Victor's Electric-Car Division ...

where
precision

RED/LINE
timing relays "Pay Off"!

The design engineers at Victor's Electric-Car Division sought a way of making their Dyna-Powered Maintenance Truck accelerate automatically and smoothly through the three forward speeds. The answer: Two G-V Red/Line Thermal Relays, each providing a two-second delay between steps. This assures smooth, even acceleration every time. A third Red/Line Relay shuts off the dynamic brake after a fixed time interval, conserving battery power. So, at Victor, G-V Red/Line Timing Relays are "paying off".

More and more companies are finding the reliable performance of G-V Red/Line Timing Relays makes them best for their products. G-V Red/Line Relays will "pay off" in your product, too. Your customers appreciate the importance of high quality, reliable components. G-V Red/Line Timing Relays are specially designed for industrial applications. They have the precision, reliability and long life needed to "pay off" in industrial use.

Your G-V distributor has them in stock now. Call him or write for Bulletin 131 today.



G-V CONTROLS INC.
Livingston, New Jersey

NEW PRODUCTS

Frequency Meter Relay 360



Accuracy is 1%; input sensitivity is 10 mv rms. The frequency meter relay can be furnished as a continuous reading type or a locking type in which the meter stops reading at a set point and continues when the frequency returns to the set point. Full-scale ranges are 50 kc to 50 cps.

Anadex Instruments, Inc., Dept. ED, 14734 Arminta St., Van Nuys, Calif.

P&A: \$125 up; 30 days.

Low Density Resin 396

Medium viscosity, low density epoxy casting and potting resin, Isochemrez 444 has high structural stability and can be machined and cut to size. Color is black; specific gravity is 0.67; density is 40 lb per cu ft; shrinkage is 1%. Long pot life hardener and a flexible, low exotherm hardener give diversity in application.

Isochem Resins Co., Dept. ED, 221 Oak St., Providence 9, R. I.

P&A: sample 1-qt kit, \$9; immediate.

Current Regulator 364



Tolerance is $\pm 5\%$. The Current regulator is available in fixed ratings of 1 to 10 ma. A two-terminal device with a high incremental-to-static resistance ratio, it can be used to replace a number of other components. It is epoxy encapsulated and withstands severe environmental conditions.

Circuitdyne Corp., Dept. ED, 480 Mermaid St., Laguna Beach, Calif.

P&A: \$6.50 to \$32; 2 weeks.

When should you use Mercury-Wetted Contact Relays



IF YOUR RELAYS
MUST

SWITCH UP TO
100 TIMES
PER SECOND

HAVE A LIFE
IN EXCESS OF
A BILLION
CYCLES

BE COMPLETELY
RELIABLE
AND FREE FROM
CONTACT BOUNCE

THEN SPECIFY
P & B
MERCURY
WETTED
CONTACT RELAYS



P&B

MERCURY-WETTED CONTACT RELAYS

An unusual combination of advantages found only in mercury-wetted relays has led many design engineers to specify them for tough switching jobs. Here are but 3 typical characteristics of our JM series:

RELIABILITY. Sealed-in-glass mercury contacts are renewed with every operation. Won't pit or weld. Make or break is positive . . . every time. No bounce, no chatter. Signals ranging from a few micro amps to 5 amps are switched with singular consistency.

LONG LIFE. Think in terms of *billions* of operations when considering JM series relays. Proper application, of course, is a requisite.

SPEED. Operate time is just less than 3 milliseconds using 2 watts of power. Release time is about 3.2 milliseconds. Thus, relays can be driven 100 times per second.

If your project calls for exceptional relay performance, perhaps the answer lies in our JM Mercury-Wetted contact relay.

JM SERIES ENGINEERING DATA

Contact Rating:

5 amperes maximum
500 volt maximum
250 volt-amp max. with required contact protection.

Contact Configuration:

Each capsule SPDT. Combination of capsules in one enclosure can form DPDT, 3PDT, 4PDT. (All Form D.)

Terminals:

Plug-in or hook solder; 8, 11, 14, or 20-pin headers.

Coil Resistance:

2 to 58,000 ohms.

More information?

Write today for free catalogue.

P & B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL
ELECTRONIC PARTS DISTRIBUTOR



POTTER & BRUMFIELD

DIVISION OF AMERICAN MACHINE & FOUNDRY COMPANY,
PRINCETON, INDIANA • IN CANADA: POTTER & BRUMFIELD,
DIVISION OF AMF CANADA LIMITED, GUELPH, ONTARIO

Filament Mounting Machine

374



Automatic filament mounting machine model 1747 is for production of miniature lamps of the butt seal type. It produces the complete bead stem with conductors and mounted filament. All operations, including wire straightening, wire feeding, hook making, filament coiling, filament mounting and bead sealing are fully automatic.

Kahle Engineering Co., Dept. ED, 3322 Hudson Ave., Union City, N. J.

DC Motor

461

Permanent magnet dc motor is capable of producing torques in excess of 100 in.-lb through a speed range of at least 1 rpm to 15 rpm. Feedback is 8 v dc per 1,000 rpm. All bearings are anti-friction type. Motor is 1-1/2 in. in diam.

Globe Industries, Inc., Dept. ED, 1784 Stanley Ave., Dayton 4, Ohio.

Calibration Unit

365



Isolated balance and calibration unit model BC411, for strain-gage instrumentation, has a plug in printed-circuit card so that sets of calibrations and dummy bridge resistors can be quickly changed. Calibration is two-step, manually controlled, single or double shunt. Both chassis and circuitry are fully isolated.

Computer Engineering Associates, Dept. ED, 350 N. Halstead, Pasadena, Calif.

P&A: \$107.50; stock.

◀ CIRCLE 114 ON READER-SERVICE CARD

smallest
(maybe)
reliable,
rugged
(definitely)

SERVO
AMPLIFIERS



WHITE
AVIONICS
CORPORATION
TERMINAL BUILDING, PLAINVIEW
LONG ISLAND, NEW YORK

CIRCLE 115 ON READER-SERVICE CARD

NEW PRODUCTS

Crossbar Scanner

642



Visual and electrical readout is provided by the ST-2 series of crossbar scanners. Rated at 20 million operations per crosspoint, the unit handles 1 amp to 50 v dc; breakdown voltage is not less than 1 kv ac rms. Signal frequency range is dc to 10 mc. Bounce is less than 400 μ sec on make, none on break.

James Cunningham, Son & Co., Dept. ED, 33 Litchfield St., Rochester, N. Y.

P&A: \$1,800 to \$2,100; 4 to 5 weeks.

Ampere-Hour Meter

641



Electrochemical ampere-hour meter has a direct-reading 6-in. scale calibrated in ma-hr. A slide-rule type cursor facilitates reading. Full-scale value is 60 ma-hr. Accuracy is normally 2%.

Curtis Instruments, Inc., Dept. ED, 45 Kisco Ave., Mount Kisco, N. Y.

P&A: \$98.50; stock to 4 weeks.

Chopper Amplifier

624



High stability and high gain are claimed for this 400-cps chopper amplifier. Input is 25 mv dc for 40 v rms max ac output. Input impedance is 50 K. Unit operates at 28 v dc, 350 ma, for maximum output. Size is 2-11/16 x 2-5/16 x 3-1/2 in. Military environmental requirements are met.

M. Ten Bosch, Inc., Dept. ED, 80 Wheeler Ave., Pleasantville, N. Y.

Price: \$285.

NEW
transistorized
GAUSSMETER
MODEL 900



This quality precision built Gaussmeter provides direct reading of flux densities from 0.3 gauss full scale to 30,000 gauss with an accuracy of $\pm 2.5\%$. Repeatability of readings 0.5%. Ideal for measuring and locating stray fields, plotting variations in strength and performing rapid comparisons of production lots against a standard.

SPECIAL FEATURES

- The eleven position Range Selector provides full scale readings of 0.3, 1, 3, 10, 30, 100, 300, 1000, 3000, 10,000 and 30,000 gauss.
- Significant readings as low as .05 gauss.
- Upper range extension, for comparative readings to 100,000 gauss.
- Versatile—probes employing either indium arsenide or bismuth elements can be used.
- Operates from AC supply or from own self-contained batteries for field use.

TRANSISTORIZED GAUSSMETER
MODEL 874

This instrument was designed to provide industry with a modestly priced, precision instrument for direct reading of DC flux fields from 5 to 30,000 gauss. The 5 position Range Selector provides full scale readings of 0.3, 1, 3, 10 and 30 kilogauss by use of the temperature stable indium arsenide probe. Light in weight, completely portable and operating on internal batteries, the 874 is ideal for "in plant" or field use.

Complete with probe—\$195.00

Write to



1075 Stewart Avenue, Garden City, N. Y.

CIRCLE 116 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 25, 1961

Magnetic-Reed Switches 369



With 10^{15} ohms open contact resistance. Model MGR-15 magnetic-reed switches are rated at 12 va ac or 3 va dc, resistive. Contact resistance is 40 to 60 milliohms, plus 40-milliohms load resistance. Actuating time is 1 msec. Life is 100 million operations at full rating.

Hamlin, Inc., Dept. ED, Lake and Grove Sts., Lake Mills, Wis.

Positioner Programmer 465

Completely automatic operation of any two-axis antenna positioner having a 1 to 1 and 36 to 1 synchro system is possible with the model PCP 1 Positioner Programmer. Completely solid-state circuits are used; automatic stop is at positioner limits.

Scientific-Atlanta, Inc., Dept. ED, 2162 Piedmont Road, Atlanta 9, Ga.

Price: \$750, programmer, \$690, limit control.

Terminal Block 380



All common lead terminations are accepted in the Uniblock terminal block. Top and side entry, with feed-thru pins are for applications requiring fast, positive connections. Mechanical connection has a withdrawal pressure of 35 to 40 lb. They can be placed end-to-end, or side-by-side to provide any number of terminations in a relatively small area.

Modular Electronics Co., Dept. ED, 6211 S. La Brea Ave., Los Angeles 56, Calif.

CIRCLE 117 ON READER-SERVICE CARD ➤

new SERVO CONTROL



Positions and Monitors Remote Variacs



The new 1590-A Remote Control positions motor-driven Variac® autotransformers from a distance. The Control is a servo — the output voltage from the remote Variac is automatically held to the value set by a Variac in the Control Unit. Moreover, if the line voltage supplied to the Control Unit is held constant, the remote Variac can be used as a source of continuously adjustable regulated voltage. Correction speed is fast . . . up to 60 volts per second for small 2- and 5-ampere autotransformers.

Other features include: Continuous monitoring of output voltage by meter . . . ability to control 120-volt Variac autotransformers of any size . . . where continuous monitoring and control are not required, one 1590-A can be switched to control any number of remote units individually . . . a built-in circuit breaker protects unit from damage . . . the control is completely passive — with no active elements, reliability is high.

Tracking accuracy of the system is $\pm 2\%$ of input line voltage when used with motor speeds listed in table (halving speed increases accuracy to $\pm 1\%$). Price of the Control Unit is \$95.



Motor-driven, basic Variacs range from \$108 to \$272.

REMOTE VARIAC TO BE CONTROLLED	SINGLE UNIT			TWO-GANG		THREE-GANG		
	Ampere Rated	Ampere Max.	Traverse Time (Seconds)	Approximate Correction Rate (Volts/Sec)	Traverse Time (Seconds)	Approximate Correction Rate (Volts/Sec)	Traverse Time (Seconds)	Approximate Correction Rate (Volts/Sec)
W2	2.4	3.1	2	60	2	60	4	30
W5	6.0	7.8	2	60	4	30	8	15
W10	10.0	13.0	4	30	8	15	16	8
W20	20.0	26.0	8	15	16	8	32	4
W30	30.0	36.0	16	8	32	4	32	4
W50	50.0	50.0	32	4	64	2	64	2

For control of 3-gang W30 and W50 Variacs, tracking accuracy is 3%.

GENERAL RADIO COMPANY

WEST CONCORD, MASSACHUSETTS

NEW YORK, WOrth 4-2722
District Office in Ridgefield, N. J.
WHimey 3-3140

CHICAGO
Oak Park
Village 8-9400

PHILADELPHIA
Abington
HAncock 4-7419

WASHINGTON, D.C.
Silver Spring
JUniper 5-1088

SAN FRANCISCO
Los Altos
WHitecliff 8-8233

LOS ANGELES
Los Angeles
HOLlywood 9-6201

IN CANADA
Toronto
CHerry 6-2171

NEW PRODUCTS

Electron Beam Gun

640



Self-accelerated and electrostatically deflected, electron beam gun 2025G operates within a 3-in. circle. Rated at 20 kv, 5 kw, gun welds refractory and reactive metals. It can be used for evaporation in thin film deposition, button melting and zone refining.

High Vacuum Equipment Corp., Dept. ED, 2 Churchill Road, Hingham, Mass.

Multiplexer System

609



High-speed multiplexer and digital conversion system 7330 scans up to 50 low-level inputs per second, and converts data to digital form with over-all accuracy of $\pm 0.065\%$. Output is bipolar 14-bit binary decimal code. Operation is manual or automatic. The 10 dc amplifiers used have common-mode rejection of 100,000 to 1.

Monitor Systems, Inc., Dept. 32, Dept. ED, Fort Washington Industrial Park, Fort Washington, Pa.

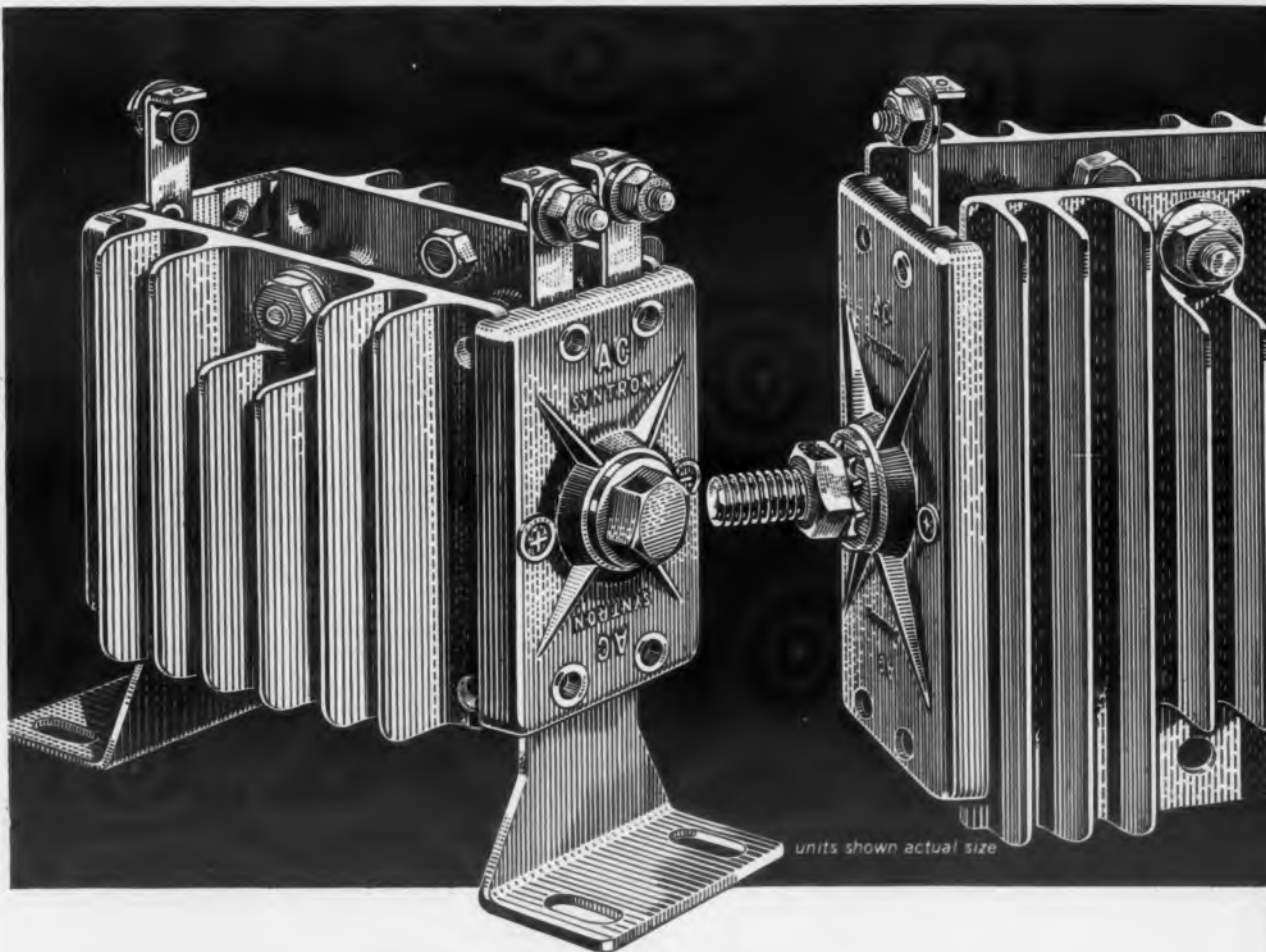
Delay Lines

623



Miniature, tapped delay lines of type 3T provide extreme bandwidth in small physical size. Rise time is less than 6% of total delay; attenuation is 0.1 db per μsec . Distortion and overshoot are less than 2%. Up to 30 taps can be provided; units meet military specifications. Temperature coefficient is less than 100 ppm per degree C.

Ad-Yu Electronic Lab, Inc., Dept. ED, 249-259 Terhune Ave., Passaic, N. J.
P&A: \$46 to \$66 ea; 1 to 2 weeks.



New SYNTRON Power Point Delivers up to 22 KW

Plagued by the lack of space for your power rectifier circuits?

Looking for more delivered d-c power?

Like to reduce the costs of the rectifier assemblies you're using by 30% or more? Want certified and guaranteed* performance? You'll want the new Syntron Power Point**, the new component you mount right at the point of use, right where you need the d-c. It's a single unit replacing the usual complicated assembly of silicon rectifiers, heat sinks, cooling fins, terminal posts and mounting lugs, spacers, etc.

It's a compact unit that supplies a lot of power. Example: a force cooled heavy duty model, measuring only $4\frac{5}{16}$ by $3\frac{1}{8}$ by 4 inches, can deliver 22 kw at the d-c terminals. If you prefer to use the smaller of the two available models, you can get as much as 17 kw d-c. This little fellow is only 4 by $2\frac{9}{16}$ by $2\frac{1}{2}$ inches.

You can get either of these two sizes for single phase or

three phase operation . . . current range from 3-25 amps (75 amps on force cooled units).

What about cost? . . . Depending on the number you need, you'll find that the Power Point costs from 30% to 50% less than any comparable silicon rectifier assembly. If you want a firm dollar quote, let us know your requirements and the quantity desired. We'll tell you exact prices along with delivery dates. Usually, delivery is 15 days or less after you order. (We can make it fast because the Power Point is in stock NOW and it's available direct from Syntron or from selected distributors throughout the country.)

Want a quote or more information? A complete data sheet showing performance curves, dimensions, operational characteristics is yours by completing the coupon or by writing Syntron Company, Semiconductor Division, Homer City, Pa. In Canada: Syntron Company Ltd., Stony Creek, Ontario.

**Syntron Trade Mark



Replaces Bridge Assemblies in 50% less space, 30% less cost

WHERE TO USE THE POWER POINT

- on clutches, computers, for cathodic protection
- business machines, and burglar alarms, and battery chargers
- on magnetic chucks and amplifiers and magnetic reactors
- on motors and brakes and to close circuit breakers
- in circuits with telephones, telegraph and other equipment, such as
- vibrators and relays and traffic control
- power supplies for autos and airplanes and electro-plating
- in short: almost anywhere you need d-c power close to the Point of use

SYNTRON

certified SEMICONDUCTORS

CIRCLE 118 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 25, 1961

* SYNTRON CERTIFIED SEMICONDUCTORS

All Syntron semiconductors have been tested and inspected to AQL level of 1.0 (Inspection Level I), and are so certified. Electrical and mechanical tests include:

- Inspection to the appropriate JEDEC outline drawing.
- Stated PRV for specific current ratings over a range of diode or cell temperatures.
- Forward drop at rated current and a diode or cell temperature of 25°C.
- Testing of all rectifier assemblies at rated load conditions.

We guarantee that our semiconductors will meet their certified AQL performance levels for up to 18 months after manufacture provided they are not misused or mishandled. All Syntron semiconductors found to be defective in materials or workmanship will be replaced at no charge upon return to our plant.

SYNTRON CO., Semiconductor Div., Homer City, Pa. ED-10

Please send me more information on Syntron Power Point.

Please have a Syntron representative call.

name _____ title _____

company _____

address _____

city _____ state _____

Firing Unit

636

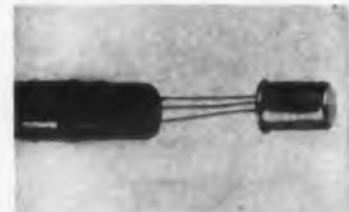


Exploding bridgewire firing unit P-782 has adjustable outputs for static testing of electroexplosive ordnance. Capacitor discharge pulses range from 100 to 2,500 v. Remote plug-in switch may be operated at up to 250 ft from the instrument.

McCormick Selph, Products Div., Dept. ED, Hollister Airport, Hollister, Calif.

Germanium Transistors

631



Industrial communications requirements are met by germanium alloy diffused mesa transistors of the 2N2188 series. Minimum BV_{CBO} and BV_{CES} for the 2N2188 and 2N2189 is 40 v; for 2N2190 and 2N2191, 60 v. Dissipation is 125 mv max at 25°C ambient. Package is smaller than TO-5.

Texas Instruments Inc., Semiconductor-Components Div., Dept. ED, P. O. Box 5012, Dallas 22, Tex.

Availability: stock.

Frequency-Selective Voltmeter

633



Amplitude measurements from 3 kc to 2 mc are quickly and accurately made with frequency-selective voltmeter model 2173A. Levels from -80 dbm to +32 dbm are indicated with accuracy of ± 1 db. Wide crystal filter is used with demodulator for monitoring ssb speech or tone signals.

Rycom Instruments, Dept. ED, 9351 E. 59th St., Raytown 33, Mo.

P&A: \$1,045; stock to 90 days.



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a science for 20 years!

At EAD, rotation has been a science since the early days of electronics... 20 years ago... when EAD first specialized in the design and production of miniaturized rotating electrical equipment.

For the designer of military or commercial systems, this experience combined with EAD's single-minded insistence on constant product improvement, means a line of standards and specials to meet the most critical of today's demands.

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391 Central Ave., Dover, New Hampshire

*Send us your specifications. Let us submit our proposal
without obligation...Our service is as reliable as our products!*

CIRCLE 119 ON READER-SERVICE CARD



MOTORS

Fractional, sub-fractional. Induction and hysteresis types with associated gear reductions. Available in 50, 60, 400 cycles, single, dual and variable frequency, dual voltage. Single-, two-, three-phase operation. Horsepower from 1/3500 to 1/2. Dia. from 1" to 6 1/2".



ALTERNATORS

From 1" to 6 1/2" diameters. Power to 1000 VA. Wide frequency range. Low harmonic content. Sine waves with maximum 2% total distortion. Single-, dual- (sine-cosine), three-phase. Dual frequency units, for special applications, produce a combination of frequencies.



SERVO MOTOR GENERATORS

Avail. in Sizes 8, 10, 11, 15 & 18. Damping servo motor generators (tachometers) and temperature compensated, integrating tachometers — supplied as tachometers only or with integral servo drive motor. Special voltages, scale factors and different compensation characteristics can be provided.



SERVO MOTORS & INERTIALLY DAMPED SERVO MOTORS

The basic actuating devices in AC automatic control systems. Provide dynamic response, reliability in extreme environments and high efficiency. Supplied with leads or terminals, with special voltage and power ratings and with precision gear heads for any reduction ratio. Sizes 8, 10, 11, 15 & 18.



BLOWERS & FANS

Light weight centrifugal blowers, ring mounted fans and vane axial fans. Capac. to 1000 cfm. Special designs available for high static pressures. Single, double ended. 50, 60, 400 cycles, special frequencies and variable frequency (50-450 cycles, 360-1600 cycles, etc.).

NEW PRODUCTS

Selenium Rectifiers

634



Flat, conduction-cooled selenium rectifiers provide power-handling capability to 250 va or higher in small packages. Units include half-wave, doubler, and bridge configurations in 1-phase or 3-phase circuits, for input up to 130 v rms, output to 10 amp dc.

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

Gallium Antimonide

635



Polycrystalline and single-crystal GaSb is available in ingots of 3/4 in. diam, weight 20 g per linear inch. Zinc or tellurium is used as dopant.

Micro State Electronics Corp., Dept. ED, 152 Floral Ave., Murray Hill, N. J.
Price: \$4.25 to \$23 per g.

Plotting Board

612

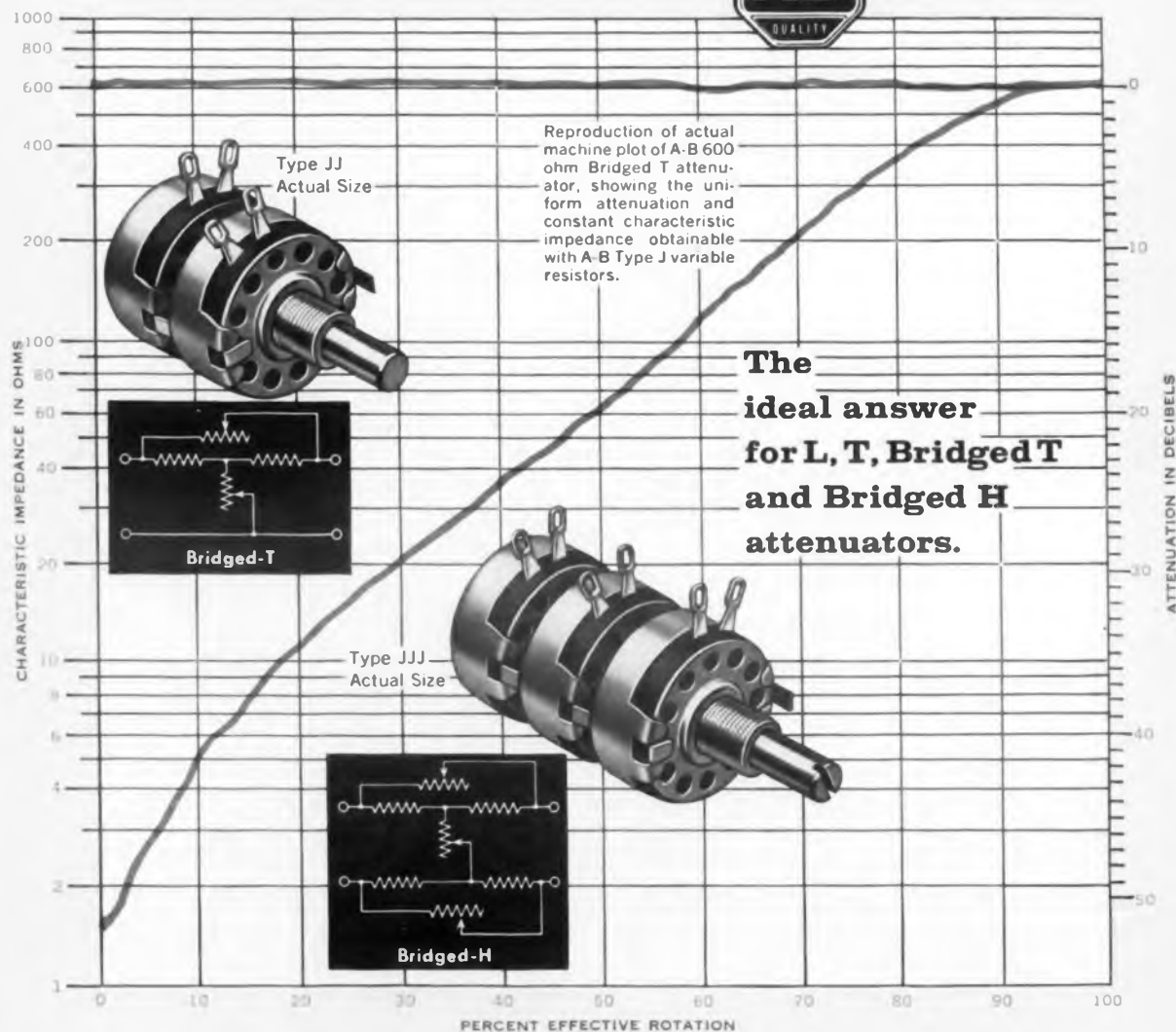


Smith chart plotting board handles standard 8-1/2 x 11 in. charts. Made of white plexiglass, the Mega-Plotter mounts independently rotatable peripheral and radial scales. A snap-on chart clamp is provided.

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

CIRCLE 120 ON READER-SERVICE CARD ►

Use Low Cost Allen-Bradley Type J Pots for Constant Impedance Attenuators



Allen-Bradley dual and triple Type J variable resistors are widely used in attenuators in electronic circuitry because they provide dependably smooth and uniform attenuation plus constant characteristic impedance.

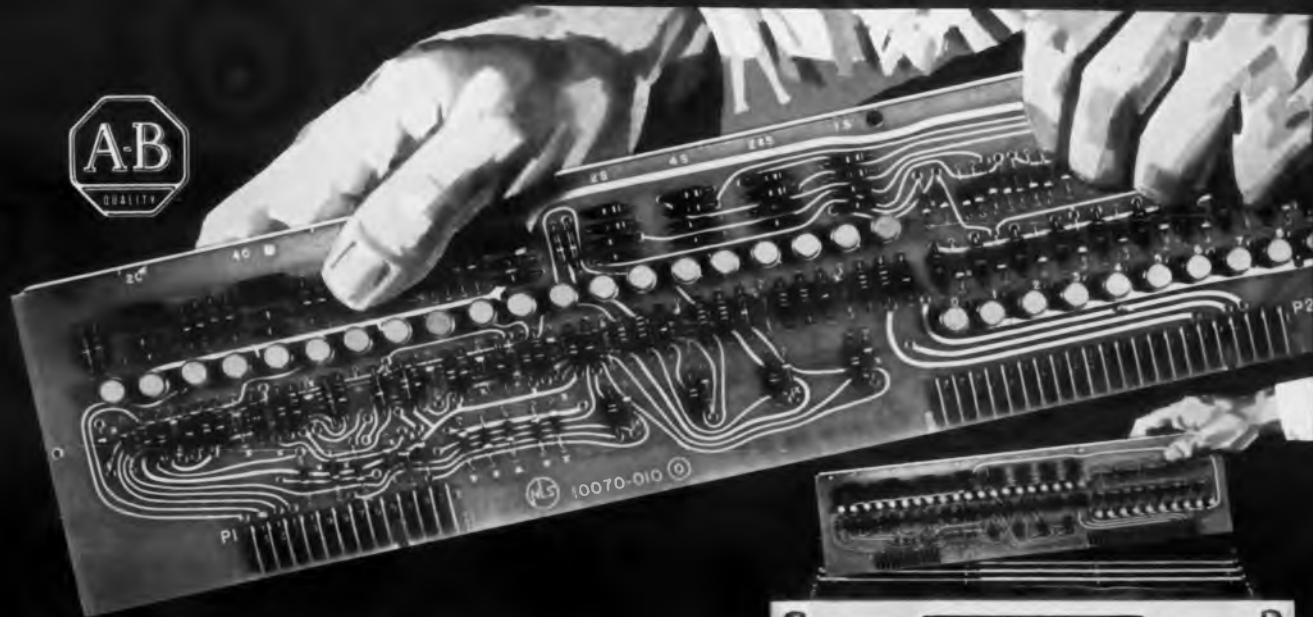
Stability, high wattage, long life, ideal uniformity, plus remarkable compact structure are combined in the Type J to assure top performance. The solid resistance element—made by A-B's exclusive hot molding process—provides smooth control at all times.

Allen-Bradley Co., 222 W. Greenfield Ave., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

With this precise control over the resistance-rotation characteristics during production, A-B attenuators have a consistently uniform attenuation that approaches calibration accuracy . . . and the characteristic impedance can be held to $\pm 10\%$ over *entire* rotation—*end to end*. The virtually infinite resolution eliminates the definite incremental steps of wire-wound units, while freedom from inductance insures excellent high frequency response. For full details on Type J variable resistors, send for Publication 6024.

ALLEN-BRADLEY

**QUALITY
ELECTRONIC
COMPONENTS**



Non-Linear Systems, Inc. designs first digital voltmeter to satisfy critical standards for missile work



Digital voltmeters – originated by NLS – permit rapid and accurate voltage measurements. New Series 20 unit – with one plug-in decade board removed – shows the use of Allen-Bradley fixed resistors.

Resistor Failures UNHEARD OF

...naturally, NLS uses ALLEN-BRADLEY hot molded resistors

To satisfy the high standards of consistent accuracy and reliability demanded for missile and weapons checkout, Non-Linear Systems, Inc., developed this digital voltmeter. It uses scores of Allen-Bradley fixed resistors. (For example, the latest Series 20 unit, shown above, contains about 1,000 in each instrument.) "In the selection of A-B resistors," says NLS, "quality and availability have never been a problem."

A-B resistors have such consistently uniform electrical characteristics that their performance can be accurately predicted over long periods of time under various operating conditions . . . with *complete freedom* from catastrophic failure while in service! The hot molding process used exclusively by A-B is the reason for this uniformity and reliability.

To obtain this same measure of superior performance for your equipment, always insist on Allen-Bradley quality fixed resistors available in various types. For full details, send today for your copy of Technical Bulletin 5000 or Publication 6024. Write to: Allen-Bradley Co., 222 W. Greenfield Ave., Milwaukee 4, Wis. In Canada: Allen-Bradley Canada Ltd., Galt, Ontario.

ALLEN-BRADLEY

ALLEN-BRADLEY Hot Molded Resistors ACTUAL SIZE

Hot molded composition resistors are available in all standard EIA and MIL-R-11 resistance values and tolerances.

**Pending MIL Spec Assignment*

Type TR 1/10 Watt		MIL Type RC 06*
Type CB 1/4 Watt		MIL Type RC 07
Type EB 1/2 Watt		MIL Type RC 20
Type GB 1 Watt		MIL Type RC 32
Type HB 2 Watt		MIL Type RC 42

QUALITY
ELECTRONIC COMPONENTS

9-41-E

Miniature Converter

534



For servo amplifier systems, computers, telemetry and multiplexing equipment. Model 725170 converter is less than 2 in. high and plugs into a nine-pin miniature socket. Special magnetic shielding and isolation of the drive coil from the contact circuit provide for very low noise. Life is 10,000 hr-min.

Minneapolis-Honeywell Regulator Co., Dept. ED, Fall River, Mass.

P&A: \$45; stock.

Heat Dissipators

632



Kit of heat dissipators for transistors, rectifiers, and diodes has 90 units of 18 different sizes and configurations. Snap-on and stud-mounted types are included. Finish is black anodize.

Vemaline Products Co., Dept. ED, Franklin Lakes, N. J.

Price: \$50.

Silicon Rectifiers

540



Rated at 3 amp, silicon rectifiers types 3RC2 through 3RC40 have a peak reverse voltage range of 25 to 400 v. Designed for low-power switching and control applications, they enable rapid firing with a current of 2.5 ma at 125 C in computer circuitry, servo-mechanisms, static inverters, temperature and lighting controls.

International Rectifier Corp., Dept. ED, 233 Kansas St., El Segundo, Calif.

P&A: \$6.25 to \$53.24; stock.

◀ CIRCLE 120 ON READER-SERVICE CARD



How to find laminations when you need them fast!

High permeability lamination stock list goes out to purchasing agents and engineers semimonthly

A stock list, mailed every other week, pinpoints the quantities and sizes of our high permeability laminations that are immediately available from stock. It's sent to purchasing agents and interested engineers throughout the country. To get your regular copy, just address a request to Magnetics Inc., Department ED-94, Butler, Pa.

What makes the stock list important? Depleted inventories or stepped-up production means that when laminations are needed, they're needed fast—and in perfect condition. Magnetics Inc. stock list shows what types are available for immediate shipment. In addition, the stock list contains information on the new higher permeability "E" grade laminations. What's more, stocks listed reinforce those maintained at regional outlets on the east and west coast (all connected by teletype to assure fast delivery).

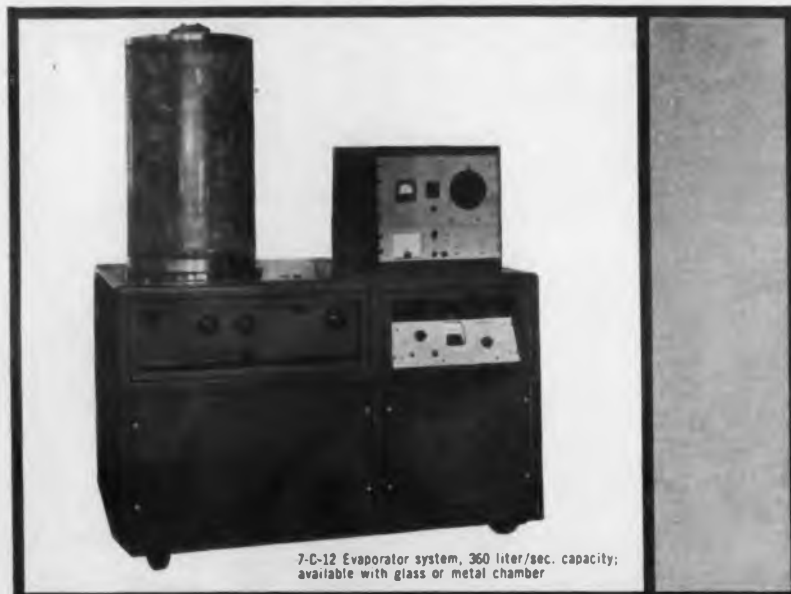
What makes Magnetics Inc. high permeability lamina-

tions special is the fact that they are the heart of high performance audio transformers, chokes and countless other fast response magnetic devices. They're burr-free, precision-sized and flat (thanks in part to a standardized 9" long carton that keeps the laminations undistorted during shipment and stocking). For more information, write to Magnetics Inc., Dept. ED-94, Butler, Pa.

Magnetics Inc. also publishes a bi-weekly stock list on tape wound cores and permalloy powder cores. It's available to you along with the laminations stock list. Ask for it.

MAGNETICS inc.

◀ CIRCLE 121 ON READER-SERVICE CARD



7-C-12 Evaporator system, 360 liter/sec. capacity; available with glass or metal chamber

Ultek ELECTRONIC high-vacuum SYSTEMS

clean vacuum—no fluids, no contaminants

high vacuum— 10^{-5} through 10^{-9} mm Hg and below, chamber volumes from 0.001 to 100 cubic feet

low-cost operation — UlteVac ionic pumps need minimum maintenance, operate unattended for months. System completely self-contained and movable. No water lines or plumbing connections. Requires only an AC outlet.

high-vacuum applications . . .

- vacuum tube processing
- thin film deposition
- space simulation
- environmental testing
- general physics research

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- standard and custom systems, with pumps from 5 to 2000 liters/sec.
- sorption roughing pumps
- metal-sealed fittings
- high-vacuum valves
- ambient foreline traps
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FREE Reprint of technical article, "Ionic Vacuum Pumps," by Dr. Lewis D. Hall

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Ultek vacuum station designed for experimental tube processing



NEW PRODUCTS

Delay Line

652



With 80 taps. Model DL 356 lumped-constant delay line has a total delay of 4 μ sec, a tapped output every 0.05 μ sec, rise time of 0.15 μ sec. Impedance is 100 ohms, attenuation 4 db max. Applications include phasing of multichannel tape recorders. Size is 1.5 x 1.5 x 1.5 in.

Valor Instruments, Inc., Dept. ED, 13214 Crenshaw Blvd., Gardena, Calif.

Availability: 2 to 3 weeks.

Pyrotechnic Initiator

553



Heavy-duty pyrotechnic initiator model 1N-113 contains a low-brisance squib which fires at 500 v ac rms or 700 v dc but will not fire with 250 v ac rms applied continually. It is shielded and filtered for protection against rf and other radiation. Mil specs are met.

Fleming Industries, Inc., Dept. ED, 2433 Moreton St., Torrance, Calif.

Telemetry Calibrator

485



Frequency stability of the model 612 telemetry calibrator is better than 0.1%. The instrument contains 18 separate high stability oscillators which supply simultaneously all IRIG subcarrier frequencies. These frequencies can be deviated by $\pm 7.5\%$ for 3-point calibration and discriminator adjustment. Output impedance is 400 ohms.

Dytronics Co., Dept. ED, 5485 N. High St., Columbus 14, Ohio.

P&A: \$2,400; 3 weeks.



Be sure your cards and packages are signed, sealed and delivered with

**CHRISTMAS
SEALS
TO FIGHT TB**

ANSWER YOUR CHRISTMAS SEAL LETTER TODAY

Communications System 362



Parallel-data communications system Mark 1 consists of simple data transmission and reception; Mark 2 and 3 combine transmit and receive systems with error correction and other editing features. Perforated tape is transmitted at speeds of 60 characters per sec or 600 words per min.

Tally Register Corp., Dept. ED, 1310 Mercer St., Seattle, Wash.

Hook-Up Wire 459

Tin-coated, solid copper hook-up wire, Turbotemp Teflon FEP/Nylon, is insulated with fluorinated ethylene propylene and is jacketed with nylon. It is suitable for continuous operation over a temperature range of -55 to $+120$ C at 300 v rms. It has low capacitance and dielectric constant.

American Enka Corp., Brand Rex Div., Dept. ED, 31 Sudbury Road, Concord, Mass.

Miniature Ovens 381



Designed to control the temperature of crystals and other temperature sensitive components, these miniature ovens cause units mounted in the oven cavity to remain constant in temperature through a wide temperature ambient. Model SO-1042 holds components or crystals; model SO-1047 holds one HC18/U crystal; model SO-1064 holds two HC18/U crystals. Temperature stability is ± 1 C.

Monitor Products Co., Inc., Dept. ED, 815 Fremont Ave., South Pasadena, Calif.

CIRCLE 122 ON READER-SERVICE CARD ►



10 years without periodic maintenance!

The reed relays in the new Cubic V-70 series of digital voltmeters assure you of a decade of flawless service. These relays (which replace the stepping switches used in conventional DVMS) have been life-tested for 100 million operations—the equivalent of over ten years of normal operation. The V-70 covers the full DC range from 1 millivolt to 999.9 volts. Balance time is 500 milliseconds; maximum readout time, 750 milliseconds; absolute accuracy is 0.01% plus or minus 1 digit. The meter has no vacuum tubes or moving parts; it operates in any position and is heat and shock resistant; the relays require no maintenance. The V-70 series offers the highest operating speed available in its price range: V-70, only \$1,580; V-71 (with automatic ranging and polarity), \$2,200. For further information, write to Department ED-110.



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NEW PC CONNECTOR for critical computer applications

Now—from Continental—a printed circuit connector that combines all the advanced design features for rugged service in missile, ground support and other critical applications. Expressly designed for high speed automatic wire-wrap connection techniques which combine better reliability with maximum wiring density in minimum space. Type 600-83-10 meets all applicable specifications of Buships MIL-C-21097.

3/4 ACTUAL SIZE



Designed specifically for automatic wire-wrap connections. Solid square, sharp-edged brass terminations, gold plate over silver plate. Three #20 AWG wire-wrap connections can be made on each terminal.

- 64 contacts, bifurcated beryllium copper. Patented "Bellowform" construction accepts .054" to .075" printed circuit boards. Up to 192 connections in less than 7 1/2" length.
- Special molding geometry assures superior ruggedness under severe shock and vibration. Compound is glass filled Diallyl Phthalate per MIL-M-19833, Type GDI-30.
- Polarizing slots in molding permit any required polarization by customer while retaining use of all 64 contacts.

DESIGNERS' DATA FILE

If you're designing around printed circuits you'll want to have Continental's Con-Dex File PC, compiled to help you select and specify the PC connectors best suited to your needs. For your copy, please write to: Electronic Sales Division, DeJur-Amsco Corporation, Northern Boulevard at 45th St., Long Island City 1, New York (Exclusive Sales Agent) RAvenswood 1-8000.



MICRO-MINIATURE • SUB-MINIATURE • MINIATURE • PRINTED CIRCUIT • RIGHT ANGLE PIN & SOCKET • CENTER SCREWLOCK

CONTINENTAL CONNECTORS

CONTINENTAL CONNECTOR CORPORATION • WOODSIDE 77, NEW YORK
CIRCLE 123 ON READER-SERVICE CARD

NEW PRODUCTS

Transistor Tester

541



For service, research or design use. Model 29 transistor tester checks general-purpose, rf, low power and switching transistors of npn and pnp types. It checks manufacturers ratings, indicates shorts, opens and defective transistors, shows leakage and gain.

Shepherd Electronic Industries, Inc., Instant Circuits Corp., Dept. ED, Terminal Drive, Plainview, L. I., N. Y.

Price: \$69.

Tapered Header

625



Diallyl phthalate header has a 6-deg tapered edge for tight fit between header and case, preventing leakage of liquid encapsulant. Header fits standard 9-pin tube sockets. Outside diameter is 0.700 in.

Epoxy Products Div., Joseph Waldman & Sons, Dept. ED, 137 Coit St., Irvington 11, N. J.

Price: \$0.20 to \$0.095 ea.

Power Supply

613



Continuously variable output from 0 to 36 v dc at up to 3 amp is provided by dc power supply BL 36/3. Line and load regulation is 0.01%, ripple less than 0.3 mv rms, output impedance less than 0.001 ohms. The convection-cooled supply operates to 50 C ambient. Rack or bench models are made.

Kaiser Electronics, Inc., Dept. ED, 4 Monroe St., Union, N. J.

P&A: \$395 up; stock.

ELECTRONIC DESIGN • October 25, 1961

Nor Gate

558



Convertible nor gate, called the N-131-DC Nand-gate has two triple-input and two dual-input gates. Addition of external capacitors converts it to an integrator, a differentiator or multivibrator. Additional inputs are available by terminal interconnection. Switching rates are to 1 mc.

Digital Design Corp., Dept. ED, Box 21, Clay, N.Y.

P&A: \$79; stock to 6 weeks.

Linear Accelerometers

556



Have self-test circuit. Series 310 linear accelerometers have full-scale ranges of 0.1 to 10 g, natural frequencies from 5 to 40 cps and output voltages of up to 10 v. The self-test feature checks the response of all mechanical, hydraulic and electronic systems which accept and respond to the output of the accelerometer.

Dynamic Measurement Co., Dept. ED, 106 Terwood Road, Willow Grove, Pa.

Power Supplies

604



Low-ripple power supplies models 1514 and 1515 offer decade output dialing from 500 to 5,060 v. Regulation is within 0.001%, with variations up to 10 v in the 115-v line. Load regulation for no-load to full-load output of 10 ma at any voltage, is 20 mv +0.001%; stability is 0.005% per hr; ripple is 1 mv rms.

Carad Corp., Dept. ED, 3381 Junipero Serra Blvd., Palo Alto, Calif.

Price: \$580 up.

ADC TRANSFORMERS · FILTERS · REACTORS JACKS & PLUGS · JACK PANELS



Military Standard POWER Transformers, Types MS-90016 through MS-90036.



Military Standard AUDIO Transformers, Types MS-90000 through MS-90008.



Sub-Miniature, hermetically sealed, low frequency inductors and transformers.



Transformers and filters for TRANSISTOR and PRINTED CIRCUIT applications to meet MIL-T-27A Grade 5, Class R or S.



Toroids, Hermetically sealed or open units for all frequency ranges.



Filters, Sub-Audio to 1.5 mcs.



Telephone Coils, Mechanically and electrically interchangeable with Western Electric.



Broadcast Quality Transformers, Standard of the Industry.



Magnetic Amplifiers and Saturable Transformers—For servo motor control, DC-DC Power Supplies, and switching silicon controlled rectifiers.



Balanced Modulators—Designs over a wide range up to 500 kcs.



Encapsulated Transformers—Using custom epoxy compounds for military and commercial applications.



Terminal Blocks, Molded to your specifications. Six popular sizes in stock.



Jack Panels—Several size panels in stock.



Plugs, Patch Cords and Jacks—Standard in the communication industry. Long frame telephone type jacks; wide variety; two and three conductor.

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ADC PRODUCTS

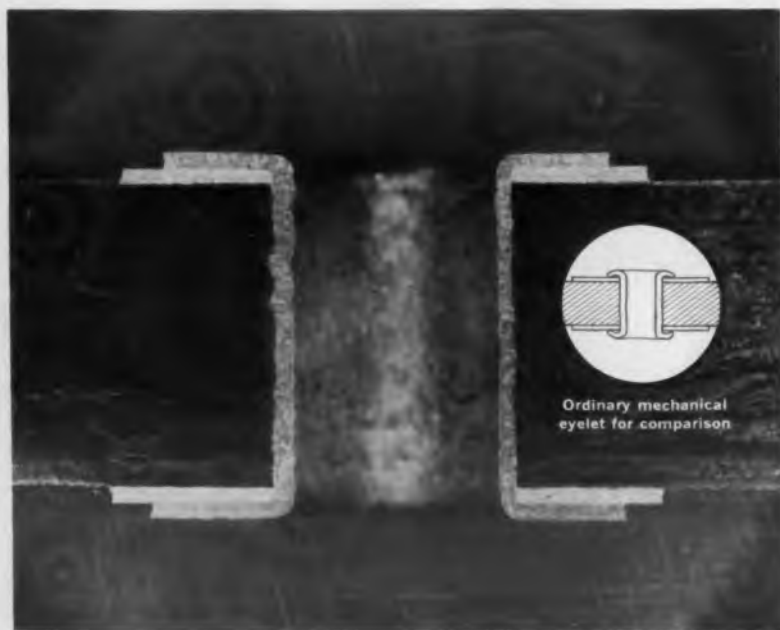
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TRANSFORMERS • REACTORS • FILTERS • JACKS AND PLUGS • JACK PANELS

CIRCLE 125 ON READER-SERVICE CARD

A NEW IMPORTANT EXCLUSIVE IMPROVEMENT IN THRU CONNECTIONS



The Electroformed Eyelet

Here's a welcome answer to your printed circuitry problems—the **Electroformed Eyelet**, new from Graphik Circuits. This remarkable thru connection is as strong as an eyelet, as reliable as the finest plated thru-hole. A new GC technique eliminates failures due to gas entrapment as well as other common eyelet troubles caused by vibration, intermittancy, or high electrical resistance at mechanical connections. Economical, too—if a precious metal finish, such as gold, is desired in the thru-hole, use of the **Electroformed Eyelet** eliminates the need to gold-plate the entire pattern and conductor paths. Extremely close line width and spacing tolerances are possible, as are heavy wall deposits of .005 or greater without danger of excessive build-up on surface conductors.

The **Electroformed Eyelet** is just one more example of the superb craftsmanship you always find in Graphik Circuits printed circuitry.

Write us, or call your nearby Cinch Manufacturing office.



Graphik Circuits

Division of Cinch Manufacturing Company, 200 So. Turnbull Canyon Road, City of Industry (Los Angeles), Calif.
Offices in 19 Principal Cities throughout United States listed under Cinch Mfg. Co. or United Carr Fastener Corp.

CIRCLE 126 ON READER-SERVICE CARD

NEW PRODUCTS

Data Acquisition System 536

High-speed, solid-state digital acquisition system samples several hundred channels of analog data at up to 15,000 samples per sec. Converted to four-place digital form, data is stored on magnetic tape or printed out. Input impedance is 10 meg or more. Conversion accuracy is 0.02% of full scale $\pm 1/2$ count. Tape section of the Microsadic unit has a transfer rate of 30,000 characters per sec. Tape speed is 150 ips, recording density 200 bits per in.

Consolidated Systems Corp., Dept. ED, 360 Sierra Madre Villa, Pasadena, Calif.

DC Amplifier 548



For analog computing and instrument use, model N-15 Nuvamp stabilized dc operational amplifier uses five nuvistors and maintains a dc gain of over 10 million while delivering ± 100 v into a 6.8-K load. Bandwidth is 4 kc into a 1- μ f load. Noise and drift are under 100 μ v.

Embree Electronics Corp., Dept. ED, 993 Farmington Ave., West Hartford, Conn.

P&A: \$120; stock.

Molding Compounds 428

Two compounds of fiberglass-reinforced polyester are for molding electrical parts. Grade 1706 has dielectric strength of 400 v per mil and impact strength of 6 ft-lb per in. Grade 1504 is a flame retardant compound with medium impact of 3 ft-lb per in.

The Glastic Corp., Dept. ED, 4321 Glenridge Road, Cleveland 21, Ohio.

Epoxy Resins 515

Low-viscosity, noncrystallizing epoxy resins, called Isochemrez FR, are for applications requiring self-extinguishing properties. Specs are: viscosity, 4,000 cps, tensile strength of 14,300 psi; dielectric constant of 3.89 at 60 cps or 3.83 at 10⁶ cps.

Isochem Resins Co., Dept. ED, 221 Oak St., Providence 9, R. I.

P&A: \$8 per kit; stock.

P
**ELECTRICAL
TUBING**

made from **TEFLON***

In $3/8$ " to $1\frac{1}{2}$ " I.D.
sizes for electrical
and electronic uses

- outstanding electrical properties
- unaffected by moisture
- low coefficient of friction
- wide service temperature range
- flexibility
- unharmed by a hot soldering iron

Buy electrical tubing of Teflon from PENNSYLVANIA FLUOROCARBON and you can be sure of getting tubing that:

- More than meets S. P. I. Spec. F. D. 103 and MIL-I-22129B
- Shrinks less than 1% so it won't expose terminals
- Is properly cured—has a tensile strength of between 2500 and 6000 psi at 200% elongation
- Is thoroughly cleaned and 100% inspected

Write, wire or call for a quotation. We can tailor electrical tubing of Teflon with colors for identification or with modifications for changed texture and mechanical properties and we offer prompt deliveries.

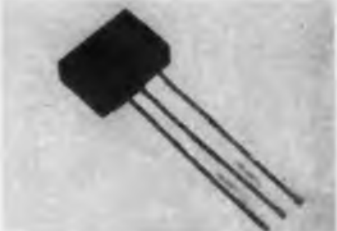
P
**PENNSYLVANIA
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Phone: EV 6-0603 TWX: PH 252

*DuPont Registered Trade Mark
CIRCLE 127 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 25, 1961

Silicon Rectifier

377



Full-wave, center-tap silicon rectifier circuit package, type CT, are available in voltage ratings from 50 to 600 v. They are for applications in power supplies used in transistor and vacuum tube circuits. Leads may be paralleled to make a high-current rectifier; two ct circuits can be wired to form a full-wave bridge; three may be wired to form a full-wave three-phase bridge. Circuit will handle 0.75 amp forward current up to 50 C.

P. R. Mallory & Co., Inc., Dept. ED, Indianapolis 6, Ind.

P&A: \$0.655 to \$1.12 each in 1,000 lots; immediate.

Ferrite Material

462

Low power losses insure a high degree of power conversion for this ferrite material at normal operating frequencies. Material C-2 is used in solid-state converters of the dc to ac or the dc to dc types and magnetic amplifier applications.

Indiana General Corp., General Ceramics Div., Dept. ED, Keasbey, N. J.

Availability: from stock.

VHF Multicoupler

356



Broadband vhf multicoupler model VHM-3 couples up to six receivers to one antenna system over the range of 15 to 70 mc. Noise figure is 4 db with a nominal gain of 16 db for each output. Ripple of the rf passband is less than 3 db. Isolation between outputs is 60 db; between output and input, 90 db.

Applied Technology Inc., Dept. ED, 930 Industrial Ave., Palo Alto, Calif.

P&A: \$1,985; 60 days.

NEW POWER through C and X band



NEW PPM METAL-CERAMIC TRAVELING WAVE TUBES

Climaxing ITT's long history of pioneering in the traveling wave tube field are these new PPM types covering C and X bands and distinguished by the highest power output over the greatest bandwidths thus far available. The X-band TWT Type X-354 is rated at 5 watts CW from 8 to 12 kilomegacycles; the C-band TWT Type X-370 is rated at 10 watts CW from 4 to 8 kilomegacycles. Type X-368 serves as a driver for the X-354. As in other ITT traveling wave tubes, construction is exclusively metal and ceramic.

Power output and frequency coverage of this caliber result in a new standard of performance. For ECM requirements, frequency diversity radar or any other broadband microwave application, ITT has a complete line of S-band, C-band and X-band TWTs rated from .050 to 10 watts CW and to 1 kilowatt pulse output. ITT traveling wave tubes are available for immediate delivery and are backed by the world-wide resources and facilities of the ITT System.



Write for information on the complete line of ITT traveling wave tubes. Application assistance is available for your specific requirements.

ELECTRON TUBE DEPARTMENT ■ COMPONENTS DIVISION

INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION, CLIFTON, NEW JERSEY

ITT COMPONENTS DIVISION PRODUCTS: POWER TUBES • IATRON STORAGE TUBES • HYDROGEN THYRATRONS
TRAVELING WAVE TUBES • SELENIUM RECTIFIERS • SILICON DIODES AND RECTIFIERS • TANTALUM CAPACITORS

NEW PRODUCTS

Pressure Standard

538

Pneumatic signal generator is made for shop and laboratory work with all pneumatically operated devices. A typical unit provides pitot pressure signals from 1.5 to 110 in. Hg absolute, and static pressure from 0.5 to 35 in. Hg absolute. Accuracy is ± 0.015 in. Hg. It provides changes corresponding to 1 Mach per minute or 30,000 ft per minute, and sinusoidal pressures of variable amplitude and frequency.

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

Linear Accelerometers

560



Photo-resistive linear accelerometers models AH1L and AH2L produce 5 or ± 2.5 v from 10-v dc excitation without amplification. Other features include: temperature range of -65 to $+250$ F, overload of 500%, excellent stability and rugged construction. Uses may be in flight-test instrumentation, container drop and shock tests and airborne telemetry.

Data Sensors, Inc., Dept. ED, 13112 Crenshaw Blvd., Gardena, Calif.
Availability: 30 days.

DC Timing Motor

512

Nonferrous winding and cage assembly minimize speed changes due to loading and temperature variations. Series 43100 dc timing motor is for commercial and industrial applications where dc generator or battery power is required. Windings for 6, 12 or 27-1/2 v are standard.

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

Precision Terminations

505

For pulse, video, rf coaxial cables. Types BNC, PL 259 and N precision test terminations use high-grade L% metal film resistors and can be supplied in any value required. Types BNC and PL 259 are rated at 0.5 w; type N, 1 w.

Holland Electronics, Inc., Dept. ED, 772 E. 53 St., Brooklyn 3, N. Y.

P&A: \$2.45 up; stock to 4 weeks.



Painting in background: "The Piping Shepherd," by Sir Joshua Reynolds, P. R. A. (1723-1792)

New cost savings for users of dielectric materials

... a progress report on the MYCALEX METHOD
from Jerome Taishoff, President, Mycalex Corporation of America

"I don't have to tell you about the profit squeeze. It's a hard fact-of-life throughout our industry today. That's why we feel the MYCALEX METHOD—the unique molding and finishing technique we recently developed—offers so much promise.

Sample quotations point to cost savings up to 84%

"The many months spent in the developing of this new process enable us to turn out better-performing products for less: savings we, in line with our policy, will pass along directly to our customers. And those savings promise to be substantial! Note the typical parts shown in the photograph below, as well as the two mechanical diagrams, as you can see, this new production technique reveals cost reductions of 78% and 84%, respectively, when compared to previous cost quotations." Just as important, the savings are in addition to the high reliability SUPRAMICA® ceramoplastics and MYCALEX® glass-bonded micas are noted for.

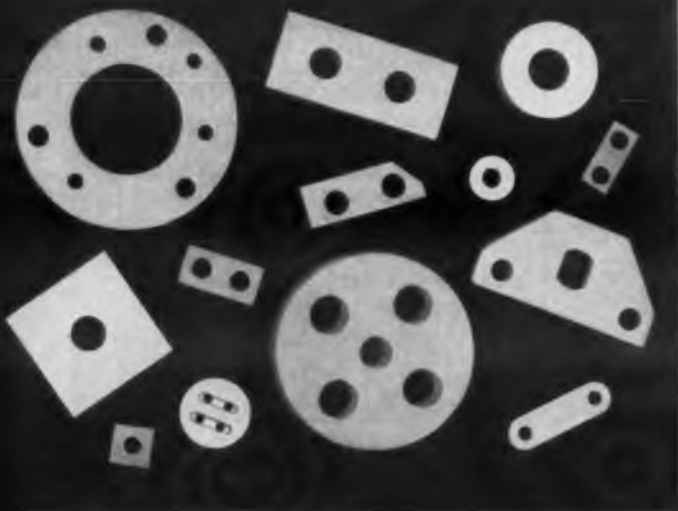
Savings plus quality with the MYCALEX METHOD

Though these intricate parts now cost much less to make—they offer the temperature endurance, total dimensional stability, high dielectric strength and low loss that SUPRAMICA and MYCALEX formulations have been delivering for years.

Choose from any of these famous materials

SUPRAMICA 620 "BB", 560 and 555 ceramoplastics and MYCALEX 410 glass-bonded mica. *Maximum Temperature Endurance* (unstressed): 1200, 930, 650 and 650°F; *Loss Factor* (10⁶ cycles/sec.): 0.020, 0.010, 0.013, 0.010; *Compressive Strength* (psi): 30,000, 25,000, 40,000 and 40,000, respectively.

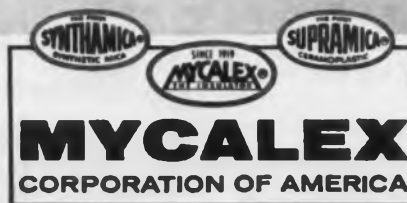
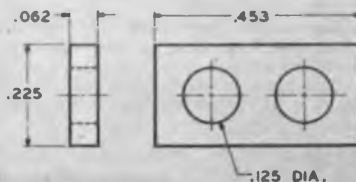
So for electronic insulation materials with the high-performance properties you must have—at a profit-protecting price — look into the new MYCALEX METHOD. Send your blueprints and drawings for specific quotations and information.



78% LOWER IN PRICE



84% LOWER IN PRICE



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Executive Offices: 30 Rockefeller Plaza, New York 20, N. Y.

World's largest manufacturer of ceramoplastics, glass-bonded mica and synthetic mica products

CIRCLE 129 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 25, 1961

Environmental Test Chamber

605



Temperatures from -320 to +400 F are produced by the model 2-300 test chamber. Unit, 72 x 40 x 38 in., has a triple-laminated observation window. A front panel opening permits insertion of wiring, thermocouples, and vibration testing devices. Unit has a bracket for mounting liquid CO₂ or nitrogen. Circulating fans maintain uniform temperature.

Solar Systems, Inc., Refrigeration Div., Dept. ED, 11936 Valerio St., North Hollywood, Calif.

Load Cell

617



Compression force transducer model 321 has an output of 2 mv per v ±0.10%. Standard ranges are from 50 to 250,000 lb, with higher ranges available on special order. Cell is hermetically sealed.

Allegany Instrument Co., Div. of Textron Electronics, Inc., Dept. ED, 1091 Wills Mountain, Cumberland, Md.

Field Strength Meter

728



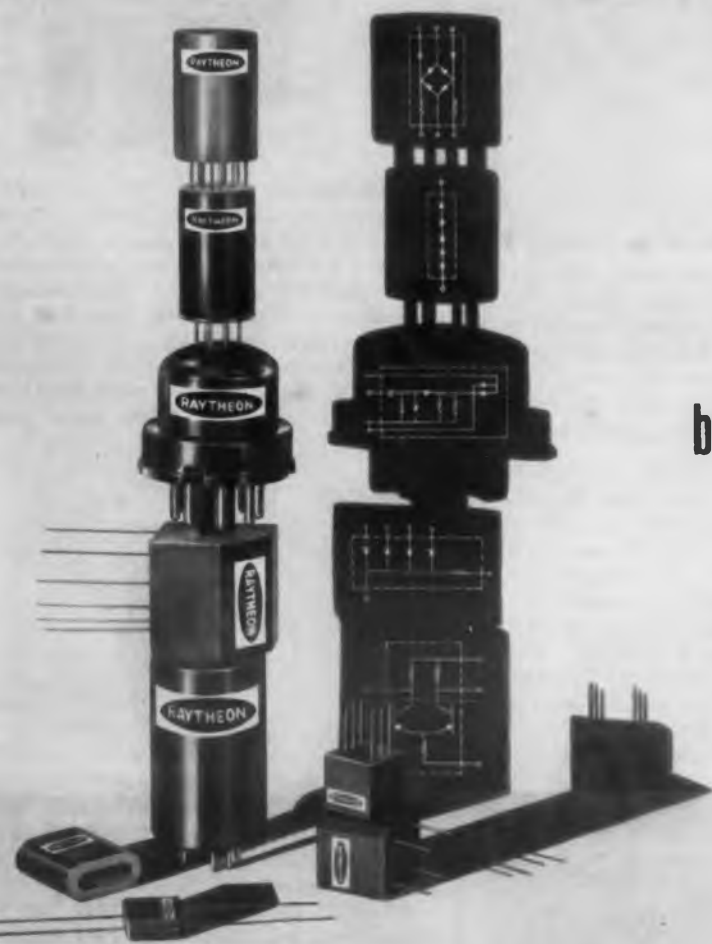
Portable field strength meter uses six transistors and a Zener-regulated battery supply. All vhf picture and sound carriers can be tuned, and their strength measured from 20 μv to 1 v. Power output of vhf translators from 0.1 to 1.5 w can be measured. Unit, 8 x 4-1/4 x 2-1/2 in., weighs 3 lb.

Sadelco, Inc., Dept. ED, 601 W. 26th St., New York 1, N. Y.

Price: \$195.00.

129

RELIABLE products from RAYTHEON



how to
build
better
circuits

Raytheon Circuit-Pak modules can raise your circuit designs to new levels of reliability — at surprisingly low cost. Many years of experience in the refinement of circuit packaging and the development of extensive facilities and capabilities enable Raytheon to provide you with many engineering and economic advantages.

Carefully matched semiconductor devices interconnected by precisely engineered techniques and encapsulated by advanced methods of high temperature epoxy molding assure compact, ruggedized packaging. You save by eliminating expensive package development costs and by cutting lead time from design to production units.

Complete facilities are available for efficiently developing any custom design you may require. You may also choose from large stocks of standardized circuit-paks which include 54 new diode quads designed as bridge rectifiers, ring modulators, voltage multipliers, and series strings. For technical data as well as consultation on circuit packaging please call your local Raytheon office listed below.

RAYTHEON COMPANY SEMICONDUCTOR DIVISION



SILICON AND GERMANIUM DIODES AND TRANSISTORS • SILICON RECTIFIERS • CIRCUIT-PAKS

BALTIMORE, MD., Southfield 1-0490 • BOSTON, MASS., Decatur 2-7177 • CHICAGO, ILL., National 5-4000 • DALLAS, TEXAS, Lakeside 6-7921 • DAYTON, OHIO, Baldwin 3-8128
DETROIT, MICH., Trinity 3-5130 • ENGLEWOOD CLIFFS, N. J., Lowell 7-4911 (Manhattan, Wisconsin 7-6400) • LOS ANGELES, CAL., Plymouth 7-3151 • ORLANDO, FLA., Garden 3-0518
PHILADELPHIA, PA. (Haddonfield, N.J.), Hazel 8-1272 • SAN FRANCISCO, CAL. (Redwood City), Emerson 9-5566 • SYRACUSE, N. Y., Howard 3-9141 • CANADA: Waterloo, Ont., Sherwood 5-5831
GOVERNMENT RELATIONS: Washington, D. C., Metropolitan 8-5205

CIRCLE 130 ON READER-SERVICE CARD

NEW PRODUCTS

Waveform Generator

719



Frequencies from 0.001 cps to 10 kc. continuously variable, are produced by the model 250 waveform generator. Square, triangle, sine, cosine, or ramp outputs are available at up to 30 v, 25 ma. Continuous operation, external triggering, or push-button triggering is available. Frequency accuracy is better than 3%. Dc reference level is adjustable.

Exact Electronics, Inc., Dept. ED, P. O. Box 234, Hillsboro, Ore.

P&A: \$600; 90 days.

Low-Voltage Power Supply

724



Regulated to 0.002%, the model PS110 power supply has a 15 v dc output, adjustable ± 1.5 v, with a load current of 0 to 400 ma. Line transients are suppressed in less than 1 μ sec. Ripple is 50 μ v. Overload protection is provided. Under complete short-circuit, internal regulating transistor dissipates less than 1 w. Unit measures 2-1/2 x 8 x 5 in. and weighs 5-1/2 lb.

Dynex Industries, Inc., Dept. ED, 170 Eileen Way, Syosset, N. Y.

Voltage Divider

721



Decade transformer voltage divider is linear to ± 0.5 ppm. Designated type DT-72A, the unit is similar to the firm's previous type DT-72, with improved linearity and extended windings providing taps with -0.1 and $+1.1$ settings. Decade identification above each dial is provided.

Electro Scientific Industries, Inc., Dept. ED, 7524 S. W. Macadam Ave., Portland 19, Ore.

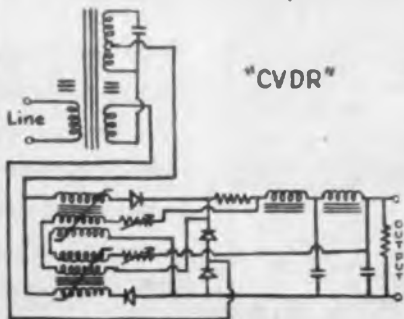
P&A: \$695 to \$795.

calculated advantage

For all your a-c and d-c power supply requirements or special engineering, contact your nearest SOLA representative:

New SOLA "CVDR" d-c supply simplifies missile-age circuit design, reduces costs.

It's a natural for computers, communications equipment, and similarly sophisticated electronic gear. Made for today's stringent operating parameters. Ends costly dependence on over-engineered d-c power sources.



CVDR provides both line and load regulation without tubes or transistors. Line regulation $\pm 1\%$, for $\pm 15\%$ line voltage changes; 1% load regulation from zero to full load; 1% peak to peak ripple. Fits 19" relay racks, and measures only $3\frac{1}{2}$ " high. Custom configurations and power ratings available on special order.

Line voltage stabilization is by means of the Sola "CV" self-regulating transformer. Load voltage stabilization is accomplished by the series "IX" voltage drop in the saturable reactor (see schematic). This voltage drop is controlled by the load current itself.

CVDR is ready right now, off-the-shelf, in units rated 6-volts, 10-amps . . . and 12, 18 or 24 volts, 5-amps. For outstanding reliability in a-c and d-c power supplies tailored to every application, see your SOLA representative . . . or write to address below.

SOLA ELECTRIC CO., 1717 Busse Road, Elk Grove Village, Ill. NEmpstead 9-2800
IN CANADA, Sola-Basic Products Ltd., 377 Evans Ave., Toronto 18, Ontario

SOLA



Division of Basic Products Corporation

CALIFORNIA, San Francisco: Sola Electric Co., Three W. 37 Ave., San Mateo, Fireside 1-6538
• Los Angeles: Sola Electric Co., 2907 West Vernon Avenue, AXminster 2-0166

COLORADO, Denver: Slaybaugh & Thompson 100 W. 13th Avenue; AComa 2-5826

FLORIDA, Winter Park; James Millar Assoc., P O Box 1603; Midway 7-7407

GEORGIA, Atlanta; James Millar Assoc., 1036 Peachtree Street N. E. TRinity 6-0919

INDIANA, Indianapolis; R. O. Whitesell & Assoc., 6620 E. Washington Street; Fleetwood 9-5374

IOWA, Des Moines; McDowell Redlingshafer Sales Co., 3615 Olive St.; JEFFerson 3-3277

KENTUCKY, Louisville; R. O. Whitesell & Assoc., 400 N. 38 Street; SPring 6-2024

MASSACHUSETTS, Newton; Sola Electric Co., 272 Centre Street; Bigelow 4-3354

MICHIGAN, Detroit; R. C. Merchant & Co., Inc., 18411 W. McNichols Rd.; KENwood 5-6000

MINNESOTA, Minneapolis; Heimann Co., 1711 Hawthorne Avenue; FEderal 2-5457

MISSOURI, Kansas City; McDowell-Redlingshafer Sales Co., 1103 E. Armour; WEstport 1-5622

• St. Louis; McDowell-Redlingshafer Sales Co., 3615 Olive Street; JEFFerson 3-3277

NEW JERSEY, Little Ferry; Sola Electric Co., 84 Industrial Avenue; HUbbard 9-1060

NEW YORK, Buffalo; R. W. Mitscher Co., 487 Ellicott Square Building; TL 4-2517

NORTH CAROLINA, Charlotte; Ranson, Wallace & Co., 116½ E. 4th St.; EDison 4-4244

OHIO, Cleveland; Sola Electric Co., 14235 Detroit Avenue; LAkewood 1-8038

PENNSYLVANIA, Philadelphia; Sola Electric Co., (Philadelphia answering service — WAINut 2-5340); or 210 North 6 Street, Camden 2, N. J.; EMerson 5-7744

• Pittsburgh; R. G. Sidnell & Co., 675 Princeton Blvd.; CHurchill 2-1476

TEXAS, Dallas; Robert E. Nesbitt Co., 1925 Cedar Springs; RIVERSide 7-4145

WASHINGTON, Seattle; Northwestern Agencies, Inc., 4130 First Ave. So.; MAINE 3-8882

WASHINGTON, D. C.; Sola Electric Co., contact 8719 Colesville Rd., Silver Spring, Md.; JUniper 5-0331

CIRCLE 131 ON READER-SERVICE CARD

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EMCOR® STANDARD CABINETS



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- EMCOR MODULAR ENCLOSURE SYSTEM Cabinetry provides for thousands of control center combinations.
- Choose from hundreds of EMCOR Cabinet widths, depths and heights offering an exclusive combination of engineered features.
- Engineered simplicity of basic frames and components affords quickest and easiest erection of control center assembly.
- EMCOR Cabinetry Engineers backed by the research and development "know-how" of the Roy C. Ingersoll Research Center set the pace for the packaging needs of electronics, instrumentation and electro-mechanical engineers from coast to coast.
- Rugged frame construction surpasses all standard requirements for increased load carrying capacities.
- Compatible cabinet design assures simplified and economical expansion at any time.
- EMCOR Cabinet manufacturing meets rigid quality-controlled craftsmanship standards.
- Nationwide organization of EMCOR Sales-Engineering Representatives assist in planning stages and assure customer satisfaction beyond the sale.

Condensed Version of Catalog 106 Available Upon Request.

Originators of the Modular Enclosure System

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Division of Borg-Warner Corporation
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CIRCLE 133 ON READER-SERVICE CARD

NEW PRODUCTS

Precision Calibration Console

727



Resistors, capacitors, ac and dc dividers can be calibrated on the model 5 precision calibration console. Unit is self-checking. Resistance and capacitance is measured relative to certified standards. Capacitance measuring system has an accuracy of 0.01% and resolution of 10 ppm. Voltage ratios are compared with those of decade transformer divider and resistive divider. Equipment compensates for leads and phase differences. Terminals for auxiliary indicators are provided.

Electro Scientific Industries, Inc., Dept. ED,
7524 S. W. Macadam Ave., Portland 19, Ore.

Proximity Counter

622

For production-line applications, model SP-1A proximity counter detects objects up to 4 in. from a wire-sensing device. Unit does not require photoelectric or radiation sources for activation. Both nonmetallic and metallic objects are detected. Control circuit is mounted in epoxy. Device weighs less than 10 lb.

Five Mile Electronics, Dept. ED, P. O. Box
301, Olean, N. Y.

Price: \$149.00.

Pistol-Shaped Test Meter

718



For difficult-to-reach areas, this pistol-shaped test meter, called Pistolmeter, measures current, voltage, and resistance. Revolving jaws can be inserted into cramped quarters. A lock on the meter pointer permits the reading to be taken after the device is removed from the tested conductor. Meter has test leads, a battery charger, and holster.

Federal Pacific Electric Co., Dept. ED, 50
Paris St., Newark, N. J.

SINCE 1917



We've been
meeting the
need for
precision
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ELECTRONIC DESIGN • October 25, 1961

General Electric High Reliability Tantalytic* Capacitors

AC Motor

629



Compact, lightweight, continuous duty, 400 cps motor, model 4440, has an output of 1/5 hp, 37 w. Weight is 1.0 lb; length is 3.02 in.; diameter is 1.74 in.; operation is to 80,000 ft. Efficiency is 68%.

Hoover Electric Co., Dept. ED, Hangar Two, Port Columbus Airport, Columbus 19, Ohio.

Load Cell

639



A precise universal force transducer, the Alinco model 341LS load cell is for rocket and missile testing. Designed for tension and compression service the unit has an output of 3 mv per v $\pm 0.15\%$ in both tension and compression. Standard ranges are from 50 to 250,000 lb.

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

Inertia Switch

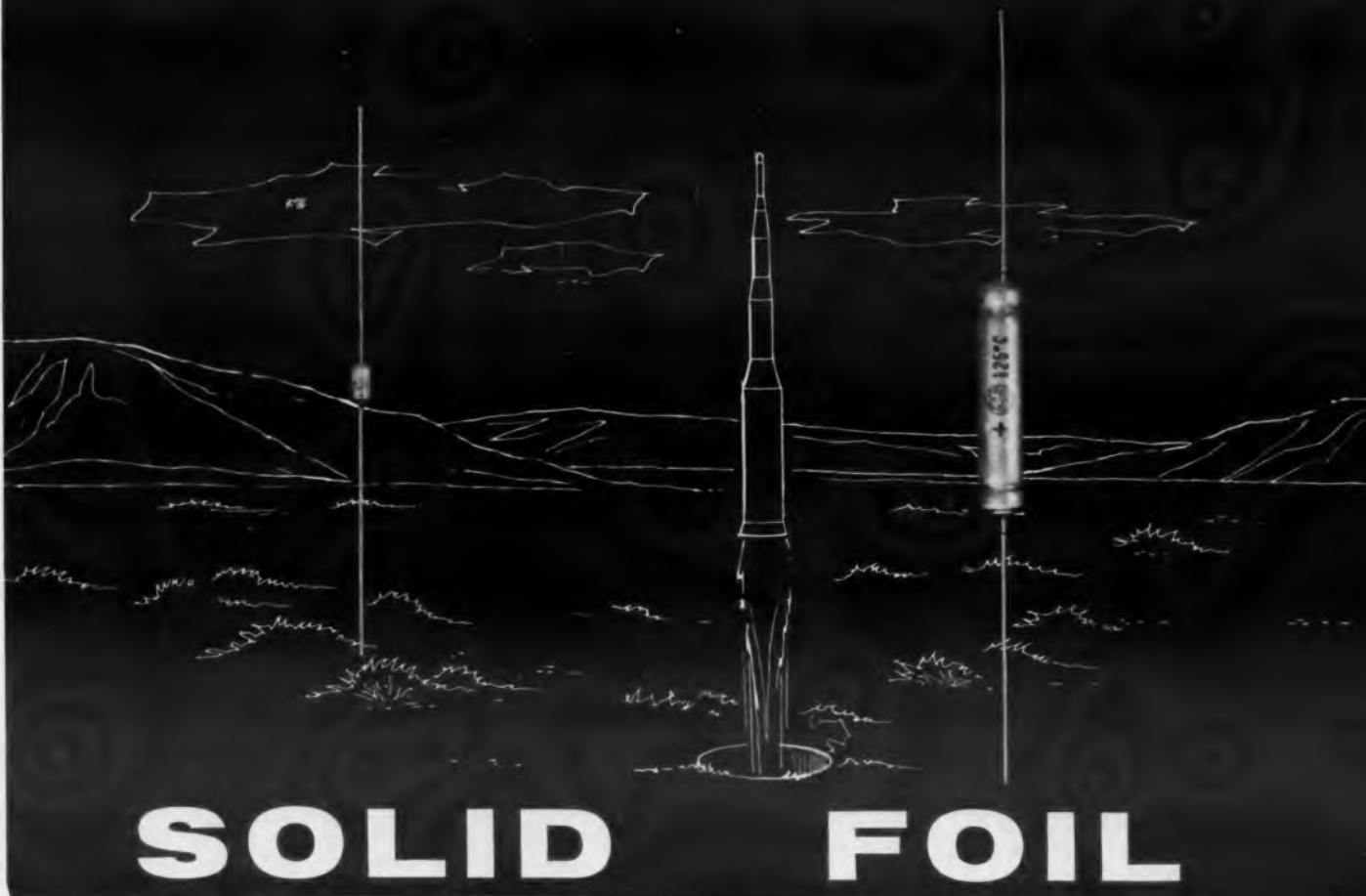
637



Time delay inertia switch is gas-damped for maximum reliability. Used primarily in applications where a time delay or acceleration-time integration is required. Can be set to function at ranges as high as 50 g-sec. Variation in time delay between -65 and +250 F is $\pm 25\%$.

Inertia Switch, Inc., Dept. ED, 311 W. 43 St., New York 36, N. Y.

CIRCLE 135 ON READER-SERVICE CARD ➤



Both now qualified for MINUTEMAN Both now available for other programs

Both Solid and Foil General Electric High Reliability Capacitors are now qualified for the unprecedented MINUTEMAN missile reliability program.

Perfected and qualified under separate MINUTEMAN development contracts, G-E solid and foil types now approach final objectives—a failure rate of .001%/1000 hours (under specified test conditions).

To prove such reliability, General Electric logs 250,000 unit test hours each week. The total now surpasses 5,000,000 sequential test hours—smaller samples do not satisfy high-reliability objectives!

So that tomorrow's units will equal those produced today, General Electric calls on unique in-process

controls. An outstanding example is the Integrated Reliability Data System which measures and controls each variable from incoming material test to field performance.

To help the customer calculate system reliability, General Electric will provide reliability test data on each rating. This information is up-dated every 1000 hours.

The MINUTEMAN-qualified capacitors described are now available for all electronic systems. For specs, contact your G-E Sales Engineer. For descriptive bulletins, write to Section 430-05, General Electric Co., Schenectady, New York. Capacitor Department, Irmo, South Carolina.

* Reg. Trade-mark of General Electric Co.

Progress Is Our Most Important Product

GENERAL  ELECTRIC

NEW PRODUCTS

Resistor Sorting System

722



A programmed precision Kelvin bridge, the model CA-989 resistor sorting system uses four-terminal measurements to sort resistors into five adjacent, equal-percentage bands. The bridge also determines resistors falling above the highest or below the lowest band. Band ranges of 0.01% of 0.1% can be chosen by plug-in networks; repeatability is 0.001%. More than 500 resistors can be measured per hr.

Electro Scientific Industries, Inc., Dept. ED, 7524 S. W. Macadam Ave., Portland 19, Ore.

Printed-Circuit Connector

616



With 130 contacts on 0.1-in. contact centers. The double-row printed-circuit connector has staggered terminations. Insulator material is diallyl phthalate; contact material is beryllium copper, gold over silver plate. Current rating is 3 amp; voltage breakdown is 2,200 v ac.

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

Availability: 30 days.

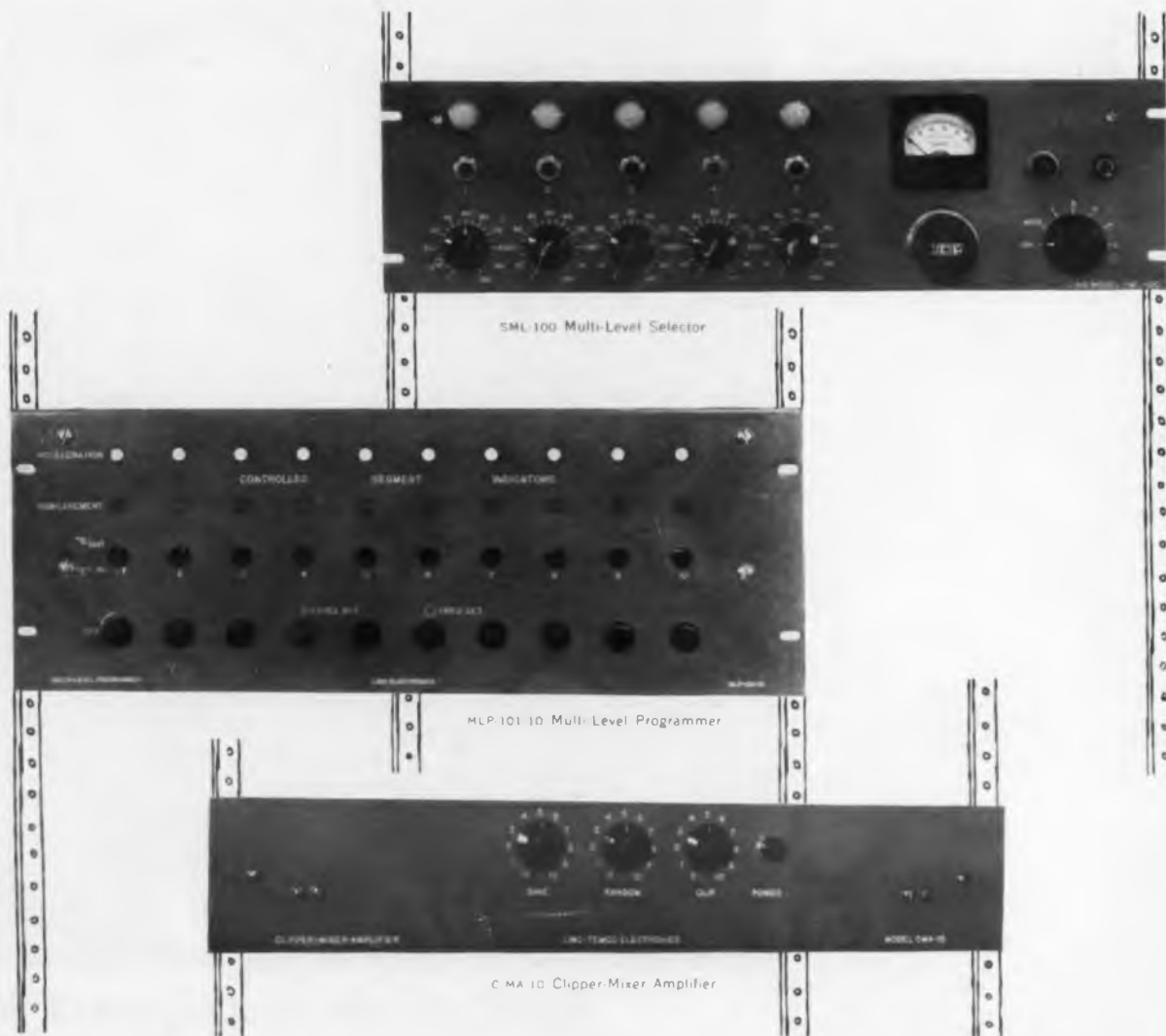
Teflon-Impregnated Packing Material

716



Containing more than 30% Teflon by weight, styles 5875 and 5881 Teflon-impregnated packing materials resist temperature changes, glazing, swelling, chemicals, and corrosives. Called Lattice Braid, the materials are made for packing active liquids and devices with moving parts. Temperatures from -90 to +500 F are withstood.

Garlock Inc., Dept. ED, Palmyra, N. Y.



LING EXPANDS INSTRUMENTATION FOR THE VIBRATION TESTING INDUSTRY - adds three new products for control and programming

MULTI-LEVEL SELECTOR: Top, Model SML-100 allows each of five accelerometer signals, calibrated for operation at predetermined "g" levels, to limit shaker excitation to package; prevents excessive excitation of critical points in test specimen. Built-in calibrator... panel selector for automatic operation or individual channel control... light indicators identify control accelerometer... compatible with existing servo systems. **MULTI-LEVEL PROGRAMMER:** Center, Model MLP-101-10 is manually preset for change-over at desired frequencies and then automatically holds preset "D" or "g" levels over each band of frequencies. Ten transfer points are provided. The programmer is compatible with existing servo systems. **CLIPPER-MIXER AMPLIFIER:** Bottom, Model C-MA-10 is a high quality, stable yet economical unit for level control of sine or random noise signals. An internal acceleration clipper may be switched in to provide adjustable clipping of the noise signal, and sine and noise signals may be mixed for complex wave operation. For more information on Ling systems, write Department ED-1061 at the address below.

LTV

LING-TEMCO-VOUGHT, INC.

LING ELECTRONICS DIVISION

1515 SOUTH MANCHESTER, ANAHEIM, CALIFORNIA • PROspect 4-2900
CIRCLE 136 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 25, 1961

LING ELECTRONICS

Here is further proof that Ling always provides vibration systems with greatest flexibility, versatility and convenience. The R1007 Master Control Console shown below is recognized the finest of its kind, and is a prime example of the human engineering incorporated into all Ling equipment.

The R1007 features a signal patch panel in which signal source, signal shaping and equalization are all connected for normal operation. By patching, equipment not used in a given test may be bypassed, or inputs to the various monitors can be changed so almost any point in the signal path can be measured. External signals can be fed into the system's read-out devices, or equipment integrated into the console may be patched for external measurements.

The patch panels graphically display signal flow from left to right and top to bottom, giving the operator a ready picture of system operation.



The R1007 offers pushbutton convenience all the way! Pushbutton selector switches are provided with measuring devices such as VTVM's, X-Y Recorder Log Convertors and Scopes to allow rapid measurement of signals at key points. Pushbuttons light up for visual monitoring.

Whatever your needs in super power electronics, vibration testing, acoustics or sonar, you'll find Ling systems offer highest performance ratings, highest reliability...setting the industry standard.

LTV

LING-TEMCO-VOUGHT, INC.
LING ELECTRONICS DIVISION

HIGH POWER ELECTRONICS FOR
VIBRATION TESTING-ACOUSTICS-SONAR
CIRCLE 137 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 25, 1961

Relay-Assembly Machine

717



Made for telephone relays, this production machine aligns and compresses a relay stack-up and tightens four screws. The relay assembly is compressed at a pressure of 3,500 lb by a hydraulic press. A relay is processed in 3-1/2 sec.

Gardner-Denver Co., Dept. ED, Gardner Expressway, Quincy, Ill.

Miniature Magnetic Amplifier

723



Providing 75-w output from a 2-ma signal, the model MA110 magnetic amplifier is made for airborne and missile applications. Output is 110 v, 0.75 amp ac. Response time is 8 msec. Power gain is rated at 40,000. Unit withstands shock and vibration and meets MIL-E-5272-C specifications for humidity. Hermetically sealed and potted, the device measures 3-1/16 x 3 x 2-5/8 in. and weighs 2-1/8 lb.

Dynex Industries, Inc., Dept. ED, 170 Eileen Way, Syosset, N. Y.

Sub-Plate Chassis Systems

715



Detachable chassis sub-plates 4-1/2 in. wide can be mounted together in this chassis. Plates can be removed from the main chassis for repairs or replacement. Made for rack mounting, they are 8-1/2 through 21-1/4 in. deep and support 150 lb per sq ft.

Vent-Rak Inc., Dept. ED, 525 S. Webster St., Indianapolis 19, Ind.

RELIABILITY
EVERY
TIME



Another advance by M/M . . . QT17 stereo head tapered design to permit easy, foolproof insertion of cartridge tapes.



It's easy for head manufacturers to talk about the *theoretical* superiority of their particular designs . . . but the all-important proof is in the results achieved in actual *mass production*.

Michigan Magnetics' design is conventional yet efficient . . . it lends itself to modern production conditions and economies. No one has matched Michigan Magnetics' record for reliability. No one has a quality control and inspection system that can beat M/M . . . that's why you get 1000 reliable, dependable heads every time you order 1000 heads from M/M. Take the gamble out of head purchases . . . order only from the leading manufacturer of OEM heads for home tape recording equipment . . . always specify Michigan Magnetics!

THIS GUARANTEE TAG IS YOUR CUSTOMER'S ASSURANCE OF FIDELITY AND RELIABILITY.



MICHIGAN MAGNETICS, INC.

VERMONTVILLE, MICHIGAN

1-1

CIRCLE 138 ON READER-SERVICE CARD



135

2 TO 3 TIMES GREATER TRACKING ACCURACY

than 12ACP Types!

With electrical characteristics similar to conventional 12ACP types, this 12" 2-gun M1030 Radar and Fire Control Indicator C-R Tube provides twice the tracking accuracy over a 10" diameter useful area—and with a maximum error of 0.070". With additional electrodes providing further electrical correction, accuracy can be improved to approximately 0.050".

Throughout, the ETC Type M1030 is a new, improved design incorporating ruggedized all glass rodded construction. In addition to the big boost it gives to tracking accuracy, defocussing, line width and angle alignment characteristics have all been materially improved. Write for ETC Bulletin M1030.



pacing trends
IN CATHODE RAY TUBE DESIGN
...since 1937



The M1030 is one of six ETC 12" tubes developed during recent months to provide new concepts in radar tracking and fire control indication efficiency. Types include single- and dual-trace tubes with greatly enhanced defocussing and tracking accuracy. All can be designed with more than two guns for special uses. Inquiries for specific requirement will receive prompt attention.

electronic tube & instrument division

of General Atomics Corporation
1200 E. MERMAID LANE, PHILADELPHIA 18, PENNA.

(formerly Electronic Tube Corporation)

CIRCLE 139 ON READER-SERVICE CARD

NEW PRODUCTS

Wirewound Resistors

711



Rectangular shaped. Called Squaristors, these miniature precision wirewound resistors are offered in values of 1 to 1,200,000 ohms. They have accuracies of up to 0.01% and meet MIL-R-93B and C and MIL-R-9444. Normal temperature coefficient is ± 10 ppm per deg C.

General Resistance, Inc., Dept. ED, 430 Southern Blvd., New York 55, N. Y.

Precision Static Inverter

529

Voltage regulation to $\pm 1\%$ under wide load unbalance, and frequency tolerances of 1%, 0.05%, or 0.01% are provided by the model SIS-3-450042SV static inverter. Unit operates at 500 va, 3 phase, 400 cps. Phase angle errors are 1 deg max under 50% load unbalance. Automatic overload and short-circuit protection is provided. Mil specs are met.

The Siegler Corp., Magnetic Amplifiers Div., Dept. ED, Anaheim, Calif.

Circuit Breakers

621

Molded-case circuit breakers type QCC are offered in current ratings of 125, 150, 175 and 200 amp in the following combinations: one-pole at 120 and 240 v ac, two-pole at 120 and 240 v ac, two-pole at 240 v, three-pole at 240 v. Interrupting rating is 10,000 amp.

Westinghouse Electric Corp., Standard Control Div., Dept. ED, Beaver, Pa.

Edge-Reading Meters

720



Designed to be stacked one atop another, these edge-reading meters can easily be attached to or removed from flush panel mountings. Model 12 meter is a null-type zero center indicator with ranges from 500-0-500 μ a to 3-0-3 ma. Model 13 is available as an ammeter or a voltmeter, either ac or dc. Maximum size is 1-13/16 x 3/4 in.

Electro-Mechanical Instrument Co., Dept. ED, 8th and Chestnut St., Perkasie, Pa.

HIGH PURITY METALS AND ELECTRONIC MATERIALS

METALS AND ALLOYS

ALUMINUM	ANTIMONY
ARSENIC	BISMUTH
CADMIUM	GOLD
INDIUM	LEAD
SILVER	TIN
	ZINC

High purity alloys are made from these metals to customer specifications.

COMPOUND SEMICONDUCTORS INDIUM ANTIMONIDE

Available as crystals, wafers, circles, rings and other shapes made to precise tolerances.

STANDARD FORMS

INGOTS	SHEET
BARS	SHOT
RODS	POWDER
RIBBON	WIRE

PREFORMS

Preforms are available in a range of sizes and shapes such as discs, dots, washers, squares and spheres. Enquiries are invited on our alloy preforms.

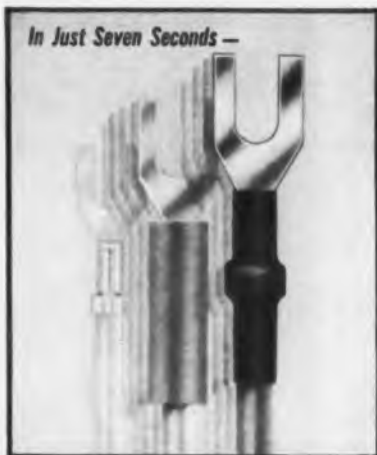
CHEMICALS SALTS SOLUTIONS

COMINCO PRODUCTS INC.

Electronic Materials Department
933 West Third Avenue
Spokane, Washington
Ph. RI 7-7103 TWX. SP 311

CIRCLE 140 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 25, 1961



Shrinks Skin-Tight... Then Stops!

New — ALPHLEX®

SHRINKABLE TUBING

With Controlled Shrinkage

Shrinkable Tubing is an irradiated Polyolefin insulation that, when heated to 135°C, shrinks within seven seconds to form a permanent, flexible, tight-fitting bond.

Slip it over a group of wires, an exposed connection or component, or even a tool handle needing insulation, apply heat (135°C) for seven seconds — watch it shrink smoothly and firmly to the exact configurations of the object to be covered. Further heating does not affect it.

Alphlex Shrinkable Tubing is supplied in expanded form so that it may easily be slipped over the component to be covered.

HOW TO USE: The use of a hot air gun is recommended; however excellent results may be obtained by oven heating, radiant heat, the heat of a soldering iron, a burner, or dipping in hot fluids.

Available in sizes =24 thru =4 in black, white, red or yellow; in sizes =2 thru 1" in black.



Write for descriptive catalog — ST-275



ALPHA WIRE CORPORATION

Subsidiary of LORAL Electronics Corporation
200 Varick Street, New York 14, N. Y.
Pacific Division: 11844 Mississippi Ave.
Los Angeles 25, Calif.

CIRCLE 141 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 25, 1961

Miniature Rheostat

704



Rated at 12.5 w, miniature rheostat can be furnished as a standard unit or to meet special requirements. Shafts, bushings, taper windings and other characteristics are available as specified. It is suitable for military or commercial applications.

Tru-Ohm Products, Dept. ED, 3426 W. Diversey Ave., Chicago 47, Ill.

Detector Amplifier

607



For wide-band fm signals. Model 5100 detector amplifier recovers pcm, pam and fm signals which have been heterodyned to standard 5-mc if. A high-gain, wide-band dc amplifier follows the discriminator which is capable of driving a long 75-ohm coaxial line.

Dynatronics, Inc., Dept. ED, P. O. Box 2566, Orlando, Fla.

Toroidal Coils

507

Up to 150-h inductance and Q-factors greater than 20 at 200 cps are features of type 0330 toroidal coils. Applications are in commercial and military equipment including aircraft navigation systems. Dimensions are 1-5/16-in. OD, 5/8-in. height.

Components Corporation, Dept. ED, 2857 N. Halsted St., Chicago 14, Ill.

Remote-Control Modules

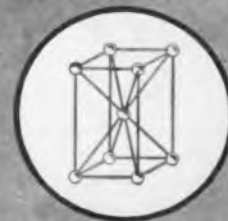
709



Dual-channel. Designed for console control of distant power sources, each control module consists of a 3.5-in. high standard rack panel with two sets of controls. Pushbuttons raise and lower output voltage. Vernier controls permit 1-v variation for full rotation; 2.5-in. panel meters monitor voltages at the load.

Mid-Eastern Electronics, Dept. ED, Springfield, N. J.

P&A: \$58; stock.



TIN COATING from .00002 to .0025



For the first time tin coated thin strip is available in solderable coatings up to .0025" thick.

Pure tin and tin-lead alloys are now coated on copper, brass, or nickel in all gauges from .002 to .012 in thicknesses of .00002 to .0025.

Over 50 years experience in the highly specialized field of thin strip makes Somers your #1 source for that one job in ten that must meet rigid specifications. Write for confidential data blank to get the exact thin strip for your requirements — no obligation, of course.



SOMERS BRASS COMPANY, INC. • 94 Baldwin Ave., Waterbury, Conn.

CIRCLE 142 ON READER-SERVICE CARD

137

NEW PRODUCTS

FM Limiter Amplifier

725



Dual-channel limiter amplifier is made to recover fm signals which have been heterodyned to a 5-mc if frequency in a receiver system. Designated model 5101, the unit limits an input signal over the range of 7 mv to 2 v rms. The 3-db bandwidth is 0.9 mc. Ratio of the 40-db to the 6-db bandwidth is less than 3. Output is adjustable from 0 to 2 v rms.

Dynatronics, Inc., Dept. ED, P. O. Box 4368, Panorama City, Calif.
Availability: 60 days.

Plug-in Cans

620



Aluminum plug-in cans with 8-pin plugs are offered in heights of 2, 2-1/2, 3, 3-1/2 and 4 in. Base is 2 x 2 in. and 0.04 in. thick with 0.02-in. covers. The mica-filled plug is swaged into the can.

Vector Electronic Co., Inc., Dept. ED, 1100 Flower St., Glendale 1, Calif.
P&A: \$0.50; stock.

Silicon Rectifier

713



Coaxial silicon rectifiers have a piv range of 10 to 1,000: 500 ma at 1.2 v and 1 amp at 1.5 v. Elimination of the cooling flange permits greater latitude in packaging, and mounting where space is limited. Dimensions are 0.220 in. diameter, 0.330 in. length.

Erie Resistor Corp., Dept. ED, 644 W. 12th St., Erie, Pa.
Availability: 6 weeks.

For new Raytheon miniature right-angle printed circuit test jacks or any of Raytheon's complete line of reliable components for commercial, industrial and military applications, see your Raytheon Distributor. If no Raytheon Distributor is listed for your area, we will be pleased to send you the name of the Distributor nearest you. Write: Raytheon, Distributor Products Division, 411 Providence Turnpike, Westwood, Massachusetts.

RAYTHEON DISTRIBUTORS coast to coast offer PRINTED CIRCUIT TEST JACKS

... at no penalty in price



Raytheon Distributors in your area include:

ALABAMA Birmingham MG Electrical Equipment Company FAirfax 2-0449 Mobile Forbes Electronic Distributors, Inc. HE 2-7661	COLORADO Denver Ward Terry Company AMherst 6-3181	MICHIGAN Detroit Newark-Ferguson Electronics, Inc. UN 1-6700	CLEVELAND Main Line Cleveland, Inc. Express 1-4944 Pioneer Electronic Supply Co. Superior 1-9411
ARIZONA Phoenix Radio Specialties & Appl. Corp. AL 8-6121 Tucson Standard Radio Parts, Inc. MA 3-4326	CONNECTICUT East Haven J. V. Electronics MObart 9-1310 Stamford Sun Radio & Electronics, Inc. DA 5-4336	MISSISSIPPI Jackson Ellington Radio, Inc. FL 3-2769	COLUMBUS Buckeye Electronic Distributors, Inc. CA 8-3265
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MARYLAND Baltimore Wholesale Radio Parts Co., Inc. MUIberry 5-2134	MASSACHUSETTS Boston Cramer Electronics, Inc. COpley 7-4700 DeMambo Radio Supply Co., Inc. AL 4-9000 Lafayette Radio Corp., of Mass. HUBbard 2-7850 Cambridge Electrical Supply Corp. UNiversity 4-6300	NEW YORK Binghamton Stack Industrial Electronics, Inc. RA 3-6326 Buffalo Genesee Radio & Parts Co., Inc. TR 3-9661 Elmira Stack Industrial Electronics, Inc. RE 3-6513 Ithaca Stack Industrial Electronics, Inc. ITHaca 2-3221 Mineola, Long Island Arrow Electronics, Inc. Pioneer 6-8686 New York City M. L. Dalis, Inc. EMpire 1-1100 Milo Electronics Corp. BEkman 3-2980 Sun Radio & Electronics Co., Inc. OREgon 5-8600 Terminal-Hudson Electronics, Inc. CMEIsea 3-5200 Utica Valley Industrial Electronics, Inc. RA 4-5168 White Plains Sun Radio & Electronics, Inc. White Plains 9-7715	PENNSYLVANIA Harrisburg D & H Distributing Co., Inc. CEDar 6-8001 Philadelphia Almo Radio Company WAINut 2-5918 Radio Electric Service Co. WAINut 5-5840 Reading Barbey Electronics FR 6-7451 York Wholesale Radio Parts Co., Inc. 47-1007
TEXAS Fort Worth SWIECO, Inc. ED 2-7157 (in Dallas: AN 2-5026)	UTAH Salt Lake City Standard Supply Company EL 5-2971	VIRGINIA Norfolk Priest Electronics MA 7-4534	WASHINGTON Seattle Western Electronic Supply Co. AT 4-0200
WASHINGTON Seattle Western Electronic Supply Co. AT 4-0200	WISCONSIN Milwaukee Electronic Enterprises, Inc. GR 6-4141		

Graybar Electric Company, Inc. — Nationally (see Yellow Pages)

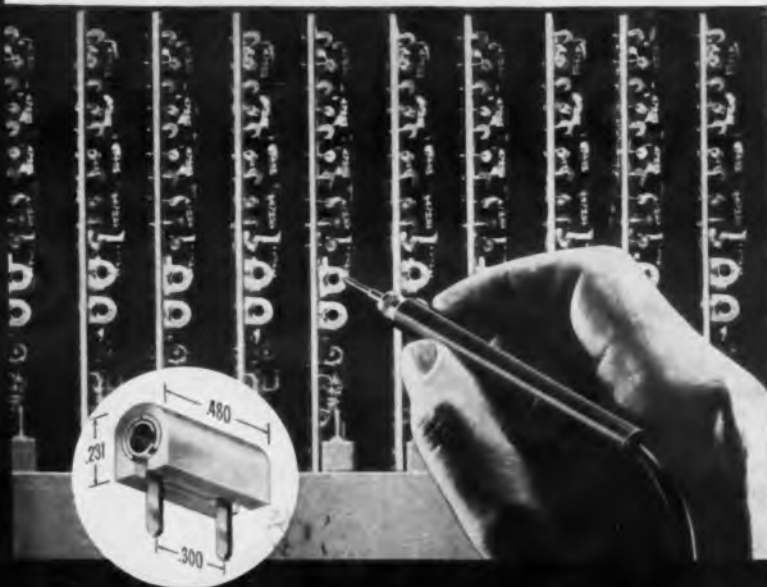
RAYTHEON COMPANY

DISTRIBUTOR PRODUCTS DIVISION

CIRCLE 143 ON READER-SERVICE CARD

RAYTHEON

ELECTRONIC DESIGN • October 25, 1961



Save time, save space...
TEST IN PLACE
 with new printed circuit
 test jacks from Raytheon

Test compact, closely mounted circuits quickly with new Raytheon miniature right-angle printed circuit test jacks for .080" test prods. No need to remove in-the-way circuit boards or use test prod adapters. Molded nylon construction features exclusive design beryllium-copper damage-proof spring pin contact. Double gold plating over silver plate assures reliable electrical

contact and fast dip-soldering of terminals. All materials meet military specifications. Available in eight MS16108 colors, plus gray and violet.

For more information on the new right-angle printed circuit test jack and other Raytheon styles please write: Raytheon Company, Industrial Components Division, 55 Chapel Street, Newton 58, Mass.

OTHER RAYTHEON TEST JACKS



SHORT RINTED CIRCUIT STANDARD PRINTED CIRCUIT SUBMINIATURE FIXED CONTACT SUBMINIATURE SNAP-IN CONTACT MS16108 (Turret) MS16108 (Spade)

For small order or prototype requirements
 see your local franchised Raytheon distributor

RAYTHEON COMPANY

RAYTHEON

INDUSTRIAL COMPONENTS DIVISION
 CIRCLE 144 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 25, 1961

AC-DC Volt-Ohm Meter

611



Combined in a single unit, model M-201 ac volt, dc volt and ohmmeter measures 0 to 300 v ac in six ranges, 0 to $\pm 1,000$ v dc in seven ranges and 0 to 500 meg in seven ranges. Covering 20 cps to 700 mc, it is suitable for laboratory, broadcasting and testing applications. Dc input impedance is 122 meg on all ranges.

Borg-Warner Controls, Dept. ED, P. O. Box 1679, Santa Ana, Calif.
 P&A: \$250; stock.

Paper-Tape Reeler

707



Bidirectional paper-tape handler model RS-300 is for tape speeds of up to 40 in. per sec with 5 to 8 in. reels. Spring-loaded dancer arms provide positive on-off control of tape feed, maintain constant tension and prevent tape spillage. The modular unit is compatible with the firm's other paper-tape equipment.

Omnitronics, Inc., Dept. ED, 511 N. Broad St., Philadelphia 23, Pa.

Step-Down Autotransformer

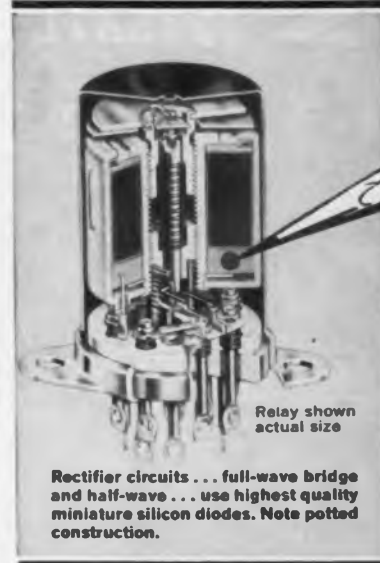
562



For aircraft applications, 9.33-oz autotransformer model 9808-199 is designed to step 115 v down to 6 v. It meets MIL-T-27 and Class T thermal shock requirements. Rated output is 42 va. It is impregnated and encapsulated in epoxy resin.

Varo Inc., Dept. ED, 2201 Walnut St., Garland, Tex.

NEED AC-OPERATED MILITARY RELAYS?



Relay shown actual size

Rectifier circuits... full-wave bridge and half-wave... use highest quality miniature silicon diodes. Note potted construction.

For reliable switching
 ... try "Diamond H"
 Series RA and SA
 relays with a-c coils

These relays for 400 cps and 60 cps operation are identical in size and weight to Hart's widely specified Series R and S d-c relays and meet the same specifications*. They provide the same shock resistance (to 50G), the same vibration resistance (to 20G-2000 cps), and the same performance under temperatures ranging from -65°C to $+125^{\circ}\text{C}$. Contact ratings from dry circuit to 10 amps, 115 volts a-c resistive and 30 volts d-c resistive.

The "Diamond H" line includes hundreds of standard models and special variations are possible. Ask for literature and specification list.

*Like the R and S series, they meet the requirements of MIL-R-5757C. Models are also available to fill the requirements of MIL-I-6181.



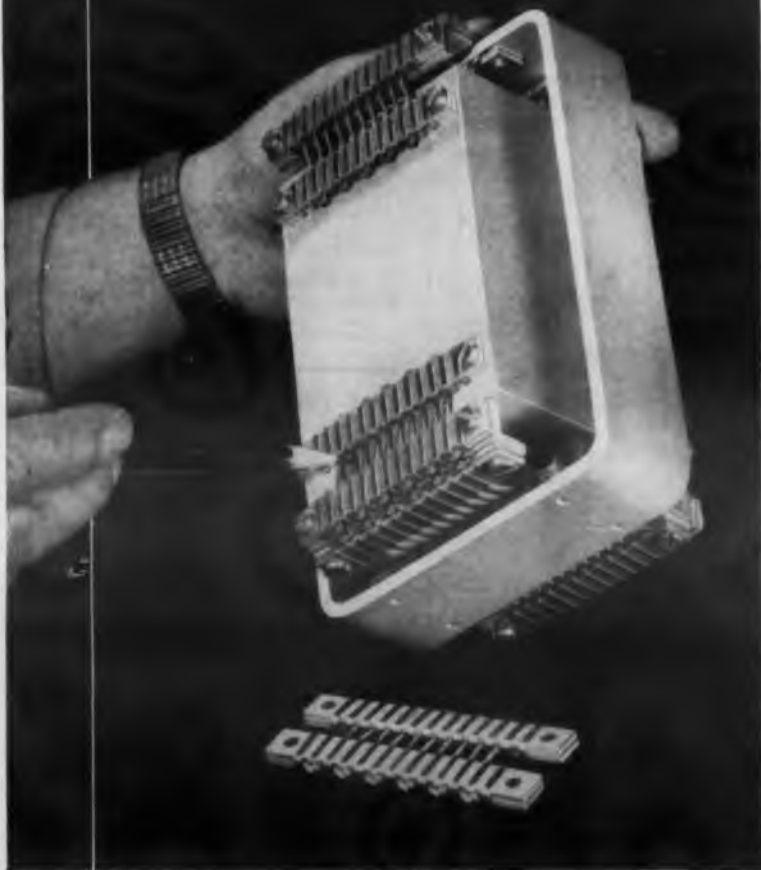
THE **HART**
 MANUFACTURING COMPANY
 210 Bartholomew Avenue
 Hartford 2, Conn.
 Phone Jackson 5-3491

CIRCLE 145 ON READER-SERVICE CARD

139

DETUNE VIBRATION ISOLATE SHOCK

From Aeroflex Laboratories—a major development in the control of vibration and shock—the all new field proven Cable Isolation System.



NOW YOU CAN:

- Isolate your equipment against shock, vibration and noise, or any combination thereof—even in the presence of constant or long term "G" loading.
- Have three dimensional, all attitude isolation.
- Tune your isolation system in the field.
- Have a vibration control system that does not bottom out under heavy "G" loading and functions in a wide variety of environmental conditions including a temperature range of -100°F to $+1000^{\circ}\text{F}$.

For information on how an Aeroflex Cable Isolation System can be used to solve your vibration and shock problems, write today to Dept. BR-6.

Licensed under Patents and Patent Application of Kerley Engineering Inc.

AEROFLEX LABORATORIES INCORPORATED

48-25 36th STREET • LONG ISLAND CITY 1, N. Y.

CIRCLE 146 ON READER-SERVICE CARD

NEW PRODUCTS

Decade Resistance Boxes

712



With numeric dial switches. The Dial-A-Stat decade resistance boxes have simplified value selection and in-line readout. Three-decade type DS 4035-4 and five-decade types DS 4055-5 and DS 4051-6 have total resistances ranging from 11.1 to 1,111.1 K. Accuracies are $\pm 0.05\%$ and $\pm 0.01\%$; temperature coefficient is $\pm 0.002\%$ per deg C.

General Resistance, Inc., Dept. ED, 430 Southern Blvd., New York 55, N. Y.

P&A: \$108 up; 10 days.

Stainless Steel Connector

532

With 20 feedthroughs of tubular design, Assembly No. 2 mounts four high-current conductors and four coaxial connectors. Stainless steel connector, Assembly #2, has an OD of 4 in. and a thickness of 1/4 in. The outer periphery is designed for heli-arc welding.

Vacuum Ceramics, Inc., Dept. ED, Cary, Ill.

Wide-Band DC Amplifier

726



A 10-kc bandwidth is provided on the model 860-4000 dc amplifier. Called FIFO, the device is a floating-input floating-output unit made to amplify high-frequency data from wide-bandwidth transducers. Gain is 1,000; linearity is $\pm 0.1\%$; dc input impedance is 100 meg. Typical input is 10 mv. Unit measures 2 x 7 x 15 in. and is available with an individual power supply; eight units can be rack-mounted with a single power supply.

Sanborn Co., Industrial Div., Dept. ED, 175 Wyman St., Waltham 54, Mass.

MAXSON
INSTRUMENTS
DIVISION

New

PRECISION PHASEMETER



The Only Phasemeter To Operate AT 0.1° ABSOLUTE ACCURACY

- Incremental Accuracy 0.01°
- Frequency Range 30 to 20,000 cps
- Phase Range 0 to 360° without ambiguity

Research Development activities, laboratory standards and production applications have a demanding need for more accurate phase measurements. Now, the Model 1010 Phasemeter permits wide flexibility of application at high accuracies, thus offering instrument buyers the most economical investment available. Additional advantages can be gained for high speed, high accuracy production versatility when the Model 1010 is operated with one or more of the new Model 1281 Phaseshifter.

Write

today for complete literature and specifications.

MAXSON
INSTRUMENTS
DIVISION

475 TENTH AVENUE
NEW YORK 18, NEW YORK

MAXSON ELECTRONICS CORPORATION
CIRCLE 147 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 25, 1961

- the ultra
new YOKE!



Deflectron*
By Celco

MAJOR ADVANCE IN
THE SCIENCE OF
ELECTRON BEAM DEFLECTION!

SPOT RECOVERY

Fastest! to 1 μ s

SPOT SIZE


Smallest - by 25%

SPOT SWEEP

Straightest.....

* DEFLECTRONS for DISPLAYS

Where ordinary precision
yokes FAIL to meet your
requirements.

Write for NEW "DEFLECTRON"
Data and Standard Yoke
Catalog. 

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CENTRAL DIV.- LANESBORO, PA. ULYsses 3-3500

CIRCLE 148 ON READER-SERVICE CARD
ELECTRONIC DESIGN • October 25, 1961

Wire Stripper

615



Semiautomatic thermal wire stripper, model AT-1 Auto-Therm, handles up to 1,000 ends per hr. Any type of insulation including Teflon, Kel-F, polyester and vinyl in sizes of #30 to over 3/8 in. in diameter can be stripped. Coaxial, shielded and irregular shaped insulation can be accommodated.

Western Electronic Products Co., Dept. ED,
2420 N. Lake Ave., Altadena, Calif.
P&A: \$395; stock.

Signal Generator

614



Covers 50 kc to 65 mc in six bands. Model G-101 signal generator has a pushbutton attenuator system to provide step-by-step reduction of the rf output signal amplitude from 0.1 v into a 50-ohm load. Level control maintains indicated output to ± 1 db regardless of frequency output or per cent of modulation.

Borg-Warner Controls, Dept. ED, P. O. Box
1679, Santa Ana, Calif.
Price: \$1,350.

Plug and Jack Assembly

702



For printed-circuit cards, the Polarite device consists of a plug, assembled to the circuit board, and a jack, assembled to the edge connector. Each plug and jack assembly provides 12 discrete combinations. It meets MIL-C-21097A.

The Ucinite Co., Dept. ED, Newtonville,
Mass.

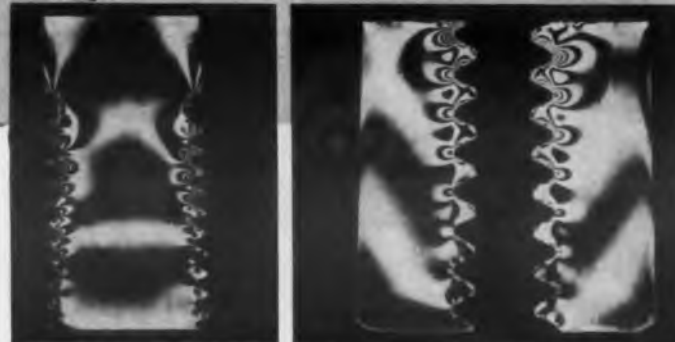
Availability: stock.

How HELI-COIL® Stainless Steel Wire Inserts Eliminate Stress Concentration and Insure Maximum Strength in Threaded Assemblies

with HELI-COIL INSERT



without HELI-COIL INSERT



Made of stainless steel wire, precision-rolled to a diamond-shaped cross-section, **Heli-Coil** screw thread inserts provide two exclusive characteristics directly related to threaded assembly strength:

1. **Permanent, resilient threads between the threads of the male and female assembly members.** These eliminate stress concentrations (upper photos) by distributing the load evenly along the full length of thread engagement in both members. By contrast, note the sharp stress concentrations (lower photos) around the first two threads of the conventional assembly.

NOTE: Diagrams at right show how **Heli-Coil** Inserts compensate for lead and angle error between female and male threads.

2. **A superior surface finish (8-15 RMS).** This holds friction loss to a minimum and, thus, provides maximum, consistent clamping load at any given wrench torque load.

RESULT: No stress concentration; improved fatigue strength in the male member; and a stronger assembly under all conditions.

There is a complete line of **Heli-Coil** products for every thread need: inserts, taps, tools and gages. Let us help with your design and application problems. Write today for complete information.

3146



HELI-COIL CORPORATION
410 Shelter Rock Lane, Danbury, Conn.

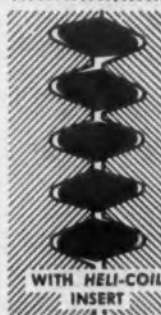
In Canada: ARMSTRONG BEVERLEY ENGINEERING LTD., 6675 Jeanne Mance St., Montreal 15, Que.

CIRCLE 149 ON READER-SERVICE CARD

SCREW THREAD
ENGAGEMENT

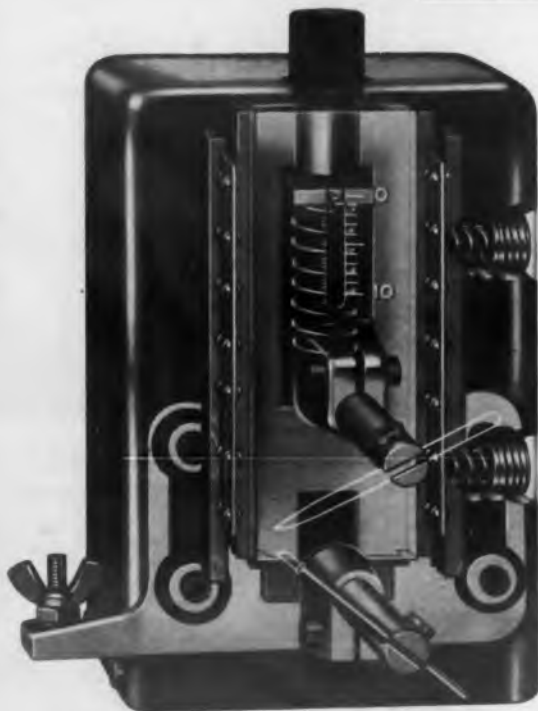


CONVENTIONAL



WITH HELI-COIL
INSERT

THIS WELDMATIC WELDING HEAD IS USED TO PRODUCE MORE MODULES THAN ALL OTHER MAKES combined



Here's why—

Fastest Follow-Up

Model 1032 combines (1) near-zero inertia of lightweight electrode arm with (2) minimum friction (thanks to self-adjusting spring loaded linear raceways) and (3) low spring-rate driving force, to supply *ultimate* acceleration capability throughout the weld formation period. The vital combination of these 3 factors determines the resultant Weld-Schedule optimum "maximum-strength" area.

Absolute Linear Electrode Movement

Long linear ball-bearing raceways allow only perfect, non-wiping action—wiping action being a major contributor to mediocre welds.

True Force Firing

Patented, pure force-firing action is designed into the Model 1032. Weld energy is released to the electrodes only—and exactly—when the preset force is reached, regardless of setup configuration.

Self-Adjusting Raceways

Dual, linear ball-bearing raceways,

spring loaded for full compliance, compensate for wear, thermal effects, and normal dirt and provide absolute, lowest constant friction over full electrode arm stroke.

Minimum Movable Mass

All parts moving during follow-up total less than 4 ozs. Die-cast electrode arm and holder, with electroplated high conductivity interfaces, offer highest welding efficiency yet lowest mass.

Full Flexibility and Accessibility

The head features full frontal 3-dimensional access with fully adjustable arm lengths. The head operates at any desired work position, either singly or in double head combinations.

Full Line of Tailored Accessories Available

Optimum production weld repeatability results through minimizing operator fatigue. Tailored accessories such as actuators, illuminator, magnifiers, riser assembly, horizontal adaptor, etc., provide these results.

For detailed specifications write:

WELDMATIC DIVISION / UNITEK

950 ROYAL OAKS DRIVE, MONROVIA, CALIFORNIA

CIRCLE 150 ON READER-SERVICE CARD

NEW PRODUCTS

Test Sequence Controller

606



Programmed by interchangeable plugs, the series 910 test sequence controller provides test-bench automation. Instrument controls equipment operation during test cycle, activates loading devices, and turns equipment on and off. Circuitry, including power supplies, is self-contained.

Slaughter Co., Dept. ED, Piqua, Ohio.

Price: \$850 to \$875.

Image Orthicons

714



Fiber-optic face plates eliminate the need for lenses and achieve light transmission gains of up to 50 times that obtained with conventional optics. Image orthicon type ZL-7809 has an S-10 photo surface peaking at 4,500 A; type ZL-7810, S-20, at 4,250 A.

General Electric Co., Cathode Ray Tube Dept., Dept. ED, Syracuse, N. Y.

Availability: 30 to 90 days.

High-Speed Counter

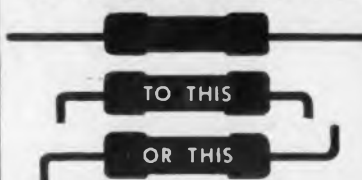
710



For high-volume counting. Model HA 4000A counter has speeds up to 15,000 counts per min. Using an optical sensing head, the unit counts anything from small pills to large containers. It consists of one decade of electronic counting followed by five decades of electro-mechanical registering to reduce the counting load.

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

IN LESS THAN 4 SECONDS



WITH THE REVOLUTIONARY PRODUCTION AID TOOL!

"PIG-TAILOR"®



Foot operated
No accessories
3 minute set up

\$125.00

"PIG-TAILORING"™

a revolutionary new mechanical process for higher production at lower costs. Fastest PREPARATION and ASSEMBLY of Resistors, Capacitors, Diodes and all other axial lead components for TERMINAL BOARDS, PRINTED CIRCUITS and MINIATURIZED ASSEMBLIES.

PIG-TAILORING eliminates: • Diagonal cutters • Long nose pliers • Operator judgment • 90% operator training time • Broken components • Broken leads • Short circuits from clippings • 65% chassis handling • Excessive lead tautness • Haphazard assembly methods.

PIG-TAILORING provides: • Uniform component position • Uniform marking exposure • Miniaturization spacing control • "S" leads for terminals • "U" leads for printed circuits • Individual cut and band lengths • Better time/rate analysis • Closer cost control • Invaluable labor saving • Immediate cost recovery.

Pays for itself in 2 weeks

"SPIN-PIN"®

Close-up views of "SPIN-PIN" illustrate fast assembly of tailored-lead wire to terminal.

- No Training
- No Pliers
- No Clippings
- Uniform Crimps
- 22 Sizes

PAYS FOR ITSELF THE FIRST DAY!

\$500 EACH



Write for illustrated book to Dept. ED-10



BRUNO-NEW YORK INDUSTRIES CORP.

DESIGNERS & MANUFACTURERS OF ELECTRONIC EQUIPMENT
460 WEST 34th STREET • NEW YORK 1, N. Y.

CIRCLE 151 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 25, 1961

NOW . . . FROM ONE OF
THE NATION'S FASTEST
GROWING MAKERS OF
CONTROLLED ATMOS-
PHERE EQUIPMENT . . .



Tempcor
**RF
SHIELDED
ENCLOSURES**

**PROVIDE MAXIMUM RF
ATTENUATION AND
THERMAL INSULATION
AT A MODERATE PRICE**

Plus . . .

Engineering service in assist-
ing you to solve your most
critical RF interference prob-
lems. There is a right
Tempcor RF Shielded Enclo-
sure for your exact needs.

T

Write for complete
technical information

Temperature
ENGINEERING CORPORATION

Manufacturers of
Constant Temperature, Vacuum
and Controlled Atmosphere Equipment

600 Tempcor Boulevard,
Riverton, N. J.

Heat Dissipator

618



For TO-5, TO-9 semiconductors. Model T8020 medium-power heat dissipator has a thermo-resistance of 16 C per w. Tapered fins are designed for still or forced-air applications. The unit is stud-mounted. It measures 1 in. in diam, has an over-all height of 1 in. and is 5/8 in. from chassis.

Vemaline Products Co., Dept. ED, Franklin Lakes, N. J.

Availability: stock.

Voltage and Current Controls

708



Up to 200,000 amp and 5 kv can be controlled. Voltage controls and current controls, called Transductors, are static control packages requiring no auxiliary hardware or compensating circuitry. Proportional output is linear within $\pm 0.5\%$ full scale.

Norbatrol Electronics Corp., Dept. ED, 356 Collins Ave., Pittsburgh 6, Pa.

Meter Calibrator

703



Accuracy is 0.25%. Model MC-5400 meter calibrator has 54 full-scale ranges covering 20 μ a to 10 amp ac, 2 v to 1,000 v dc, 20 ma to 10 amp ac and 2 mv to 1,000 v ac. Ac ranges are compensated and calibrated for 60 and 400 cps; dc supplies are filtered to 0.5% or better.

Twincor Inc., Dept. ED, 10 Cheney St., Roxbury 21, Mass.

Price: \$975.

I-S solves tough production problem

—to meet critical

SPRING "SPECS"

ELECTRO SNAP



OVERLAP ON CONTACT
POINTS WAS CONSIDERED
IMPOSSIBLE TO MASS-PRODUCE.
I-S ENGINEERS PRODUCED THE
PART WITH PRECISION TO SPARE

Hermetically Sealed Limit Switch employs I-S Beryllium Copper Flipper Blades

- FOR SUPER PRECISION ACCURACY
- COMPLETE FREEDOM FROM FATIGUE

The Electro-Snap component illustrated is hermetically sealed, ruggedly constructed to provide an environment-free, super-durable limit switch. The I-S flipper blades of beryllium copper offer excellent electrical characteristics, super precision accuracy and freedom from fatigue. If you have a spring problem, I-S engineers will be happy to explain the unique advantages of Beryllium Copper and make specific recommendations.

Write or call today for the I-S catalog on Beryllium Copper compression springs, flat springs, strip springs, contact strips, contact rings and screw machine parts.

**INSTRUMENT
SPECIALITIES CO • INC**

270 Bergen Blvd., Little Falls, New Jersey
Telephone: Cliford 6-3500



CIRCLE 153 ON READER-SERVICE CARD

high level capabilities for

high power AC

When considering the need for high power AC equipment, consult CML — specialists in the development and production of tube type or transistorized units for systems or laboratory use.

Another CML first... a new 3 kilowatt wide band sonar amplifier versatile enough to match any transducer load.

Model S-3000 operates at full power from 50 to 20,000 cps into load impedances of 15, 30, 60, 120, 250, 500 and 1,000 ohms. Half power is delivered at 30,000 cps. Harmonic distortion is less than 2% over entire frequency range. Available in dual cabinet (each 47" x 25" x 27").



For consultation on any HIGH POWER AC requirement, write today to:

COMMUNICATIONS MEASUREMENTS LABORATORY, INC.

TWX = PLFD 1772

CIRCLE 154 ON READER-SERVICE CARD

350 Leland Ave., Plainfield, N.J. PL 4-5502

A Subsidiary of Tenney Engineering, Inc.

NEW PRODUCTS

Hipot Tester

706



With 5- μ a circuit breaker, adjustable from 0 to 5,000 μ a, hipot tester provides direct monitoring of either ac or dc output and grounded return. Five models have ranges of up to 2, 5, 10, 20 kv ac or dc and up to 30 kv dc.

Peschel Electronics, Inc., Dept. ED, R.F.D. 1, Patterson, N. Y.

P&A: \$540 up; stock to 3 weeks.

Current Rectifier

511

Miniature selenium rectifier is half the size of the unit previously announced. Called the Vac U Sel, it accommodates up to 15 kv with a block reverse voltage of 31.5 kv. It has a paper base, phenolic housing and operates at 130 C.

General Electric Co., Dept. ED, 3325 Wilshire Blvd., Los Angeles 5, Calif.

Stainless Steel Connector

535

For space-chamber applications, Assembly No. 1 stainless steel connector consists of 459 feedthroughs grouped in 17 patterns. Two tubular feedthroughs are designed for thermocouple sensing probe. Outside diameter of connector is 10 in. with a thickness of 5/8 in.

Vacuum Ceramics, Inc., Dept. ED, Cary, Ill.

AC Voltmeter

705



Phase-sensitive model 302-1 transistorized voltmeter is suitable for use in military ground-support equipment. Power supply and internal reference isolation transformer are self-contained in the unit. Power low is isolated from signal low for accurate bridge or floating voltage measurements.

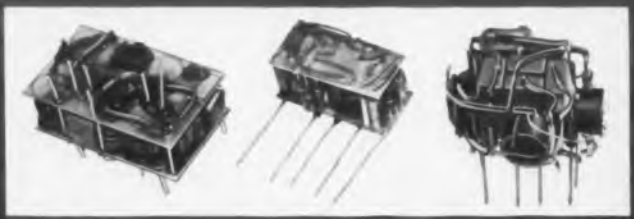
Trio Laboratories, Inc., Dept. ED, Plainview, L. I., N. Y.

CIRCLE 155 ON READER-SERVICE CARD ▶

PACKAGING PROBLEM?



Look what you can do
with a
HUGHES WELDER!



1 A Complete Line For Electronic Packaging

Hughes Welders are tailored to meet all the tough requirements of high-density electronic component packaging. New type pulse transformers provide short discharge time, optimum welding pulse width—no danger of component heat damage. Voltage regulation in all Hughes Welders assures precise repeatability of every weld—no more rejects. High-efficiency design gives you more useable weld power for your money.

ELEVEN WELDING POWER SUPPLIES TO SELECT FROM for every packaging application, and general-purpose precision welding. Stepless operation allows quick operator training—less human error.

CHOOSE FROM THREE, RUGGED WELD HEADS all with adjustable pressure settings ranging from 2 ounces to 50 pounds. True vertical electrode motion eliminates poor welds caused by skidding or wiping. Hughes also supplies welding handpieces, sequencing controls, and other accessories to simplify your welding problems.

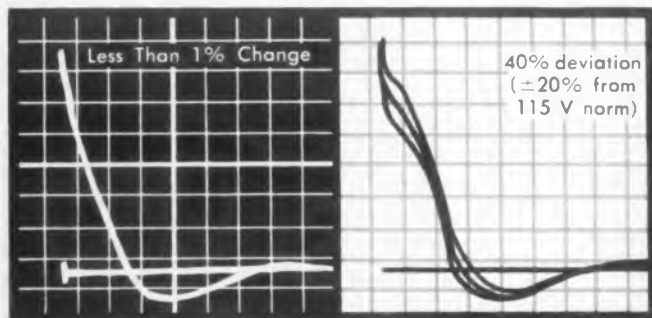
All it takes to establish a complete, versatile precision welding

station in your own location is the equipment shown below— a single control unit, two weld heads oriented vertically and horizontally, a weld tensile tester and a lab-standard pressure gauge.



2 Voltage Regulated

Hughes Welders are designed with *all-day* voltage regulation. Examine the scope patterns showing discharge pulses of two welders; input voltages have been varied from 105 to 125 volts in both cases. The Hughes Welder at left registered 80 watt seconds on every pulse, superimposing the patterns. The unregulated welder at right varied from 65 to 96 watt-seconds in the same test, producing welds of widely varying quality. When your product's reliability is so important, you can't afford to take a chance on welding uniformity — depend on a Hughes Welder.



3 Production Proven

Hughes Welders have logged enviable production records with many of the country's finest electronic firms. Proven by thousands of hours of in-plant operation, they are used extensively for assembling micro-modules, electron guns, vacuum tubes, semi-conductors, and other devices. Heavy-duty transformers and the use of derated components in their construction assures day-in day-out operation without failure.



4 Semi-Automated Welding

To make the most efficient use of manpower on the production line, and to minimize operator "knob-twiddling," Hughes provides two inexpensive multiple-heat-selector units. Both enable a single operator to perform a complete weld schedule at a single station.

The Model VTA-53 allows the use of two or three weld heads having different electrode arrangements, with a single power supply, and permits pre-selection of up to 5 different weld heats. The operator presses the proper switch to select the desired weld heat and uses the appropriate welding head to complete the weld.



The Model VTA-45 performs the same function, but weld heats are pre-set for a desired program and then sequenced automatically with each activation of the weld head.

In each case, the need for the operator making weld heat or pressure adjustments is eliminated and weld quality cannot be affected by errors in judgment.

Hughes offers welding application and training assistance in their laboratory or at your plant. Application data is also available in numerous Hughes technical reports on applied welding techniques.

For additional information contact our representative in your area, or write:

EQUIPMENT SALES

HUGHES

Hughes Aircraft Company

VACUUM TUBE PRODUCTS DIVISION

2020 Short Street, Oceanside, California

Telephone SARatoga 2-2101

Miniature Pre-Amplifier

552



Power gain of 333,000 on 1 pw signal is feature of model 104, epoxy potted Acrostat. Input drift over environment is less than 50 μ v. The unit operates from 115 v ac and has fully isolated input, output and power-in. Pig-tail leads eliminate most thermal contact potentials found with socket mounting. Suitable for all low-level signal sources.

Acromag Inc., Dept. ED, 22515 Telegraph Road, Southfield, Mich.

P&A: \$139; stock.

Coated Metals

591

Dielectric strength is 400 v. Two types of insulating and printed-circuit materials called Amfoil are available. The first, aluminum or copper foil coated with Teflon is suitable for electrical equipment or as very thin high temperature gasketing. A second laminate is of Tissuglas (1-mil thick) with 3/4-mil copper. This material will operate at temperatures above 300 F.

American Machine & Foundry Co., Dept. ED, 261 Madison Ave., New York 16, N. Y.

Transistor Mounting

550



Dissipates 12 w. The Uni-Mount universal transistor mounting will support transistors in several positions. It has transistor, mounting-device, and connecting leads all on one side of mounting wall. One mounting fits all similar transistor packages. Model SR23 fits diamond shape and model SR26 will take large round transistors and diodes.

Accel Electronic Products, Dept. ED, Box 467, Monterey Park, Calif.

P&A: quantity discount to \$1.00 ea; stock.

KAY Precision Random Noise Generators



Mega-Node 3000



Microwave Mega-Nodes

1 kc to 1000 mc . . . Therma-Node

The Therma-Node is a basic noise source which provides extremely high accuracy by utilizing a basic noise generation technique—thermal noise from a heated resistive element.

- Noise figure to 10 db
- Output impedance, 50 ohms unbalanced
- Accuracy ± 0.1 db
- Operates from line or 24 V dc . . .

2 — 1000 mc. Price \$550.00, f.o.b. factory. (\$605.00 F.A.S., N. Y.)

1 kc — 300 mc, add \$135.00 (\$149.00 F.A.S., N. Y.)

1 mc to 3000 mc . . . Mega-Node 3000

The Mega-Node 3000 is a calibrated random noise source providing output over a wide frequency and power range. It employs a coaxial-type noise diode with a tungsten filament as a temperature-limited noise generator.

- Noise figure, 0-20 db
- Output impedance, 50 ohms unbalanced
- Accuracy ± 25 db below 250 mc, ± 1.0 db below 2000 mc, ± 1.5 db at 3000 mc

Price \$790.00, f.o.b. factory. (\$869.00 F.A.S., N. Y.)

3 mc to 500 mc . . . Mega-Node 403-A

The Mega-Node 403-A is a calibrated random noise source providing precise operation over a more limited frequency range at proportionately lower cost.

- Noise figure, 0-19 db
- Output impedance, 50 ohms unbalanced
- Accuracy ± 0.5 db

Price \$375.00, f.o.b. factory. (\$413.00 F.A.S., N. Y.)

1120 mc to 26,500 mc . . . Microwave Mega-Nodes

The Microwave Mega-Nodes are precision machined and plated waveguide fixtures, utilizing argon, fluorescent, or neon gas discharge tubes. Single power supply operates all units. (Power Supply Price, \$125.00) (\$138.00 F.A.S., N. Y.)

- Noise output of 15.8 ± 0.25 db for fluorescent tubes, 15.45 ± 0.2 db for argon, 18.0 ± 0.2 db for neon. Supplied with power cables and fittings

Price \$175.00 up. (\$193.00 F.A.S., N. Y.)

PERMANENT RECORDS



AUDIO SPECTRUM ANALYZERS

Frequency & Amplitude vs. Time.
4" x 12" record on facsimile paper.



KAY Missilyzer 5-15,000 cps

CAT. NO. 675

- Two separate channels for simultaneous recording of two signals.
- Remote control of recording and reproducing channel selectors.

The Missilyzer is a wider range spectrum analyzer providing two identical channels for simultaneous recording of two related signals. Built-in fast acting relays permit rapid automatic remote control.

Price \$2,950.00, f.o.b. factory. (\$3,245.00 F.A.S., New York.)

KAY Sona-Graph MODEL RECORDER

CAT. NO. 662-A

- 85 — 12,000 cps
- Easily stored, permanent or reusable magnetic disc recording.

The Sona-Graph Model Recorder is an audio spectrograph for sound and vibration analysis. Unit provides four permanent, storable records of any sample of audio energy in the 85-12,000 cps range.

Price \$2,950.00, f.o.b. factory. (\$3,245.00 F.A.S., New York.)

PRECISION HIGH FREQUENCY



Attenuators

ROTARY MODELS

- Digital Readout
- 0 — 119 db

TOGGLE-SWITCH MODELS

- Up to 101 db
- Fixed 0 or 10° db insertion loss

50, 70 or 90 ohm impedance

High-Frequency, Precision Teflon & Silver Switches

1% Carbon Film Resistors Fully Shielded Units

	TOGGLE SWITCH MODELS		ROTARY MODELS
	MOD. 20 SERIES	MOD. 30 SERIES	MODEL 40 SERIES
SWR	1.2 : 1 MAX UP TO 250 MC 1.4 : 1 MAX 250 TO 500 MC		
MIN INSERTION*	0.1 db at 250 mc; 0.2 db at 500 mc		
ACCURACY	AT FULL ATTENUATION: 0.5 db at 250 mc, 1.2 db from 250 to 300 mc.	AT FULL ATTENUATION: 0.9 db at 250 mc, 2.0 db from 250 to 500 mc.	

PRICE:

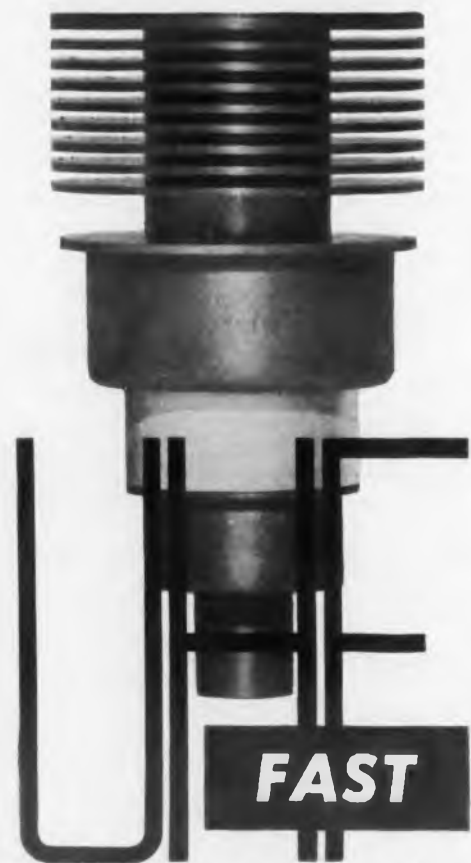
f.o.b. factory \$75. (\$79.9) \$110. \$250.
F.A.S. N. Y. \$83. (\$87.9) \$121. \$275.

KAY ELECTRIC COMPANY

MAPLE AVENUE • PINE BROOK, N. J.

DEPT. ED-10

CAPITAL 6-4000



Frequency Stabilization ML-7855

Special anode design of ML-7855 permits frequency stable operation within 10-15 seconds after application of high voltage. (Frequency change during this initial period is less than 1 mc).

ML-7855 provides frequency stable operation with unregulated supply — change in plate dissipation has no effect upon frequency.

CW operation to 2500 mc, with 1000 V Ebb, 100 ma Ia.

Plate-pulsed to 3000 mc, with 3500 v eb, 3.0 a Ib, with a tp of 3 usec at 0.0025 Du.

Send for UHF brochure

MACHLETT

The Machlett Laboratories, Inc.
Springdale, Connecticut
Subsidiary of Raytheon

CIRCLE 157 ON READER-SERVICE CARD

NEW PRODUCTS

Sensitive Relay

549

Transistorized sensitive relay CR120F is made for industrial applications such as stop-motion or liquid-level control. Contact rating is 10 amp, 300 v ac; arrangement is dpdt or dpst. Pick-up current is 0.4 ma min. Line supply is 115 v, 60 cps, 4 w.

General Electric Co., Dept. ED, Schenectady 5, N. Y.

Rotary Switch

493



No wearing contacts are used in this new spdt switch. Consisting of a slotted disk passing a beam of light to photosensitive diodes, almost any switching sequence can be provided, with angular accuracy of 0.25 deg. Designed for military or other severe applications, will function at temperatures up to 100 C. A rating of 150 ma at 28 v dc permits control of relays, or as a pulse generator for programming computer systems.

White Avionics, Dept. ED, Terminal Drive, Plainview, N. Y.

Availability: 3 to 4 weeks.

Low-Noise Transistor

527

Planar transistor has a guaranteed maximum noise of 3 db. Designated type 2N2049, the device is made for audio, differential, and dc amplification. With h_{FE} , I_C of 100 μ a and V_{CE} of 10 v, gain is 60 min. I_{CBO} is 10 ma max, 0.4 ma typical; collector-base voltage is 60 v; power rating is 300 mw.

Fairchild Semiconductor, Dept. ED, 545 Whisman Road, Mountain View, Calif.

P&A: \$16 each for 100 to 999; from distributors.

Ruby Rods

619

Needs no silvering. Design of the TIR ruby rods is a roof-top geometry polished into the rod with a 90-deg included angle forming a two-dimensional reflector. Output ends are flat and parallel to the plane of the corner reflector. Four types, SCR 100-UT through 400 UT range in size from 0.040 x 0.040 x 2 in. to 0.3 x 0.3 x 3 in.

Trion Instruments, Inc., Dept. ED, 1200 N. Main St., Ann Arbor, Mich.

P&A: \$100 to \$200; up to 30 days.



Metal Sleeved SAGE "CS" Clipper

miniature - precision - wire wound
POWER RESISTORS
provide outstanding performance
features vital in today's complex
and highly reliable circuitry.

10 Watt Rating Actual Size



"CS" type designates a structural adaptation of long proven silicone coated SAGE Resistors by the addition of exterior heat sink sleeves. Design simplification and adherence to basic heat transfer principles speak for this product in terms of expected reliability over long life.

If you require anything beyond low grade (unspecified stability) power resistors you surely will benefit by investigating these features:

MINIATURE SIZE, or cooler hot spot operation for given size and wattage. Metal heat sink sleeves when clip mounted provide 2 for 1 increase in assigned wattage ratings over free air conditions.

PRECISION: to $\pm .05\%$ tolerance and low values to .05 Ω .

STABILITY: TC of ± 20 ppm/ $^{\circ}$ C. Typical 1000 hour (full) load life drift .5%. Although design hot spot temperatures are less than 275 $^{\circ}$ C, units are unharmed by prolonged exposure as high as 350 $^{\circ}$ C.

MECHANICALLY RUGGED to withstand rough assembly techniques plus vibration and shock hazards.

DIELECTRIC STRENGTH: 1000 volts rms minimum.

Style	Length in.	Diameter in.	Power Rating		Resistance 05 II to
			Free Air	Body Mounted	
CS3W	3/4	1/4	3	6	36,000 Ω
CSR5W	1	5/16	5	10	80,000 Ω
CSS7W	1 1/4	3/8	7	14	100,000 Ω
CSR7W	1 1/2	3/8	8	16	150,000 Ω
CS10W	1 3/4	3/8	10	20	220,000 Ω

Test samples available on request.



SAGE ELECTRONICS CORP.
Country Club Road - East Rochester, N. Y.

CIRCLE 158 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 25, 1961

Counter and Shift Register 670

Flexible in application. The 24-bit micromodular shift register, with speeds to 1 mc, can be used as a word generator, sequencer, delay block. Applications of the counter include time-interval meter, event sequencer, event recorder, coder and decoder.

Ling-Temco-Vought, Inc., Micromodular Components Div., Dept. ED, P. O. Box S-1, Anaheim, Calif.

Availability: 60 days.

Coaxial Terminations 610

For 50-ohm use, the coaxial terminations have thin film metal-to-glass attenuating elements and are designed to withstand shock and vibration. Power rating is 3 w avg; frequency range is 0 to 5,000 mc; vswr is 1.09 or less. Connector types available are N, C, BNC, TNC male and female.

Meca Electronics, Inc., Dept. ED, P. O. Box 645, Dover, N. J.

P&A: \$30 to \$40; 1 week.

Rosin-Core Solder 590

A solid-center core, coated with flux and covered with an outer sleeve of solder insures 33-1/3% greater flow, increased wetting and more joints per lb. Available in diam from 0.032 in. up and varying flux percentages, all alloys of tin and lead, including tin-lead-silver can be had. Meets federal spec QQ-S-571C.

Alpha Metals, Inc., Dept. ED, 56 Water St., Jersey City 4, N. J.

Infrared Hygrometer 679

For laboratory and industrial uses, infrared hygrometer has a high speed or response regardless of the temperature of the sample. It instantaneously samples path lengths from a few inches to thousands of feet. It consists of a radiation source, optical filters, a sensing tube, detector, servo-balance system and zero reference.

General Mills, Inc., Electronics Group, Dept. ED, 1620 Central Ave., Minneapolis 13, Minn.

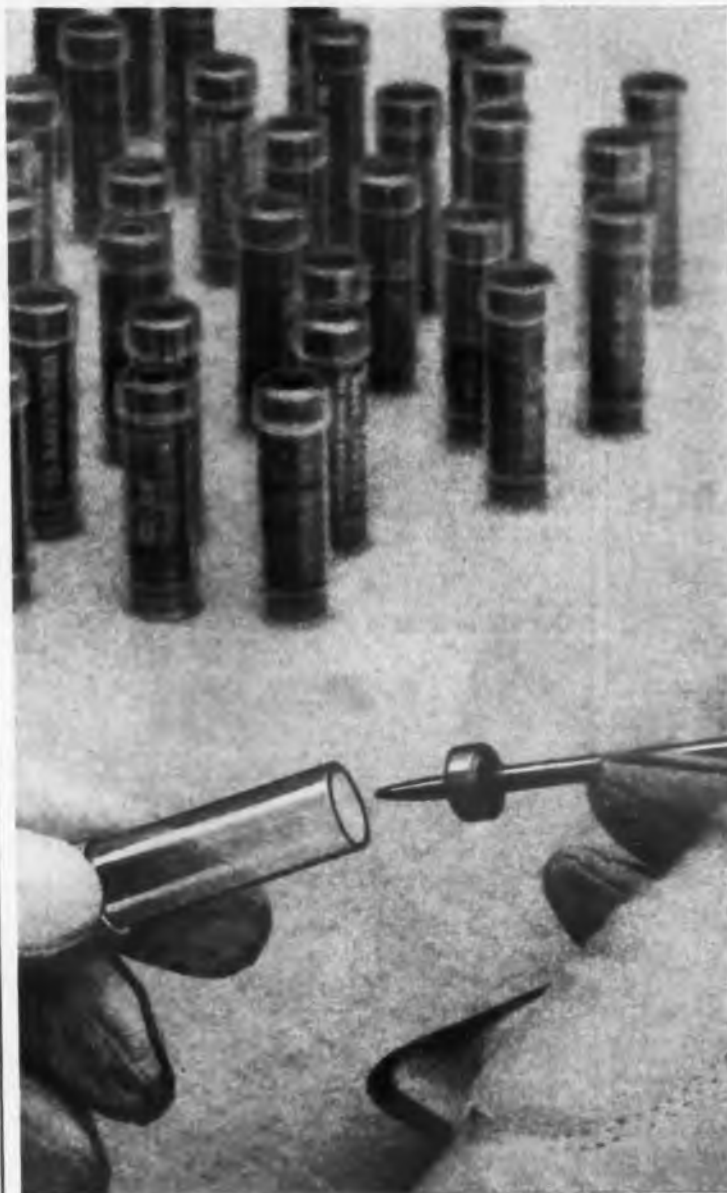
Infrared Laser Material 664

Barium fluoride doped with uranium has an output wavelength of 26,000 A. This infrared laser material can be furnished as grown or in fabricated, finished crystals.

Semi-Elements Inc., Dept. ED, Saxonburg Blvd., Saxonburg, Pa.

P&A: \$150 per in.; \$595, finished; stock to 30 days.

Look to FAFNIR



for these six important high performance features in miniature ball bearings

1. Centerless Honed Raceways

— The only miniature ball bearings with honed inner and outer races. Noise and vibration reduced to new, low levels.

2. Vacuum-melt Extra-Clean

440C Stainless Steel — No pits or imperfections in balls, raceways. Provides better finish, super-sensitive performance, low torque values.

3. Balanced Design

— Each size bearing has its own size retainer. No "make-do's". Fafnir "tailor-made" retainers assure optimum pitch circle of balls and bearing balance.

4. Hardened Retainers

— Hardened 410 stainless steel retainers maintain proper and accurate form when assembled. No distortion. Retainer prongs remain springy, prevent permanent bend.

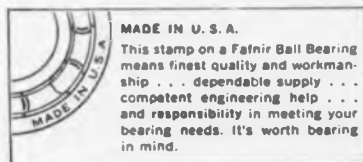
5. Heat Stabilization

— Stabilized to 600°F. Standard Fafnir Miniature Ball Bearings take high temperatures.

6. Precise Tolerances

— Bore, O.D., and internal geometry held to precise tolerances to meet the most exacting customer requirements.

Write for further information. The Fafnir Bearing Company, New Britain, Connecticut.



FAFNIR

BALL BEARINGS

CIRCLE 159 ON READER-SERVICE CARD

High Atmosphere Research— Rocket Borne Instrumentation—

Our solid propellant rocketry accomplishment has now opened new frontiers for high altitude investigation—a real challenge to the instrumentation ingenuity of our technical talent.

These combined activities have created an opening for an electrical engineer with instrumentation experience or a physicist with a good electronic background, to investigate the complex instrumentation and physics problems of the upper atmosphere. The position will include group supervision, requires a graduate degree or equivalent experience applicable to this field.

U. S. citizenship required.

For local interviews, send your resume to:

Professional Personnel Recruitment

ATLANTIC RESEARCH CORPORATION

Alexandria, Virginia

(Suburban Washington, D. C.)

An equal opportunity employer



CIRCLE 160 ON READER-SERVICE CARD

NEW PRODUCTS

AC Motor

418



Dual-speed hysteresis synchronous motor type 5003 provides 300 or 600 rpm with input of 115 v, single phase, ± 40 v. Rotor revolves around outside of stator, with motor ring acting as a permanent magnet and the poles shifting as frequency varies. Primary application is tape drive.

Beau Electronics, Inc., Dept. ED, 1060 Wolcott Road, Waterbury, Conn.
P&A: \$95; 30 days.

Communications Equipment

586



Dual sideband unit has four modes of frequency shift key transmission. The TG-2S operates on voice and facsimile, or cw, as well as four modes of frequency shift key. All signals are monitored visually, as well as aurally. This rack mounted unit can be obtained in a case unit as a TG-2SE.

RF Communications Associates, Inc., Dept. ED, 13 Canal St., Rochester 8, N. Y.

Carbon Potentiometer

454



Measuring 3/4 in. long, trimmer potentiometer model 3001 operates from -65 to 150 C and meets humidity specifications of MIL-STD-202A, Method 106. Rating is 0.2 w at 70 C; resistance range is 20 K to 1 meg. The 15-turn unit weighs about 0.06 oz.

Bourns, Inc., Trimpot Div., Dept. ED, 6135 Magnolia Ave., Riverside, Calif.
Price: \$5 to \$6.



THIS IS ONE
USE FOR INDIUM

... THERE ARE X MORE!

"Indalloy" Intermediate Solders, manufactured exclusively by The Indium Corporation and used extensively in printed circuit work, are noted for their wettability, corrosion-resistance, help when special temperatures are important, flowability and workability. Indium is available in many forms and can be tailor-made for ANY application. Write today for research help.

"INDALLOY" SOLDER ADHERE TO • 26 METALS, ALLOYS
• 21 THIN METAL FILMS • 18 NON-METALS
FREE SOLDER BOOKLET Write Dept. E7 for new Indium bulletin: "INDALLOY" Intermediate Solder.

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CIRCLE 162 ON READER-SERVICE CARD



TOROIDAL COIL WINDING

-- you name it, we make it



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EScon 5-0004

Our plant is equipped
with the MOST ADVANCED and COMPLETE line of TOROIDAL winding equipment in the world.

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ELECTRONIC DESIGN • October 25, 1961

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for a one cent job?



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STANPAT CO. Whitestone 57, N. Y., U.S.A.
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 Kindly send me STANPAT literature and samples. Dept. 135

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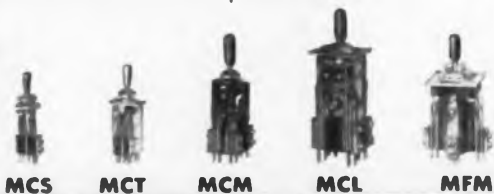
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Write for Bulletin CL-100

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A PHASE SENSITIVE NULL METER WHEREIN NOISE AND HARMONIC VOLTAGES ARE EFFECTIVELY ELIMINATED



MODEL 100A

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Flexible Coupling

544



Metallic bellow is the flexible element in the miniature shaft coupling. Two shafts can be coupled in unison without backlash or cyclic angular displacement during rotation. No. 1-MB is for 3/32, 1/8 and 5/32-in. shafts and is 0.7 in. long; No. 2-MB is for 1/8, 3/16, 1/4 and 5/16-in. shafts and is 1 in. long.

Guardian Industries, Inc., Doupling Div., Dept. ED, 1215 E. Second St., Michigan City, Ind.

Selector Switches

488



Key-operated selector switches are available with two, three, or four positions. Melamine contact blocks can be supplied with contact arrangements from 1 normally open or 1 normally closed to 4 normally open and 4 normally closed. Ferrules are offered in eight colors.

The Clark Controller Co., Dept. ED, 1146 E. 152nd St., Cleveland 10, Ohio.

Servo Package

557



Unit has self-contained oscillator and 4 w amplifier, for excitation of ac transducers. Model SSM electronic servo package is transistorized to drive servovalves with dual 1-K, 8-ma coils. Dual-regulated power supply, installed in cabinet or panel-mounted enables operation from standard power lines. Special requirements can be met by minor modifications.

Raymond Atchley Div., American Brake Shoe Co., Dept. ED, 2339 Cotner Ave., Los Angeles 64, Calif.

High Power Sweep To 1250 MC From TELONIC



With a maximum output of 14 volts — 4 watts, Telonic PD Sweep Generators provide a new era in sweep techniques. They operate in 4 different modes — swept RF, modulated swept RF, CW, and modulated CW—selected by a function switch. Their display linearity is better than 1.2:1, and output is flat within $\pm 7.5\%$ over the maximum sweep width.

The instrument's built-in turret attenuators provide a range of 0 to 59 db in 1 db steps with direct dial readout of attenuation value. Provisions for an external marker and fixed plug-in markers are also included.

Available in 7 models covering various frequency ranges up to 1250 mc, the PD units are ideal for high power applications. Since their output level is 100 times greater than that of other sweep generators, the usefulness of swept techniques is greatly expanded. In fact, the response of a device having as much as 60 or 70 db loss can be easily displayed on a high-gain oscilloscope with a PD unit.

Specifications on all PD models may be obtained from Technical Bulletin T-217B.

Telonic INDUSTRIES, INC.

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TELONIC JET ORDER SERVICE

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The TACT System, a product of Texas Instruments creative engineering, is a dramatically new concept in component test equipment design. The Transistor And Component Tester emphasizes digital control of analog functions, reducing analog circuitry to a minimum, and features absolute repeatability—never before achieved in component testing. TACT represents just one of many areas of developmental endeavor in growth-oriented Texas Instruments.

NEEDED NOW . . . senior level engineers experienced in the design and development of electronic test equipment. BS/MS degree in EE or Physics required plus five or more years' experience in electronic component test systems, commercial test instruments or high speed switching and pulse circuitry.

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NEW PRODUCTS

Synchros and Resolvers

674

Accurate to 5 min. Line of pancake synchros and resolvers, designed for direct mounting and installation in stable platforms and gyros, is offered with narrow stack heights and large internal diameters. They can be obtained as rotor and stator assemblies or with custom flanges and hubs designed for special requirements.

Giannini Controls Corp., Dept. ED, 1600 S. Mountain Ave., Duarte, Calif.

Limit Switch

701



Rotating-shaft limit switch type CR115E is offered in nine gear ratios ranging from 20:1 to 1,280:1 and can have up to four snap-acting switches to control separate functions or operate simultaneously. A typical application is stopping and starting overhead doors or hoists.

General Electric Co., Dept. ED, Schenectady 5, N. Y.

Wire Stripper

668

Precision thermo-electric wire stripper model TS 400 can be used as a hand stripper for chassis, harness or cable work or as a bench model for production use. It accommodates AWG sizes 6 to 36 and can be used for Teflon, vinyl, nylon, FEP Teflon, PVC, Kel-F and polyethylene.

National Missile & Electronics, Inc., Dept. ED, 5307 W. Century Blvd., Los Angeles 45, Calif.

Price: \$56.50.

Magnetic-Material Analyzer

665

Determines bias and sensitivity without the use of a recorder, also measures coercivity and retentivity of oxide coating on tape. The magnetic-material analyzer model 910 consists of the 910A magnetizer and the 910B fluxmeter which has a range of up to 100 maxwells.

Acoustronics, Inc., Dept. ED, 156 Olive St., Huntington Station, N. Y.

P&A: \$3,250; 60 to 90 days.



PERFORMANCE CHARACTERISTICS OF TUCOR BACKWARD WAVE OSCILLATORS

The spectral purity and stability of Tucor backward wave oscillators are suggested by the curve below. It shows the spectral power distribution of the Tucor T15C1C.

This is a voltage tunable oscillator having a low resonance and noise output through a frequency range of 5.4 to 5.9 Kmc. Further information on this and other Tucor BWO's is contained in Bulletin B-1. Just ask for it.

Spectral Power Distribution



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ELECTRONIC DESIGN • October 25, 1961

Space Heaters

685



High output. Model HE-S-140 oil-fired space heater provides 140,000 BTU per hr; its fuel consumption is 1 gal per hr. Also offered, model HE-S-325 provides 325,000 BTU per hr. Heaters producing up to 500,000 BTU can be supplied.

Aeroil Products Co., Inc., Dept. ED, 69 Wesley St., South Hackensack, N. J.

Pressure Transducer

683



Airborne pressure transducer model 185/290-2, for missile and rocket applications, measures corrosive liquid and gas pressures from 0 to 250 and 0 to 2,000 psia or psig with 0.25% accuracy. The output may be used to operate telemetering systems, servos, meters or recording equipment.

Taber Instrument Corp., Dept. ED, 107 Goundry St., North Tonawanda, N. Y.

Sealing Machine

686



Cathode-ray tube sealing machine model 255-1 is for sealing the guns into cathode-ray tubes. Head accommodates all sizes and shapes of bulbs. Sealing height and cullet drop are adjustable. Neck clamp provides positive centering. Table includes motor and reduction-gear drive.

Kahle Engineering Co., Dept. ED, 3322 Hudson Ave., Union City, N. J.

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Quality!
Dependability!
Service!

Lower cost—closer tolerances through Anton's unique facilities in manufacturing of metal parts for transmitting radar and geiger tubes.

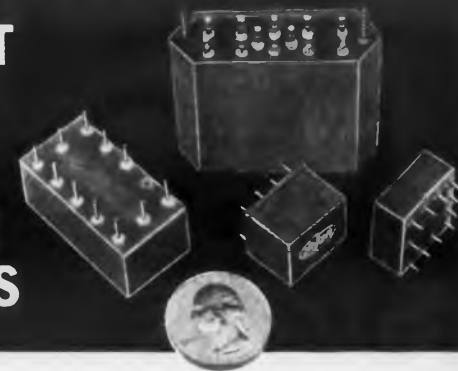
Send drawing of your designs for quotation and take advantage of our production experience in this field.

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Magnetic-core shift registers are the most reliable kind. Best of the magnetic breed is the exclusive DI-AN core-transistor circuit, in which the transistor is used only as a non-critical switch, creating high 1:0 ratios, drawing but flea-power, tolerating wide variations in voltage, temperature, signal. Encapsulated, economical, practically eternal.

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NEW solder discovery!



Two outgassed solders. Left, standard solder. (Note degree of oxides present.) Right, ALPHA Vaculoy solder is bright, clean, oxide free!

ALPHA Vaculoy® bar solder cuts printed circuit joint rejects from 1-in-50 to 1-in-5,000. No other solder does this because no other is made this way!

Above is an unretouched photograph of two solder specimens—both outgassed. Left, is a standard printed circuit solder. Note presence of impurities on surface—a sure sign of undesirable oxides. Right, is ALPHA Vaculoy. Its bright, clear surface indicates freedom from oxide-forming elements. Result? ALPHA Vaculoy bar solder cuts dross, improves wetting, produces brighter connections, increases bath life, reduces inherent inclusions and insures reliable electrical connections. Meets Fed. Specs. QQS-571C. Get all the facts. Write for data today!

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CIRCLE 898 ON READER-SERVICE CARD

NEW PRODUCTS

Ceramic Disk Capacitors

688



Three ratings. Type 5855 ceramic disk capacitor is rated at 0.05 μ f; type 5815 is available in 0.1 or 0.2 μ f ratings. For all ratings, other specifications are: 10% power factor; dielectric strength, 50 v dc flash test; RC product, 5 meg- μ f min with 1 min electrification time.

Erie Resistor Corp., Dept. ED, 644 W. 12th St., Erie, Pa.

P&A: \$0.0755; stock.

Medical Electronics Instrument

692



Blood pressure is automatically measured by model 16B automatic sphygmomanometer. It detects diastolic and systolic pressure without restricting use of the wearer's hands. Accuracy is within 1%. Output may be monitored by pen recorder or telemetry transmitter.

Systems Research Laboratories, Inc., Dept. ED, 500 Woods Drive, Dayton 32, Ohio.

Price: \$6,850.

Photoelectric Control

696



For military as well as industrial applications, photoelectric controls consist of a power supply, amplifier and control relay in one unit. They can be used in conjunction with the firm's photoelectric readers. Transistorized, they are designed for long life and ease of maintenance.

Melpar, Inc., Dept. ED, 3000 Arlington Blvd., Falls Church, Va.

REDUCE TOROIDAL COIL WINDING COSTS with these NEW WINDING MACHINES

MODEL S—first to have fully transistorized in-line digital "read-out" counter and photoelectric turns and footage counting pick-ups. Toroidally winds #16-#50 wire and down to .065" ($\frac{1}{16}$) finished I.D. 9 new twist-locking interchangeable heads for random and precise layer winding.

MODEL LS-1—has high speed, 4-digit predetermining electro-mechanical transistorized counter and photo-electric turns and footage counting pickups. Wire range #20-#46 AWG. Finished I.D. .065" ($\frac{1}{16}$). Model S twist-locking interchangeable winding heads. \$2750. Complete.



Send for further information

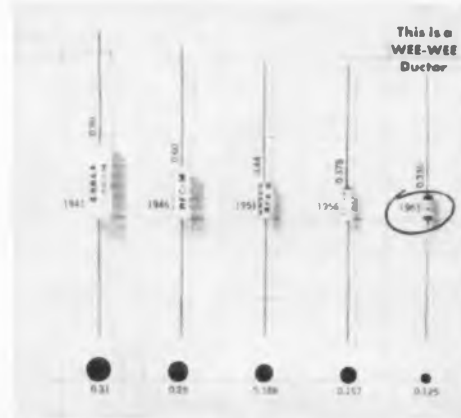
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1168E Grove Street, Irvington 11, N. J. Essex 4-9800

The most COMPLETE line of TOROIDAL equipment in the world.

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— the smallest inductor immediately available to the engineer with a complete set of values from 0.10 μ h to 1000 μ h. Meets Mil Spec. MIL-C-15305 B.

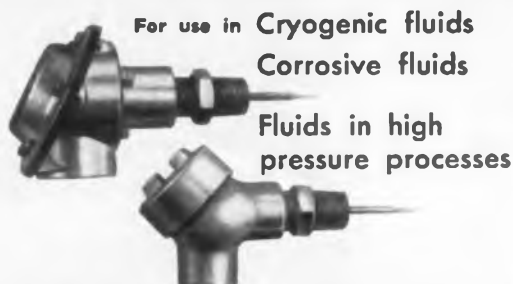
For complete engineering data, write to Dept. WW-A, or phone 464-9300.

NYTRONICS, INC.

550 SPRINGFIELD AVENUE, BERKELEY HEIGHTS, N. J.

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For use in Cryogenic fluids

Corrosive fluids

Fluids in high pressure processes

Model 171 series resistance temperature sensor is designed for a wide variety of industrial applications—wherever temperature measurements of liquids or gases in pipes, ducts or tanks are desired.

The miniature, pure platinum wire element is fully supported and strain free. Temperature range is -435° to $+700^{\circ}$ F. Stability is 0.2° F. or better. Response time is 0.75 sec. Operating pressure is up to 5,000 psi.

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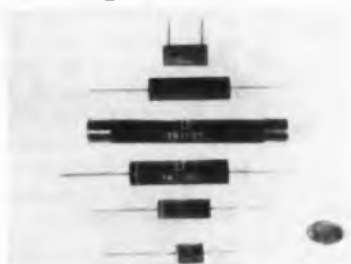
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PNP Germanium Transistors 663

In TO-36 package. These pnp germanium transistors have a beta range of 20 to 70 at 5 amp I_C and a BV_{CEO} range of 40 to 100 v. They have 150-w power dissipation, 0.5 C per w thermal resistance and 100 C junction temperature. Type designations are 2N173, 2N174, 2N277, 2N278, 2N441, 2N442, 2N443, 2N1099, 2N1100, 2N1358 and 2N1412.

Semi-Onics, Inc., Dept. ED, 4 Broadway, Lowell, Mass.

Silicon Cartridge Rectifiers 697



Complete line of kilovolt silicon cartridge rectifiers is offered. Axial-lead, cylinder types consist of 14 LT models, LT1121 through LT-1138; five JEDEC models, 1N1730 to 1N1734; and 12 JEDEC models, IN2374 to IN2385. Fuse-clip types LN1133 to IN1149 have ferule terminals. Axial-lead rectangular types LT1221 to LT1238 and lateral-lead rectangular types LT1321 to LT1338 provide to 10 kv.

Ling-Temco-Vought, Inc., Dept. ED, P. O. Box S-1, Anaheim, Calif.

P&A: \$8.80 to \$81; stock.

Magnetic-Tape Units 651

Two types of tape units are designed for use with IBM solid-state computers. The 729 VI reads and writes at speeds to 90,000 characters per sec and can be used with computers from 7070 to 7090. The 729 V operates at 60,000 characters per sec and can be used with systems ranging from the 1401 to the 7090.

International Business Machines Corp., Data Processing Div., Dept. ED, 112 E. Post Road, White Plains, N. Y.

P&A: \$950 and \$750; 9 to 12 months.

Cathode-Ray Tube 530

Rugged construction of type WX 4545 cathode-ray tube withstands an acceleration level of 20 g from 55 to 500 cps and vibration of 0.120 in. at double amplitude from 5 to 55 cps. Diameter is 7 in., deflection angle is 70 deg and neck diameter is 7/8 in. Anode operating voltage is 8,000 v.

Westinghouse Electronic Tube Div., Dept. ED, P. O. Box 284, Elmira, N. Y.



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THE SIPPICAN WELDER obtains reproducible, controllable weld operations for precision electronic packaging.

Complete control of machine variables is attained by means of a fully regulated power supply and preset pressure & energy settings. No adjustment of electrodes, heads or power settings is required at the weld stations.

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For further information
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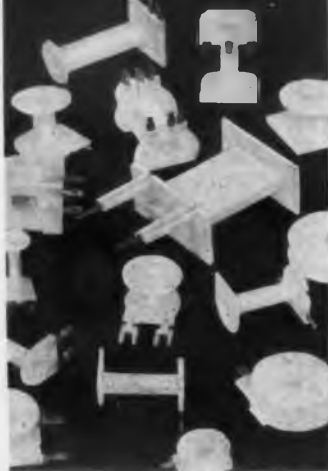
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. . . Originators of welded electronic packaging
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Nylon BOBBINS | COIL FORMS

AMERICAN MOLDED



Your coil winding can be more efficient by using American Molded Nylon Bobbins with these exclusive features:

INSULATED LEAD SLOT

Automatically insulates start of lead as an integral part of the bobbin
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Adaptable to automatic coil winding
Leading machine manufacturers have automatic winding equipment to utilize this feature

Permits uniform winding traverse. No wire distortion due to tape bulge

INSULATED LUGS

Fully insulated on all sides

Eliminates taping

Withstands over twelve pounds pull

Adaptable to most coil forms and bobbins

Forward your blueprints or sample coils to us for our engineering design suggestions.

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This group of High Q quartz crystals illustrates Bliley capability and quality. Each type meets extraordinary stability requirements in actual service . . . from time base reference to satellite equipment.

SERIES	BG93A	BG11AH-S	BG61AH	BG61AH	BG61AH-S
freq.	1 mc	2.5 mc	3 mc	5 mc	5 mc
Q	1.5×10^4	4.5×10^4	$.5 \times 10^4$	$.5 \times 10^4$	2.5×10^4

These unusual characteristics are achieved with gold-plated, optically polished crystals, vacuum mounted in glass, to insure minimum long term aging.
Additional details are given in Bulletin 527 . . . sent on request.

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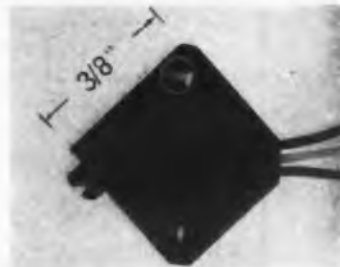
BLILEY ELECTRIC COMPANY
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NEW PRODUCTS

Trimmer Potentiometer

682



For military applications, the square trimmer potentiometer weighs 3/4 g and is rated at 1/2 w at 50 C, derating to zero at 105 C. Resistance range is 100 ohms to 20 K at -55 to 105 C. Temperature coefficient is 50 ppm per deg C. Resistance tolerance is $\pm 10\%$.

Techno-Components Corp., Dept. ED, 18232 Parthenia St., Northridge, Calif.

Price: less than \$3.

Rate Gyro

687



Hermetically sealed rate gyro type RG34-0103-1 provides output up to 50 v for use without additional amplification. Dual wipers on output pot provide low contact resistance through shock and vibration. Starting time is 2 sec; assembly withstands shock to 100 g.

Humphrey, Inc., Dept. ED, 2805 Canon St., San Diego 6, Calif.

Electromechanical Chopper

684



Less than 1/2 cu in. in volume, model 46 electromechanical chopper weighs 20.5 g. Noise is 0.65 μ v rms at 400-cps, 100-ohm load. It withstands 100-g shock, temperatures from -65 to +100 C. Insulation withstands 145 v rms at 400 cps or 200 v dc. Continuous operation life is 2,000 hr.

Airpax Electronics, Inc., Dept. ED, Cambridge, Mass.

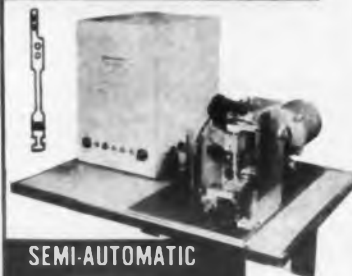
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Special Purpose Welding Machines

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- BUTT WELDERS
- CONTACT WELDERS
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SEMI-AUTOMATIC CONTACT WELDING MACHINE

. . . which feeds, welds and cuts off contact material automatically — all in one operation. Tweezer Weld has complete design facilities for special purpose welding equipment, and facilities available for producing parts for your special needs on a production basis at our plant.

BENCH MOUNTED STORED ENERGY WELDER



- TW5 low friction welding head
- Stored energy panel of 80 Watt second capacity
- Discharge time of 0.0008 to 0.0012 second
- Permits welding of difficult materials . . . copper, silver, tungsten, etc.
- Reliable welds without discoloration, deformation, metallurgical change
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Complete line of bench heads and controls available for varied purposes

FEDERAL TOOL ENGINEERING CO.
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World's most popular ultrasonic cleaner
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The fastest, highest quality method
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80	1 1/2 gal.	12" x 6" x 6" D	\$ 219.95	\$340-597
320	5 gal.	14" x 10" x 6" D	\$499.95	\$675-1040
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CIRCLE 102 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 25, 1961

Linear Accelerometer

693



Range is ± 7.5 to ± 250 g. Gas-damped model A514TC strain-gage accelerometer provides relatively constant damping from -65 to $+250$ F without heater jacket. In a ± 100 -g range, frequency response is flat from static to 2,100 cps. Full-scale output is ± 20 mv at 5 v.

Statham Instruments, Inc., Dept. ED, 12401 W. Olympic Blvd., Los Angeles 64, Calif.

Gram Electrobalance

588

Ultimate precision of this new unit is $0.1 \mu\text{g}$. While weighing, the units precision is 10 parts per million of total load. Loops A and B give a total range of 0 to 1000 mg to this unit. The weighing chamber is $6 \times 8 \times 3-3/4$ in. overall and can be removed for remote location.

Cahn Instrument Co., Dept. ED, 14511 Paramount Blvd., Paramount, Calif.

Ruby Rod

661

With sapphire overlay. For applications in laser optics, ruby rod has increased capture cross section and conduction-cooling area. The overlay can be furnished in the form of a buildup of the sapphire on the ruby rod; it can also be furnished as a sapphire rod, drilled lengthwise with an optically polished inner diameter.

Valpey Crystal Corp., Dept. ED, 1244 Highland St., Holliston, Mass.

Differential Preamplifier

492



Floating and narrowband differential dc preamplifier 459 C/N extends digital voltmeter range to $1 \mu\text{v}$ dc and provides stable amplification in the presence of high common mode noise and hum. Isolated input can be floated up to ± 300 v. Fixed gains cover -10 to -1000 in five steps.

Cohu Electronics, Inc., Kin Tel Div., Dept. ED, 5725 Kearny Villa Road, San Diego 12, Calif.

P&A: \$1,475; 1 week.

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1101 N. Royal Street, Alexandria, Virginia

CIRCLE 186 ON READER-SERVICE CARD

NEW PRODUCTS

Power Transistor

680

Low-silhouette 3-amp power transistors are made for driver applications requiring low values of I_{CBO} . Group includes five units (2N2137-2N2141) with dc gain of 30 to 60, and five (2N2142-2N2146) with gain ranging from 50 to 100, at collector currents of 0.5 amp. The I_{CBO} is 50 μ a max at collector-base voltages of 2 v, and 5 ma max at 30 to 90 v.

Motorola Semiconductor Products Inc., Dept. ED, 5005 E. McDowell Road, Phoenix, Ariz.

Price: \$1.20 to \$10.25 ea, 100 up.

Air Damping System

691



Tolerances are 0.0002 in. or closer. Called the Airpot, the air damping system can be used in system stabilization, vibration damping and time delay. Damping constant is adjustable to 2 lb-in. per sec. Maximum tension force is 4 lb in two-way and pull-damping units.

Tech-Ohm Electronics, Inc., Dept. ED, 36-11 33rd St., Long Island City 6, N. Y.

Availability: stock.

Permanent-Magnet Material

678

With 1,400-oersteds coercive force. Designated Alnico VIII, the permanent-magnet material has an energy product of 4.2 million. Temperature coefficient is low. It is suitable for periodic focusing of traveling-wave tubes and for applications where short magnetic lengths are required.

Indiana General Corp., Indiana Steel Products Div., Dept. ED, Valparaiso, Ind.

Shaft Encoder Translator

677

Dual-channel shaft-encoder translator model X-118 converts the gray code outputs of two 13-bit photoelectric shaft encoders into binary-coded decimal which is converted into visual decimal displays of input azimuth and elevation angles. Conversion cycle is 14 μ sec.

Harvey-Wells Electronics, Inc., Dept. ED, 14 Huron Drive, Natick, Mass.

P&A: \$6,000; 30 days.

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Model 501 Spray Etcher

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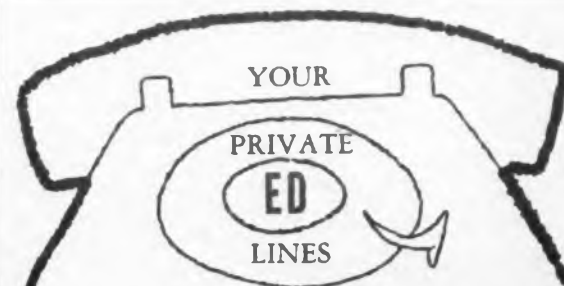
The CHEMCUT equipment line includes a model suitable for your lab or line production.

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LOW FREQUENCY GAUSSIAN NOISE GENERATORS

This instrument combines 1% accuracy and simplicity of operation to generate random signals for laboratory and systems evaluation.



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This instrument provides a convenient means of accurately measuring the amplitude probability distribution of complex or random signals.



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CIRCLE 109 ON READER-SERVICE CARD

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Model B-1 Electric, Gas, Oil or Steam Walk-In Oven

Thorough factory testing assures immediate operation. No installation crews or plant tie-up.

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CIRCLE 190 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 25, 1961

Communications Receiver

689



Universal communications receiver has two plug-in converter strips for operation from 108 to 152 mc and from 225 to 400 mc. An amplified and delayed AVC circuit holds audio output constant to 3 db from 5 mv to 0.2 v. Output is 1 w into 600 or 8 ohms.

Erco Radio Laboratories, Inc., Dept. ED, 637 Stewart Ave., Garden City, N. Y.

Snap-Action Switch

669

For extreme environments, type 65 snap-action switch withstands corrosive atmospheres, excessive moisture, temperature extremes and meets immersion test requirements of MIL-E-5272. Rated at 10 amp at 30 v dc or 120 v ac, it measures 0.320 x 0.850 x 11/16 in.

Illinois Tool Works, Inc., Licon Div., Dept. ED, 6615 W. Irving Park Road, Chicago 34, Ill.

Heat-Sink Wafers

675

With tight tolerances. Gibsotronic pressed-powdered metal or punched-metal sheet heat-sink wafers match the coefficient of expansion of silicon wafers. Pressed-powdered metal wafer compositions include silver-tungsten and molybdenum; punched types include pure tungsten, molybdenum or nickel-iron.

Gibson Electric Sales Corp., Dept. ED, Delmont, Pa.

Metal-Film Resistors

694



Rated at 1/4 and 1/2 w, metal-film resistors are 0.300 and 0.475 in. long, respectively. Range is 25 ohms to 500 K. Temperature coefficient is 100 ppm per deg C, standard; ± 50 or ± 25 ppm can be supplied. Standard tolerance is $\pm 1\%$; $\pm 0.5\%$, $\pm 2\%$ and $\pm 5\%$ can be furnished.

American Components, Inc., Dept. ED, 8th Ave. and Henry St., Conshohocken, Pa.

P&A: \$0.45 up; stock.



Try it with

CUT 'N' STRIP Trial Kit

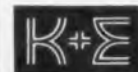
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1. 2 sheets STABILENE Cut 'N' Strip Film (NR136-2). 2. Dual-Purpose Drafting Pencil (holds both lead and cutting blade). 3. Complete Instructions. 4. Brochure: "Preparing Printed Circuits on STABILENE Film."

Have you heard about Cut 'N' Strip — the remarkable new method for preparing printed circuit masters? If not, you're in for a revelation. Cut 'N' Strip is far and away the easiest, and one of the most accurate methods of preparing printed circuit masters. With Cut 'N' Strip, there's no ink to run — no tape to stretch, shrink, pile up, or pull away on curves. What's more, Cut 'N' Strip eliminates many time-consuming photographic steps. In some cases, you can skip *all* intermediate photography.

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STABILENE Cut 'N' Strip Film yields sharp outlines for crisp reproduction, and can be exposed directly onto the laminate.

Is this remarkable new printed circuit process for you? We'd like to offer you a really *practical* means of finding out. To do so, we've compiled a complete Cut 'N' Strip Trial Kit containing everything you need to make a few trial masters. Using the kit, you'll be able to see for yourself what Cut 'N' Strip has meant to so many in terms of greater speed, accuracy, and savings. To get your kit, simply fill out and mail the coupon below.



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CIRCLE 191 ON READER-SERVICE CARD

157



DIALCO Tele-Strip No. TS 4220.
Accommodates 20 DIALCO Lens
Cap Assemblies (Series 402-).
Convex or dome lens; 6 colors.

TELE-STRIPS[®]

(MULTIPLE LAMP INDICATORS)

For switchboards and other applications
requiring multiple indication with T-2 lamps.

DIALCO Tele-Strips are available in several styles, and in
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(Back mounting, in
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- DC to 10 KC gating frequency.
- No isolated drive signal required.
- Source impedance — 0 to 10 K ohms.
- All welded construction.
- 0.29 cubic inches — 6 grams

Available in SPST and DPST versions.



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NEW PRODUCTS

Battery-Powered Motor

698



Speed variation is 2% or less. Model DBM2-
XA 9-v battery-powered motor has a governor-
regulator with a constant torque at 2,050 rpm.
For applications requiring greater speeds, the
governor unit can be removed to provide up
to 5,000 rpm.

Jonard International Corp., Dept. ED, 624
Madison Ave., New York 22, N. Y.

Teflon Wire

594

Types K, KK, and KT wire are insulated with
Teflon 100 FEP. The Teflon insulation offers
exceptional heat resistance up to 200 C, good
weatherability, toughness and strength. The
wire meets Mil spec W-16878D.

Phalo Plastics Corp., Dept. ED, Shrewsbury,
Mass.

Synchro and Resolver Tester

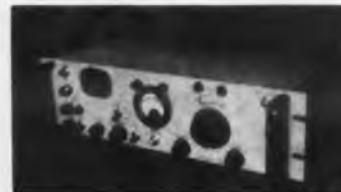
672

Performs seven tests automatically on 60
and 400-cps resolvers and synchros sizes 8 to
37. Suitable for military inspection procedures,
model CO5 9114 synchro and resolver tester
offers the following readout accuracies: error
from electrical zero, ± 30 sec; total null volt-
age, $\pm 3\%$; transformation ratio, $\pm 0.2\%$;
phase shift, $\pm 1\%$.

General Precision, Inc., Kearfott Div., Dept.
ED, Little Falls, N. J.

Spectrum Analyzer

699



Broadband spectrum analyzer measures pow-
er and coverage of radio and transmitter jam-
ming signals. Using high-powered jammer
transmitters, a sample of the rf energy is re-
duced by 40 db, delivered to the analyzer, and
further diminished within the analyzer. The
resulting diode current, shown on the meter,
is calibrated from 0 to 350 w.

General Mills, Inc., Electronics Group, Dept.
ED, 1620 Central Ave., Minneapolis 13, Minn.

AUGAT

HEAT DISSIPATORS
FOR
POWER TRANSISTORS



for TO-3
Transistors
or Diodes



for TO-36
Transistors



for 2N-1015
Transistors

Augat's new Heat Dissipators utilize
a minimum of space and still offer
the large radiating surfaces needed
for maximum transfer of heat. All
Augat dissipators feature a parallel,
open-fin construction assuring low
thermal resistance. They are readily
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Augat Heat Dissipators are manu-
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transistors or their equivalent.

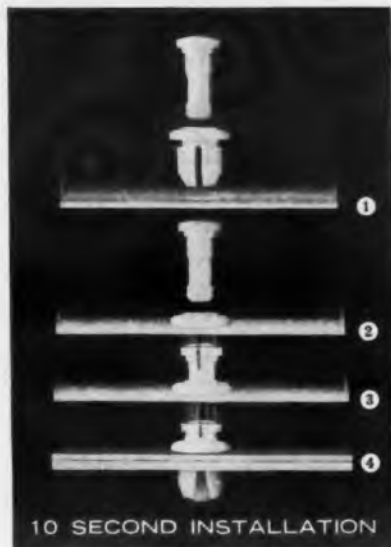
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which describes this new line in full
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AUGAT BROS., INC.
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LATCHES FOR INDUSTRY



- 10 SECOND INSTALLATION
- ① PUNCH A STANDARD HOLE
 - ② PUSH IN GROMMET — CAPTIVATED!
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Nylatch is a positive interference type fastener . . . thoroughly tested for rugged, dependable service. It will not unfasten under the severest conditions of impact or vibration, yet may easily be opened and closed 30,000 times without appreciable loss of holding power.

Nylatch is being used to replace all manner of latches, captive screws, stud fasteners and spring clips.

Here are only a few of the hundreds of different uses for Nylatch: Electronic chassis; securing printed circuits; luggage; access doors; any type of removable panels; cabinets; neon signs; tool kits; and many more.

Perhaps one of these uses reminds you of an application that will help you cut costs.

Various head configurations are available; the easy-grip, the mini-grip and the tamper-proof shown above.

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ELECTRONIC DESIGN • October 25, 1961

Infrared Detector

695



Indium-antimonide, thermoelectrically cooled infrared detector can be used in the region of 1 to 6 microns without complex gas or liquid cooling systems. Cooler power requirement is 2.5 amp at 2 v; operating temperature is -78°C . Resistance is 25 to 50 ohms and time constant is less than 10^{-6} sec.

Radiation Electronics Co., Dept. ED, 5600 Jarvis Ave., Chicago 48, Ill.

Tubular Capacitor

681

Range is 10 to 1,000 pf. Designed to meet MIL-C-11015, the Glennite CT10 tubular capacitor is now offered with weldable gold-flash dumet leads. Temperature range is -55 to $+150^{\circ}\text{C}$. Length is 0.255 ± 0.0 in., and diameter is 0.95 ± 0.003 in.

Gulton Industries, Inc., Dept. ED, 212 Durham Ave., Metuchen, N. J.

Flow-Sensing Monitor

666

Petroleum products manufacturing is a typical application of model 2 PMRC monitor and the positive-displacement meter transmitter also offered. Monitor stops the delivery of fluid through meter if the flow rate drops below a pre-determined rate. The meter transmitter is a dpst switch.

Murdock Associates, Dept. ED, Tulsa, Okla.

Microammeter

690



High-sensitivity microammeter series HSR is capable of reading $2 \mu\text{a}$ full scale and has ranges extending to $20 \mu\text{a}$. Meeting MIL-M-10304, it can be used for test equipment, magnetic sensing measurements, null detection, electrolysis and light density measurements. Accuracy is $\pm 2\%$ of full linear scale.

DeJur-Amsco Corp., Instrument Div., Dept. ED, Northern Blvd. at 45th St., Long Island City 1, N. Y.

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Fast, accurate, easy to operate and a breeze to set up. For example, just change a dial setting to change your wire length. This is the machine that companies the country over* are using to reduce their wire preparation costs.

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- Speeds up to 8,000 pieces per hour
- Single conductor wire, solid or stranded (and some types of shielded and coax)
- Lengths from 1 inch to 50 feet (or longer)
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*We'll send you a list of users and an illustrated brochure if you'll drop us a line.

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Got a glass problem? T.H. GARNER COMPANY IS DIFFERENT

We machine-draw tubing to your new dimensions and ship in a matter of hours.

If your problem can be resolved by new dimensions (O.D., I.D., length) or tolerances, call us today for service.

Our own glass tube drawing facilities running 24 hours a day give us the flexibility to handle a variety of changes quickly.

Your job is immediately assigned to one of several drawing and cutting systems guaranteed to produce the best quality and yields.

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CIRCLE 197 ON READER-SERVICE CARD

SPERRYELECTRONIC
TUBE
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microwave memo

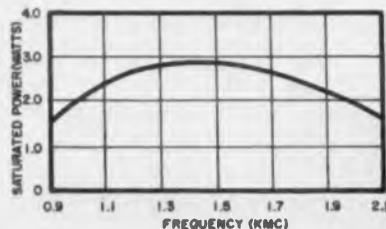


Sperry extends 30-day delivery to cover ECM and augments TWT's operating in L, S, and X bands

In a dramatic extension of its capability for delivering high-performance microwave tubes on short notice, Sperry Electronic Tube Division has added three system-proved traveling wave tubes to the list of those available in 30 days. Included in the move are tubes operating in L, S, and X bands. They cover a frequency range 1.1 to 11.0 kMc.

APPLICATION FLEXIBILITY

The tubes in this series are particularly suited to application in augmenters and ECM equipment. The inherent broadband characteristic and unusual ruggedness of these PPM focused tubes makes them unusually versatile in airborne applications. A full course of MIL and environment tests, as well as considerable in-sys-

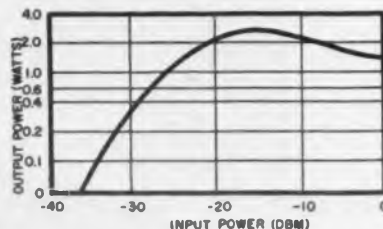


A typical saturated power versus frequency curve for an L band Sperry TWT.

tem experience have verified these characteristics.

INCREASED POWER POSSIBLE

Although these tubes nominally operate in the 1-2 watt power output range, optimum tuning can increase power to as much as 5 watts. A high-mu control grid adds to the versatility



Drive characteristics at mid-band for a typical Sperry ECM/augmenter TWT.

of these tubes by allowing remote switching, modulation control and gain adjustment.

SYSTEM DESIGN SIMPLIFIED

Use of these Sperry tubes greatly simplifies system design problems. Low voltage and high gain reduce power supply requirements. Application is further simplified, since ambient cooling is sufficient in most applications and the tubes may be mounted in any position.

For FREE technical information on these Sperry Traveling Wave Tubes, write to Section 502, Sperry Electronic Tube Division, Gainesville, Florida.

The L-Band tube is priced at \$1,900., the S-Band tube at \$2,195., and the X-Band at \$2,540.

For application assistance and quotation, consult your nearest Cain & Co. representative. His address and phone number appear in the adjacent column.

**Inquire about
Sperry Tubes
from these
convenient
Cain & Company
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CIRCLE 201 ON READER-SERVICE CARD



SPERRY RAND CORPORATION
CIRCLE 202 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 25, 1961

M I C R O W A V E S I





VA-126 TWT
 3 MW Peak
 5 KW Average
 5.4 to 5.9 kMc

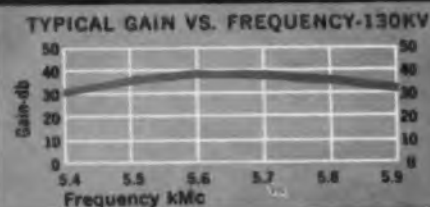
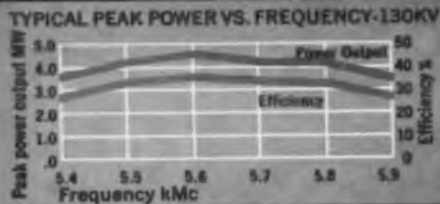
BANDWIDTH WITH HIGH EFFICIENCY HIGHEST POWER TWT 3 MEGAWATTS AT C-BAND

Varian Associates' new VA-126 pulse power amplifier traveling wave tube is particularly well-suited for advanced coherent radar systems employing frequency agility. With high gain and high efficiency over the full bandwidth, the tube offers a new standard in transmitter performance.

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MICROWAVES

Serendipity

A late-to-arrive item concerning plasma amplifiers (see article on facing page) perhaps illustrates why some people are habitually "shot with luck." It seems that a traveling-wave tube being tested at Sperry Gyroscope Co. was behaving strangely—spurious outputs and all that. Instead of trading in the tube for a good one, company engineers looked into the problem and discovered that the oscillations were coming from a small quantity of air trapped in the tube that had somehow been converted into a plasma. One thing led to another and the company is now attempting development of plasma amplifiers and oscillators along these lines. As usual, people who are good turn out to be lucky more often than not.

Designers may soon be specifying plasma amplifiers in their equipment. These essentially circuitless devices appear quite promising in broad-band receiver applications. For more details read

**Progress Reported in
 Plasma Amplifiers p 163**

Better performance and reliability are possible with socketless metal-ceramic planar tubes. The correct use of these tubes is discussed in

**Application Techniques for Socketless
 Vacuum Tubes p 164**

A reaction type reference cavity, a voltage tunable magnetron, a new line of coaxial front ends and a series of waveguide thermistor mounts head the

Microwave Products p 170

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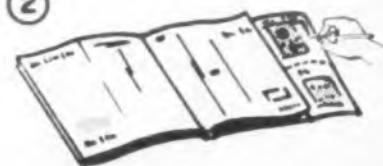
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Progress Reported in Plasma Amplifiers

PLASMA microwave amplifiers are approaching the hardware stage under intensive R&D efforts at three laboratories.

A cesium-beam amplifier at Stanford University has shown gains of 15 db at 1.5 Gc. An argon plasma amplifier developed by Metcom, Inc., Salem, Mass. is reported to have achieved gains of up to 22.5 db at discreet frequencies between 1.2 and 3.4 Gc. Work similar to that at Metcom is in progress at Microwave Associates, Burlington, Mass., but performance details have not been disclosed by the company.

The Stanford amplifier, being developed by Matthew Allen and George Kino of the university's W. W. Hansen Laboratories, is an extension of earlier experiments by other researchers with mercury vapor. Soviet researchers have followed a similar approach in obtaining some amplification at 35 Gc in ionization gage discharges.

The Stanford amplifier employs cesium vapor at a pressure of about 10^{-6} mm of mercury. A plasma is generated by discharge between tungsten electrodes and confined by a magnetic field surrounding the plasma tube. A signal-carrying electron beam is coupled into and out of the plasma by helical wind-

ings immersed in the medium. The signal itself, however, is impressed on the beam before it enters the plasma.

The most efficient operation of the device is in the vicinity of its plasma frequency, which varies according to the density of the plasma generated. This imposes a practical frequency limitation of about 30 Gc on a device of this type. Up to this frequency, however, gains of between 30 and 40 db should be possible, according to Dr. Allen.

Tuning would be achieved by controlling the plasma density. An alternate method, promising greater bandwidth, would be to establish regions of varying plasma density within a tube, so that maximum amplification of a given frequency would occur in a region of suitable density.

Work also is in progress to improve the coupling methods. The most desirable approach would be one that coupled the signal directly into the plasma. This concept could be extended so that the plasma itself would radiate, thus acting simultaneously as an amplifier and transmitting antenna.

Metcom's plasma amplifier operates on an entirely different principle. It employs argon at extremely low (micron-level) pressure.

The plasma formed in this gas also is surrounded by a magnetic field, but here the amplifier is tuned by varying the strength of the field rather than by varying the plasma density.

Low-kilogauss-level fields are employed, with the frequency increasing as the field strength. A single device readily tuneable over a range of perhaps seven octaves thus could be built, according to Lou Roberts, chief engineer at Metcom.

The company has built amplifiers both in circular and rectangular waveguide sections. The amplifier itself is about 12 in. long, but the active plasma region comprises only about 1 in. of this length. An increase in the active region, thereby improving gains, is being attempted.

Company spokesmen believe that the plasma amplifier is a natural for countermeasures receivers and broad-band communications equipment. "Noise is quite low, and only comparatively low voltages are required to operate the amplifier," Richard J. Broderick, Metcom's president, told ELECTRONIC DESIGN.

Mr. Broderick added that a typical amplifier could sell for perhaps \$3,000 to \$5,000 in sample quantities. ■ ■



Plasma amplifier developed by Metcom is housed in rectangular waveguide. External solenoid provides magnetic field for tuning the device. Bandwidths to seven octaves at microwave frequencies are believed feasible with magnetic tuning.



Cesium-beam amplifier developed at Stanford University. Plasma region is in large tube at left, with electron gun at right. The amplifier is operated in a solenoid to confine the plasma. Tuning could be achieved by varying the density of the plasma.



Application Techniques for Socketless Vacuum Tubes

Planar metal-ceramic microwave tubes designed for socketless installation can yield improved bandwidth by reduction of circuit shunt capacitances and socket losses. Greater reliability and more flexible packaging also may be obtained. To realize these advantages, however, the designer must appreciate the installation techniques and precautions necessary with these tubes. Soldered connections, in particular, require considerable care. James Rush, active in the application engineering of such tubes, describes proved installation and application techniques.



Fig. 1. Typical socketless planar triodes. The type 7296 tube at left comes with T-bolt for mounting to circuit board or metal chassis. The type 22866 tube at right is designed for direct soldering into coaxial cavities.

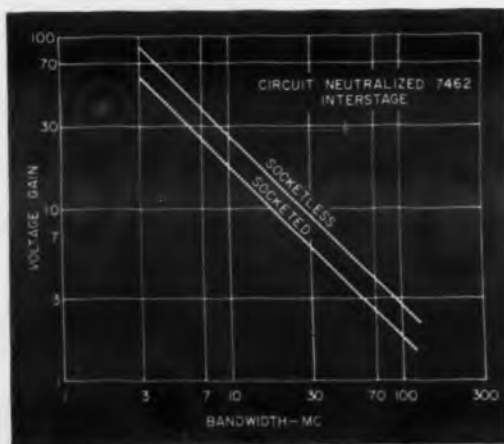


Fig. 2. Theoretical gain-bandwidth improvement of socketless tube over socketed tube in a neutralized interstage amplifier employing a 7462 tube. Performance of actual circuits confirms predictions of the graph.

James W. Rush, Jr.

Receiving Tube Dept.
General Electric Co.
Owensboro, Ky.

RECENTLY introduced metal-ceramic planar tubes, resistant to soldering temperatures and mountable by the tube elements themselves, offer designers a number of electrical and mechanical advantages resulting from elimination of tube sockets in their usual form.

Such tubes are available with solder lugs and T-bolt mounting for use on printed-circuit or metal chassis and with concentric flanges for direct soldering into coaxial circuits (see Fig. 1).

By eliminating tube sockets and connectors in their usual form, improved electrical performance is obtained.

For reasons of economy or moldability, the insulator of a tube socket is usually a high-loss-factor material. With the elimination of the socket-insulator losses, higher circuit Q's can be realized, thus leading to better performance through higher circuit efficiency.

Lower Shunt Capacitance Improves Gain-Bandwidth

In many modern circuits maximum gain-bandwidth must be obtained to process the high definition and complex signal pulse.

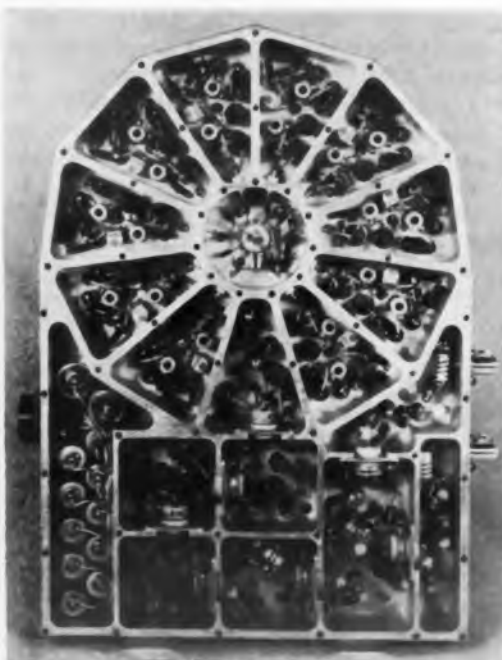


Fig. 3. Ten-channel STALO embodies socketless technique. Unit has 10 per cent bandwidth near 500 mc. The socketless tubes operated satisfactorily under Mil-spec conditions of acceleration, vibration and shock. Entire assembly is about 1 ft long.

The expression for gain-bandwidth product is:

$$G-BW = \frac{g_m}{2\pi C_t}$$

where g_m = tube transconductance and C_t = total shunt interstage capacitance.

For wide-band amplification, maximum available transconductance and minimum tube and circuit capacitances therefore are essential. The available tube transconductances are high—up to 50,000 micromhos—and are obtained with relatively small tube capacitances. To fully utilize the high gain-bandwidth product of the tube, the applied circuitry must have low shunt capacitance. Direct soldering of connections to the tube or soldering to clamps or clips supported by the tube assures maximum tube-circuit gain-bandwidth product.

The improvement in gain-bandwidth product theoretically possible with socketless tubes is described in Fig. 2. Performance

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At Douglas, as well as at test facilities around the country, Scientific-Atlanta instrumentation has been proven to operate dependably. Whenever service or technical assistance is needed, Scientific-Atlanta engineers are there in a hurry.

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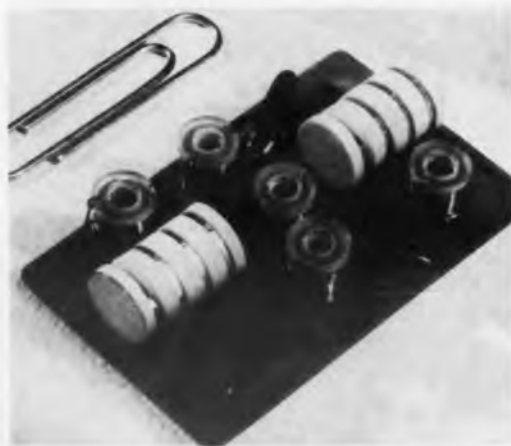


Fig. 4. Complete cascode circuit with two soldered-in metal-ceramic triodes.



Fig. 5. Triple-tuned plate circuit, grounded-grid amplifier. The grid is grounded by soldering directly to the chassis after the tube is inserted into a hole in the input-output shield. The first plate circuit resonant element to the left of the chassis shield is soldered to the anode connector at rear of tube. Circuit delivers power gain of 12-13 db at 425 mc with 10 per cent bandwidth.

of actual circuits confirms the predictions of this graph.

Socket lead inductances also can prove troublesome. For years the degenerative effect of cathode lead inductance has limited the high-frequency capabilities for conventional vacuum tubes as much as have transit time effects. The very low value of lead inductances often was wasted by high socket lead inductances, while tube instability often was due to poor grid grounding.

Socketless circuit techniques can contribute significantly to better system reliability. Troubles due to contact wear, failure or corrosion are reduced and there are no socket insulators to crack or deteriorate.

Very low contact resistances can be obtained with direct soldering techniques. Better tube reliability is possible if known and consistent heat sinks are established for the tube.

Tubes have failed as a result of additional acceleration forces resulting from poor socket design. Physical clamping of the tube directly to the chassis assures that the tube sees no more shock and vibration than does the chassis itself. Increased performance gained by socketless circuitry can mean fewer stages for the same system gain.

In some cases socketed tubes, being easy to remove, are replaced selectively to compensate for the performance loss due to a faulty component. This repair procedure usually leads to a more catastrophic failure later on.

Screwed-on or soldered connections to the tube are inspected more easily and do not depend upon an assumed contact pressure.

Socketless Tubes Cut System Size and Weight

Since many microwave triodes are miniaturized to achieve low capacitance and transit time, the sockets may be larger than the tubes themselves. System size and weight thus can be reduced by socketless techniques. Often, the socketless tube can double as a terminal strip for the connection and support of other circuit components, such as resistors and capacitors.

Socketless techniques can reduce the cost and design time associated with a socket.

Some of the ceramic triodes are fitted with mounting hardware requiring only a hole in a chassis or printboard. All connections can be made on one side of the board or chassis, thus permitting the use of dip-soldering techniques.

Socketless circuitry of good reliability usually requires soldering either to a tube clamp or tube element. Although the use of high-temperature seals and ceramic insulators greatly reduces the chance of seal damage, the tubes are not indestructible.

Ceramic tubes are tolerant to soldering temperatures as evidenced by successful life tests at temperatures of up to 450 C. However, due to the small sizes of the tubes, very large thermal gradients across the tube seals can provoke tube failure.

To reduce the possibility of tube damage the following precautions should be taken:

- Use a solder with as low a melting point as possible for the intended tube circuit ambient operating temperature.
- Use small-wattage soldering irons to reduce thermal inertia of the soldering heat.
- Preheat the tube whenever possible to reduce further thermal inrush when heat is applied. Ovens, hot plates, IR lamps, etc. can be used to preheat the tube before soldering. If these are not available, thermal shock can be reduced by operating the tube filaments for several minutes before soldering.

These precautions are most important on the smaller coaxial types; the thermal mass of these designs is small and very little thermal resistance is present between the solder surface and the tube seals. The uses of solder forms is highly recommended.

Lug versions can be used with no more than the usual precautions and can be treated as any other soldered-in circuit component. The suggested soldering procedures are conducive to cold-soldered joints, and care must be taken in this respect.

Titanium In Structure Compatible With Ceramic

The basic structure of the solderable tubes is of titanium metal and ceramic. The titanium is essential for several reasons—pri-

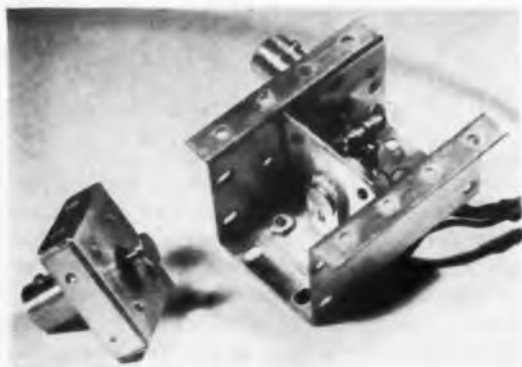


Fig. 6. A 2.7-Gc grounded-grid amplifier. The anode of the socketless tube is resonated by a short section of strip line functioning as a parallel-tuned plate circuit. Power is coupled out by an adjustable series output capacitor (shown removed from the amplifier at left).

marily, because its thermal expansion is nearly identical to that of good rf ceramic materials.

However, titanium is very difficult to plate. To provide solderable surfaces the titanium is first nickel-plated, after which a thin gold layer is applied. This gold layer is consumed by amalgamation into the solder, and the nickel undercoat is the surface to which the soldered connection actually is made.

After many solderings, nickel plating can be consumed. The titanium base metal is then exposed and one is confronted with the difficult task of soldering to titanium.

The thickness of the nickel plating must be carefully controlled between two limits. If the plating is too thin, only a limited number of solderings can be made readily; if the plating is too thick, peeling results. However, up to 20 solderings can reasonably be expected without damage. In development work where tubes are removed or resoldered many times, difficulty may be expected in soldering operations, and the use of clamps is preferable.

When it becomes necessary to remove the soldered-in tube the usual techniques apply. The tube can be treated as any other

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• broadband coaxial ferrite isolators

Excellent electrical characteristics with extreme versatility! $\frac{7}{8}$ " coaxial line construction allows higher power operation with $\frac{7}{8}$ " connectors, up to 20 kw peak, 400 watts average. (Normally supplied with Type N, $\frac{3}{8}$ " connectors; 10 kw peak, 10 watts average.) Features 15 db isolation and 1 db max. insertion loss. VSWR is 1.25 max. based on 2:1 load mismatch; 1.15 max. into matched load. Model 1233: 2.0-4.0 kmc; model 1233-1: 3.0-5.5 kmc; \$450. each.



• low power broadband waveguide ferrite isolators

Provide maximum load isolation and minimum insertion loss over full standard waveguide frequency ranges. Extremely useful for maintaining signal source stability and eliminating long line and frequency pulling effects. Front-to-back ratios are the highest available on the market today: C Band-26:1, \$250; XN Band-25:1, \$225; XB Band-30:1, \$235; X Band-30:1, \$220.



• high power broadband waveguide ferrite isolators

The only line of high power isolators that covers all of X Band with just two models (8.2-10.0 kmc and 10.0-12.4 kmc), each with front/back ratio of 40:1. Input power rating: 250 kw peak, 300 watts average, achieved through use of special high Curie temperature ferrite materials. VSWR is 1.05 max. with matched load; 1.10 max. with 3:1 mismatch. Only \$175 each. Model with same VSWR, 28:1 front/back ratio, 300 kw peak, and 300 watts average, for 7.05-10.0 kmc, \$195.



• other ferrite devices— consult NARDA for:

• Circulators • Phase shifters • Modulators • Attenuators • Special Isolators

For more information, write to Dept. ED-1.



the **narda** microwave
corporation

PLAINVIEW, L. I., NEW YORK

AREA CODE 516 GE 3-9000

CIRCLE 205 ON READER-SERVICE CARD

RECENT RAYTHEON DEVELOPMENTS
IN MICROWAVE FERRITE DEVICES



HIGH-POWER CIRCULATOR covering 7.05 to 8.5 kMc shown in use as an isolator with loads on ports 3 and 4.

X-band circulators take 20 kW CW to match state of the art in tubes

New unit tested at 20 kW continuous power; can be used as isolator or duplexer

This high-power CXH3 circulator provides greater than 20 db of isolation over the 7.05 to 8.5 kMc band with a maximum insertion loss of less than 0.3 db. The CXH3—developed under U. S. Army Signal Corps contract number DA-36-039-SC-85372—is typical of circulators Raytheon can supply for any X-band segment at power levels up to 25 kilowatts average and 2 megawatts peak.

Write for technical details on this and other significant developments in high-power microwave ferrite devices to Special Microwave Devices Operation, Raytheon Company, Waltham Industrial Park, Waltham 54, Massachusetts.

TYPICAL SPECIFICATIONS
MODEL CXH3 CIRCULATOR

Frequency Range	7.05-8.5 kMc
Power (CW)	20kW
Isolation	20 db min.
Insertion loss	0.3 db max.
VSWR	1.15 max.
Length	14.5 inches
Flanges	UG 51/U
Waveguide	RG 51/U
Weight: Incl. loads	19 lbs.
Excl. loads	12.5 lbs.
Cooling	1 gpm @ 90 psi max.
Recommended Pressurization	10-15 psig nitrogen or dry air



soldered-in circuit component.

If the coaxial tube outline is used, it becomes expedient to use auxiliary clamps not only for soldering connections but also for the mechanical support of the tube. At microwave frequencies most circuits use the tube in a grounded grid configuration in which the tube is mounted by clamping the grid element to a chassis shield or wall. In most cases dc "floating" of the grid is not essential and bypassing is not necessary. Where bypassing is required, mica or other spacers can be used without loss of mechanical support.

Cathode Clamps Facilitate Soldering, Tube Removal

Cathode location in coaxial designs may require cathode clamps to provide connections and soldering surfaces at more convenient distances from the tube. Such clamps also greatly improve the ease of tube removal. Soldering or clamping is usually optional on the heater and anode terminals. However, soldering is desirable for the heater

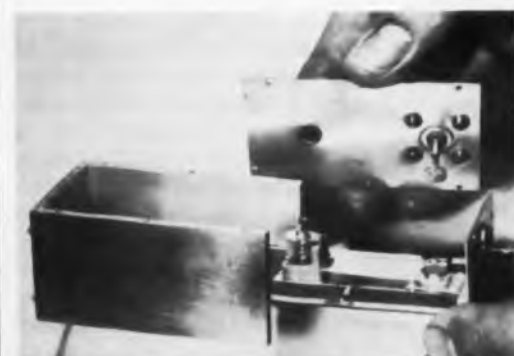


Fig. 7. A 1.2-Gc oscillator featuring snap-on slab-line resonators and screwed-down grid clamps. Circuit is a modified Colpitts oscillator. The grid line is an un-etched portion of the print board base. The tube foreshortens the half-wave line on one end and the tuning capacitor foreshortens the other. A grid-leak resistor is soldered at a low impedance point of the line.

RAYTHEON

RAYTHEON COMPANY

SPECIAL MICROWAVE DEVICES OPERATION
CIRCLE 206 ON READER-SERVICE CARD

MICROWAVES

connections since contact resistance at these points may seriously lower the tube heater voltage.

A 10-frequency crystal-controlled STALO employing socketless tubes is shown in Fig. 3. The Light Military Electronics Dept. of General Electric Co. chose these tubes to reduce size and weight, to obtain mechanical and electrical stability, and to fulfill the need for maximum gain-bandwidths for the broad-banded multipliers and amplifiers.

Small, T-bolt ceramic triodes are used in each of the 10 crystal channels and frequency selection is made by applying B+ to the desired channel. At the center of the 10 oscillators a "clamp-on" cathode connector is used as a common input to a grounded grid stage. Connections are made around the circumference of the cathode clamp.

The grid of this tube and the remaining larger coaxial triodes—eight in all—use flat sandwich or surface clamps.

The same cathode clamp is used for all the coaxial outline tubes. The wide bandwidths were essential to provide multiplication and amplification over about a 10 per cent operating bandwidth at near 500-mc center frequency.

High-gain stages were needed to reduce their total number for added reliability. Multiplication at wide bandwidths is traditionally difficult and high transconductance triodes as well as socketless circuitry were required for acceptable performance. The unit also satisfied the military specifications for acceleration, vibration and shock.

Additional examples of socketless tube technique are shown in Figs. 4 through 7. These circuits were built to illustrate the application possibilities of the socketless tubes. Although their operation was found satisfactory, these particular assemblies are not in actual production. ■ ■

The socketless tubes discussed in this article include EIA type numbers 7077, 7266, 7486, 7481, 7462, 7720, 7625, 7588, 7296, 8081, 8082 and 8083, and GE Development types Z-2823, Z-2835, Z-2869, Z-2866, Z-2897, Z-2868, Z-2354, Z-2870, Z-2731 and Z-2692.

Model No. B813T
Transistorized. Portable,
Line or Battery Powered,
Precision Standing Wave
Amplifier. Price: \$285.
Compl. with rechargeable battery



the new FXR
transistorized
precision
standing wave
amplifier has
exceptional
accuracy of
 ± 0.05 db

This ± 0.05 db accuracy, the most precise in the industry, holds true for both the full scale meter movement and for each 5 db step on the range switch. The specially designed meter and linear amplifier give a full scale maximum error at 5 db of only ± 0.05 db. This marks a significant increase in accuracy over any existing Standing Wave Amplifier. Calibrated range of the B813T is 75 db.

While extreme measurement accuracy was the major design criterion for this transistorized, portable instrument, many other design features are worthy of note: special circuitry and controls for normal, expanded and compressed scale readings (gain normalized on switching) . . . bolometer resistance checking, protection and current adjustment . . . selective meter damping . . . bandwidth selection and frequency peaking . . . range selection in 5 db steps . . . battery voltage checking and self-contained battery charging.

Write or call for Bulletin B813T for details on the most accurate Standing Wave Amplifier available for microwave measurements.



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**NOW . . . X BAND
NONDEGENERATE
PARAMETRIC AMPLIFIERS**
with a tuning range of 1.1 Gc!



Single-knob tuning over a range of 1.1 Gc in the X band is featured in this nondegenerate parametric amplifier by Texas Instruments Incorporated. Bandwidth is 30 mc and gain is 15 db. Noise figure, including circulator loss and normal second stage, is 4.5 db. Its broad-band signal frequency response and fixed pump frequency give you dependable operation with a minimum of tuning adjustment.

TYPICAL MODEL X-22 SERIES SPECIFICATIONS

Mode of Operation	Nondegenerate
Tuning Range	8.5 to 9.6 Gc
Bandwidth	30 mc
Gain	15 db
Noise Figure (Including circulator loss and normal second stage)	4.5 db
Pump Frequency	24.0 Gc
Diode	Texas Instruments Gallium Arsenide Diode
Pump Power	50 mw

For more details about this amplifier or other Texas Instruments parametric amplifiers operating at L, S, C, and X bands, contact **RADAR AND MICROWAVE PRODUCTS DEPARTMENT.**



APPARATUS DIVISION
TEXAS INSTRUMENTS
INCORPORATED
4000 LEMMON AVENUE
P.O. BOX 9015 DALLAS 22, TEXAS

CIRCLE 208 ON READER-SERVICE CARD



MICROWAVE PRODUCTS

Voltage-Tunable Magnetron 667

Bowl magnet design voltage-tunable magnetron, type ZM-6021, covers the L band in a rated range of 1 Gc to 2.3 Gc at a minimum cw power of 1 w. It operates at a maximum anode voltage of 2,000 v. The unit weighs 3 lb and is a complete rf power source requiring only input power connections and an rf power output connection. It is voltage tunable over all or a portion of its frequency range at a rate of 1.2 mc per v. The unit is designed for use with all types of receivers that use an electronically-swept local oscillator, test equipment and output tubes that cover the L band.

General Electric Co., Power Tube Dept., Dept. ED, Schenectady 5, N. Y.
P&A: \$1,350; 60 days.



Thermistor Mounts

601

Designed for the measurement of average power from a few μ w to 10 mw, model 401 series of coaxial and waveguide thermistor mounts cover the frequency range from 0.01 to 18.0 Gc. They operate in conjunction with rf power instruments capable of operating with a 100- or 200-ohm negative temperature-coefficient detector. The temperature-resistance characteristics of the thermistors used make burn-out virtually impossible. The relatively long time-constant of the series makes these devices suited for the measurement of both cw and pulsed power.

General Microwave Corp., Dept. ED, 47 Gazza Blvd., Farmingdale, N. Y.
P&A: from \$75 to \$110; stock to 30 days.

**Coaxial Front Ends****602**

Designed for operation from 250 mc to 7 Gc, series RF coaxial front ends use a balanced mixer and a 30-mc if peramplifier to permit octave bandwidth coverage with a minimum of local oscillator power and a maximum of local oscillator isolation. The use of ceramic tubes as if amplifiers permit the units use in severe environmental conditions. Noise figure of 7.5 db max with an over-all bandwidth of 8 mc and a power gain of 20 db eliminate the necessity of special circuitry in the main if amplifier.

R L C Electronics, Inc., Dept. ED, 805 Mamaroneck Ave., Mamaroneck, N. Y.
P&A: \$650 ea; 2 to 4 weeks.

**Reference Cavity****603**

An accuracy of $\pm 0.005\%$ is provided in a new reaction type reference cavity designed for use in microwave relay links. The cavity is adjustable within a frequency range of 10.7 to 11.7 Gc and exhibits a maximum resonant frequency shift of 1.0 mc over a temperature range of 0 to 140 F. The cavity is equipped with a flange which mates electrically and mechanically with other types of WR 90 waveguide components. Dimensions are 2-1/2 x 1-1/2 x 1-1/4 in.; weight is approximately 6 oz.

Frequency Standards, Dept. ED, P. O. Box 504, Asbury Park, N. J.

P&A: \$100 to \$150 ea; 45 to 60 days.



**FASTEST SWITCHING SPEED
HIGHEST CONDUCTANCE
LOWEST JUNCTION CAPACITANCE**

MA-4121 silicon point- contact diodes will work in 200 Mc computers

**THEY'RE ALREADY AT WORK
IN 100 Mc COMPUTERS**

MA-4121 computer diodes have the desired combination of parameters for use in the very fastest switching circuits.

Fractional nanosecond switching* — typically 0.5 nsec.
High forward conductance — 30 mA at 1.0 V (max.)
10 mA at 0.55 V (max.)

Low junction capacitance — 0.5 pf (max.) at zero volts bias.

They are hermetically sealed in an all-glass package with no soldered end seals, insuring no loss of hermeticity during circuit assembly.

Two years ago Microwave Associates introduced the first 4 nanosecond switching diodes on a commercial basis (1N903 series). They were rapidly adopted as industry standards.

Today the MA-4121 enables you to design computer circuits with almost an order of magnitude increase in speed. This diode is ideal for coincidence circuits, pulse circuits, ultra-high-speed switching, and all types of logic functions.

There is no substitute for capability. There is no substitute for quality. Microwave Associates computer diode technology has proven itself on both counts. We'd like to put our experience to work for you.

*Actual recovery time is so fast that the observed time in a sampling or traveling wave oscilloscope is primarily determined by the wiring configuration.



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Export Sales: Microwave International Corp.
36 W. 44th St., N.Y.C., N.Y., U.S.A. Cable: Microken

CIRCLE 209 ON READER-SERVICE CARD

Isolator

587



C-band. Available with rectangular (CMR-137) or circular (UG344/U) flanges. Three models offer frequency ranges of 5.925 to 6.425 Gc, 6.575 to 7.125 Gc, and 7.125 to 8.400 Gc. Isolation is greater than 40 db; insertion loss is 0.8 db max; vswr is 1.2 max; temperature range -40 to +70 C. Power handling capability is 10 w average.

Kearfott Div. of General Precision, Dept. ED, 14844 Oxnard St., Van Nuys, Calif.

Microwave Coaxial Connector 372

Handling 1 kw cw from 0.03 to 5 Gc, the type ALLT connectors are assembled to type RG-209/U cable. The connector remains sealed even while unmated, and the center contact can withstand a 150-lb pull. Temperatures from -55 to +95 C, 70,000-ft altitudes, salt spray, humidity, sand and dust are withstood. Straight plugs have vswr of 1.2 max; right-angle plugs, 1.25 max.

Cannon Electric Co., Dept. ED, 3208 Humboldt St., Los Angeles 31, Calif.

X-Band Maser 440



Portable X-Band maser weighs about 50 lb. Amplifier involves a permanent magnet enclosed by a Dewar, and operates for 24 hr on one filling of liquid helium. At a gain of 20 db, bandwidth is 10 mc. Unit is gain stable, and the amplifier can be tuned over a 150-mc bandwidth. Noise temperature is under 50 K.

Microwave Technology, Inc., Dept. ED, 235 High St., Waltham 54, Mass.

CIRCULAR WAVEGUIDE ROTATING PROBE SECTIONS



Model No. 5585C

These circular waveguide rotating probe sections provide a continuous 360-degree probe rotation for measuring electrical field mode orientation in circular waveguide. A universal probe mounting is provided with thumb screw lockings at three different longitudinal positions. A vernier protractor type scale is provided to read rotations to a minimum accuracy of 1/2 degree.

Typical Specifications
 VSWR 1.02 or less
 Frequency Range 3.95 to 18.0 kmc
 Unit Band Width 20 per cent
 Connector or flange type optional

CIRCULAR WAVEGUIDE SLOTTED LINE SECTIONS



Model No. 5555C

Designed for use with the Hewlett Packard 809B Universal Probe Carriage. Special design techniques are utilized to maintain rotation of the electric field orientation to a minimum in order to ensure true readings. The slot length is a minimum of 8 inches.

Typical Specifications
 Residual VSWR 1.02 to 1 or less
 Frequency Range 3.95 to 18.0 kmc
 Unit Band Width 20 per cent
 Connector or flange type optional

CIRCULAR WAVEGUIDE MOVING LOADS



Model No. 5515C

These moving loads consist of a section of circular waveguide in which is mounted a sliding, tapered, low reflection load. A plunger controls the position of the load which is variable at least one wavelength at the lowest waveguide frequency. This permits changing the phase of the residual reflection so that this reflection can be separated from the other reflections in the waveguide system.

Typical Specifications
 Residual VSWR 1.04 to 1 or less
 (independent of azimuth orientation)
 Frequency Range 3.95 to 18.0 kmc
 Unit Band Width 20 per cent
 Connector or flange type optional

COAXIAL CRYSTAL DIODE MIXERS



Model No. CM6

Particularly suitable for applications where maximum performance is desired over a reasonable bandwidth. Double or single ended mixers with fixed or variable L.O. coupling are available in any transmission line. Normal or high intermediate frequencies also are available.

Typical Specifications
 Freq. Bandwidth 10%
 I.F. 30 mc
 L.O. Coupling 13 db
 Conversion Loss 6.0 db
 VSWR 1.5:1 max.

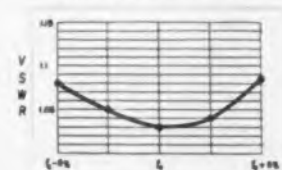
COAX TO WAVEGUIDE TRANSITIONS



Model No. 18T10

Intended for applications requiring an absolute maximum in performance. Frequency range: from 1000 to 12,400 mc. APPLIED MICROWAVE is prepared to supply transitions which have a VSWR of less than 1.03 to 1 at any specified frequency and a VSWR of less than 1.10 to 1 over any 10 per cent bandwidth.

Typical Characteristics



Direct inquiries to: **APPLIED MICROWAVE ELECTRONICS**

6707 Whitestone Road / Baltimore 7, Maryland



APPLIED MICROWAVE ELECTRONICS AND
WASHINGTON ALUMINUM CO., Inc.



WAVEGUIDE SLOTTED LINES



These waveguide slotted lines are precision-fabricated and machined sections which contain a tunable detector probe as an integral part. All units have a residual VSWR of 1.01 to 1 and slope of 0.1 db or less.

DIRECTIONAL COUPLERS



Directional couplers are available in the standard waveguide sizes, with coupling values from 30 to 70 db. Deviation is held to ± 2 db over the entire frequency band and directivity is 20 db or better. A load matched for optimum directivity is provided on one of the two secondary outputs. More than one element can be supplied on each coupler.

STRAIGHT WAVEGUIDE SECTIONS



Straight waveguide sections are available in all E.I.A. standard sizes from WR-650 through WR-2300. Because of revolutionary fabrication techniques, the VSWR is 1.02 to 1 or less over the entire waveguide frequency band. Standard length is twelve feet, with other lengths on request.

ANTENNA CAPABILITIES



Parabolic Wullenweber Antenna. Diameter of outer periphery is 97'. Base diameter 56'. Height 50'. Consists of six levels of 44 modular panels each level. Ultimate use of these antennas is classified.



Parabolic Torus antenna. Base diameter 71'. Height 60'. Six levels of 24 modular panels each level. After installation, the overall parabolic contour deviation is $\pm .093$ inches.

AVAILABLE THROUGH THE TECHNICAL AFFILIATION OF:

Direct inquiries to:
Applied Microwave Electronics
6707 Whitlans Road,
Baltimore 7, Maryland

APPLIED MICROWAVE ELECTRONICS
WASHINGTON ALUMINUM CO., INC.

CIRCLE 210 ON READER-SERVICE CARD

Wideband Amplifiers

361



Low-noise amplifiers WJ-111 and WJ-112 are designed for unattended field operation. They cover 2 to 4 Gc and 1 to 2 Gc ranges respectively, with guaranteed maximum noise figures of 5.5 and 5.0 db respectively. Amplifiers with lower noise figures over restricted parts of the band can be supplied.

Watkins-Johnson Co., Applications Engineering, Dept. ED, 3333 Hillview Ave., Palo Alto, Calif.

P&A: WJ-111, \$3,650; WJ-112, \$4,200; 4 to 6 weeks.

S-Band Parametric Amplifier 463

Broadband and narrowband amplification, and up-conversion to X-band is performed by the model SPA01 parametric amplifier. Unit, designed for S-band operation, uses a silicon diode as the variable capacitor. Gain is 15 to 20 db and noise figure is 1.5 to 4 db, depending upon application. Broadband bandwidth is 50 to 70 mc; narrowband, 10 to 20 mc.

Motorola Inc., Solid State Electronics Dept., Dept. ED, 3102 N. 56th St., Scottsdale, Ariz.

Transmitters and Receivers 626



From 6- to 8- and 11- to 15-Gc communication is provided by a series of transmitters and receivers. Transmitter power outputs of 0.1 to 1 w are available in the lower range, and 50 to 500 mw in the upper range. The receivers have a base-band frequency response of ± 0.5 db from 50 cps to 8 mc. The systems are made for wide-band data transmission, high-density communications, and video relaying.

Microwave Systems, Alpha Corp., Dept. ED, P. O. Box 1891, Dallas 21, Tex.



MICROWAVES PRODUCTS

X-Band Turnstile Switch 452



Two crossed rectangular waveguides with a 45-deg Faraday rotator comprise the model XS04 X-band turnstile switch. The Faraday rotator is in a shorted circular waveguide section. It couples any two adjacent ports and isolates the other ports. The device is a narrow-band unit, said to provide high isolation. Temperature range is -45 to +85 C.

Motorola, Inc., Solid State Electronics Dept., Dept. ED, P. O. Box 5409, Phoenix, Ariz.

Power Meter 441

Accuracy is $\pm 0.5\%$. Model 450 power meter has five scales with ranges of 100 μ w to 10 mw, calibrated from -30 to +10 dbm. It is designed for use with model 402 waveguide and coaxial thermistor mounts, but can be used with any 100- or 200-ohm, positive or negative temperature-coefficient barretter requiring 16-ma bias current.

General Microwave Corp., Dept. ED, 47 Gazza Blvd., Farmingdale, N. Y.

Price: \$495.

Traveling-Wave Tube 660



Low-noise traveling-wave tube, type Z-3031, has a saturated power output of 5 mw. Device has a noise figure of less than 14 db across its 14 to 18 Gc frequency

QKB 830 O-TYPE BWO is 1 1/4 inches in diameter; weighs only 1 1/2 lbs.



Electrostatically focused BWO provides smaller, lighter X-band signal source

New Raytheon tube combines advantages of backward wave oscillators in rugged compact package ideal for airborne and missile use.

The QKB 830 is especially suitable for local oscillator service in airborne, shipboard, or ground-based equipment such as anti-jam radar receivers. A wide-range tube, it can be tuned from 8.5 to 9.6 kMc by varying a single electrode voltage.

The small size and low voltages of the QKB 830 permit its use as a direct replacement for mechanically tuned klystrons in existing systems. It is also adaptable to many other applications requiring a voltage tunable source having provision for low-voltage pulsed or amplitude modulation.

Write today for technical data or application service to Microwave and Power Tube Division, Raytheon Company, Waltham 54, Massachusetts. In Canada: Waterloo, Ontario.

QKB 830 GENERAL CHARACTERISTICS (Typical CW Operation)

Power Output	15-30mW
Frequency	8.5-9.6 kMc
Voltage Requirements	
Tuning Voltage	150-250 Vdc
Focus Voltage	300 Vdc
Filament Voltage	6.3 V
Shock	50 G's
Cooling	convection
Overall Length	7.5 in.
Weight	1.5 lb. Max.

RAYTHEON COMPANY

MICROWAVE AND POWER TUBE DIVISION

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range. Gain is 25 db max. The tube is supplied with permanent-magnet focusing assembly, waveguide input and output, and rf connectors in a single 11.5-lb package measuring 9.25 x 4.6 x 3 in.

General Electric Co., Power Tube Dept., Dept. ED, Schenectady 5, N. Y.

P&A: \$4,500 in small lots; 90 days.

High Power Broadband 455 Isolators



The 2- to 7.9-Gc band is covered by the series I-900 broadband coaxial isolators. Devices handle 150 w. Isolation is more than 20 db; insertion loss is less than 0.3 db, and vswr is 1.25 max. The isolator is less than 3.4 in. long and operates from -55 to +71 C.

Rantec Corp., Dept. ED, Calabasas, Calif.

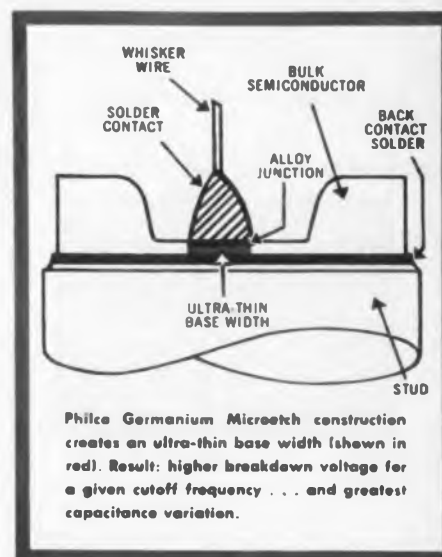
Remote-Controlled Switch 654



Signals up to 6 Gc are switched by the series SA-90 remote-controlled switch. Unit measures 2 x 1.3 x 2 in., weighs 2.5 oz, and operates in 7 msec. MIL-E-5272 specifications are met. Power requirement is 28 v dc or 115 v, 60 or 400 cps. Operation is fail-safe.

Don-Lan Electronics, Inc., Dept. ED, 1131 Olympic Blvd., Santa Monica, Calif.

P&A: \$145; 30 days.



Philco Germanium Microetch construction creates an ultra-thin base width (shown in red). Result: higher breakdown voltage for a given cutoff frequency . . . and greatest capacitance variation.

New Philco varactor types L-4110, L-4111, and L-4112—industry's first germanium varactors—herald new capabilities for harmonic generators, parametric amplifiers, RF tuning devices, and a wide variety of all-solid state power sources.

Philco Germanium Microetch process, heart of the new varactor capability, combines with the low contact

potential inherent in germanium to produce large capacitance variation. And large capacitance variation means more efficient frequency conversion—the capability that makes the varactor ideal for harmonic generators.

Originally designed for Philco's own all-solid state power sources, these varactors now are commercially available for your own designs.

DIMENSIONAL OUTLINE AND MECHANICAL SPECIFICATIONS	PHILCO GERMANIUM VARACTORS			
	Parameters	L-4110	L-4111	L-4112
<p>OUTSIDE DIMENSIONS</p>	Max. Power Dissipation	0.4 watts	0.3 watts	0.2 watts
	Breakdown voltage (minimum at -200 μ a)	80 volts	40 volts	20 volts
	Junction capacitance (at 100 kc and varactor biased at $\frac{1}{2} V_b$)	1.0-2.0 pf	0.35-0.7 pf	0.17-0.35 pf
	Series resistance (typical; measured at 2 Gc and varactor biased at $\frac{1}{2} V_b$)	5 ohms	6 ohms	7 ohms
	Cutoff frequency (minimum; calculated at $\frac{1}{2} V_b$)	25 Gc	60 Gc	100 Gc
	Lead inductance (typical; measured at 2 Gc)	0.4 nhy	0.4 nhy	0.4 nhy
	Cartridge capacitance (typical; measured at 100 kc)	0.2 pf	0.2 pf	0.2 pf

For data and applications assistance, write Dept. ED 102561X

SPECIAL PRODUCTS OPERATION

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LANSDALE DIVISION, LANSDALE, PENNSYLVANIA

IN EUROPE: Avenue de Beauregard 3, Fribourg, Switzerland

All Philco Microwave Semiconductors are immediately available from your Philco Industrial Semiconductor Distributor





MICROWAVES PRODUCTS

Pulse Compression Network 439



Radar echoes are compressed in time by this network, enabling overlapping pulses to be distinguished. Compression ratios from 10 to over 100 are available, with center frequencies as low as 1 mc, and with various bandwidths. Network impedances are from 50 to 1,000 ohms, depending on center frequency.

Ortho Filter Corp., Dept. ED, 7 Paterson St., Paterson 1, N. J.

Dual-Polarized Antennas 573



Parabolic antennas have 6-, 8-, and 10-ft diameters. Frequencies from 1.7 to 1.99 Gc are covered. Antennas are dual polarized, with cross-talk of 40 db min. Wind of 100 mph and 2-in. radial ice loads are withstood.

Prodelin, Inc., Dept. ED, 307 Bergen Ave., Kearny, N. J.

Availability: immediate.

Hybrid 436



Standard sidewall short slot hybrid, model WR-15, covers frequencies from 68 to 72 Gc. Device is 0.5 in. long, has a 0.04 in. common wall, and is cast in beryllium-copper. Unbalance is 0.25 db max, and isolation is 30 db min.

Microwave Development Laboratories, Inc., Dept. ED, Natick, Mass.

Availability: Stock to 30 days.

Scales: Five ranges, front panel selection: 0-1, 0-3, 0-10, 0-30, 0-10 milliwatts full scale. Two ranges 0-10, 5-15 db full scale. Higher power levels by using directional couplers and/or calibrated attenuators.

Accuracy: 3% of full scale reading.

Power: 105-125 volts, 210-230 volts, 50-60 cps.

Bolometer: Temperature coefficient: positive or negative, front panel selected. Resistance: 100 or 200 ohms, front panel selected.

Bias Current: 0-16 ma d-c

Recorder Output: 0-1 ma, 1500 ohms, one side ground

Oscillator Frequency: 10.7 kc

Weight: Approximately 13 lbs.

Price: \$240



POWER measured with

MICROLINE POWER METERS, measuring both average and peak pulsed power. The 31A1 Average Power Meter, with 3% accuracy, provides greatest precision and bias stability available.

The 31A2 measures peak pulse power directly without computation using Sperry's patented barretter integration-differentiation technique.

Offers improved accuracy over computation from pulse characteristics and average power.

Using the 31A1 and 31A2 with Microline barretters, thermistors and mounts, Microline accuracy is assured!

31A2 PEAK POWER METER



Repetition Rate: 50 to 5000 pps
Pulse Width: 0.25 to 10 microseconds
Rise Time: 0.15 microseconds
Power Ranges: 0-30, 0-100, 0-300 mw
Frequency Range: depends on Barretter Mount
Barretter Mount Output: Capacitance must be less than 100 mmf
Video Output: 300 millivolts
Accuracy: ±10%
Price: \$875

SPERRY

SPERRY MICROWAVE ELECTRONICS COMPANY, CLEARWATER, FLORIDA • DIVISION OF SPERRY RAND CORPORATION

Microline Instruments • Radar Test Sets • Systems Instrumentation • Solid State Devices and Materials • Microwave Components and Antennas

SPERRY *Microline*

STABILITY—the result of an entirely new approach to the manufacturing technique.

RELIABILITY—the result of new superior design.

LOW BURN OUT—the result of previously unachieved purity of materials and rigid testing.



Model	Type	Element	Cartridge Type	Nominal Resistance (Ω, Bias Current (25° C Amb))	Bias Current For Nominal Resistance (ma)	Price
3881	821	Barretter	Fuse	200	8.75	\$12
3882*	823	Barretter	Fuse	200	±0.25 8.75	\$14
3883	560	Barretter	Threaded	200	±0.25 8.75	\$15
3884*	825	Barretter	Threaded	200	±0.25 8.75	\$14
3886	Coax	Barretter	Disc	200	±0.25 4.0-5.0	\$25
3887	—	Barretter	Crystal	200	8.75	\$12
38810	543	Thermistor	Threaded	100	±0.25 12.8±1.0	\$25
				135	10.2±1.0	
				200	7.5±1.0	
38811	550	Thermistor	Fuse	100	14.0	\$20
38812	Coax	Thermistor	Disc	200	±1.0 15.0	\$25

*Specially selected and calibrated for peak power applications

Steerable Antenna

353



Portable 28-ft diameter parabolic antenna is steerable both in azimuth and elevation. The 20-ft mounting tower forms a mobile trailer unit. Designed for field use, the antenna can be put into operation at a remote site by two or three men in a few hours. It operates from 100 to 4,000 mc, withstands winds to 45 mph in operation and 100 mph stand-by, and requires 115-v, 60-cps, 1-kw power.

Smyth Research Associates, Dept. ED, 3555 Aero Court, San Diego 11, Calif.

Multihole Couplers

468

Frequencies from 2.6 to 40 Gc are covered by the 45-1 series of precision multihole couplers. Couplers are available in 3, 10, and 20 db ratings. Units have flat coupling and high directivity.

Sperry Microwave Electronics Co., Dept. ED, Clearwater, Fla.

P&A: \$100 to \$375; from stock.

Germanium Switching Diode

574



For X-band switching, the type S150 germanium diode is hermetically sealed. With 80-ma bias, insertion loss is 1.5 db. Without bias, loss is 16 db, reflective, holding off 100 mw of the rf signal. Devices can serve as an rf modulator.

Microwave Semiconductor and Instruments, Inc., Dept. ED, 116-06 Myrtle Ave., Richmond Hill 18, N. Y.

P&A: \$32.50 for samples; from stock.

SPERRY *Microline* **ACCURACY!**

BARRETTTER MOUNTS			
Model	Frequency (Gc)	Max VSWR	Price
33X2	8.20-12.40	1.35	\$ 70
33H2	7.05-10.00	1.30	\$100
33G2	5.85- 8.20	1.30	\$130
33C2	3.95- 5.85	1.30	\$140
33S2	2.60- 3.95	1.30	\$150
33L1	.95- 1.22 (coax)	1.30	\$100
33B3	.50-11.00 (coax)	1.50	\$ 75

THERMISTOR MOUNTS			
Model	Frequency (Gc)	Max VSWR	Price
33X3	8.20-12.40	1.35	\$ 75
33H3	7.05-10.00	1.30	\$ 80
33G3	5.85- 8.20	1.30	\$ 90
33C3	3.95- 5.85	1.30	\$ 95
33S3	2.60- 3.95	1.30	\$120
33B2	.50-11.00 (coax)	1.50	\$ 75

SPERRY BARRETTTERS, THERMISTORS and MOUNTS

MOUNTS . . .

LOW VSWR—the lowest available today.

HIGH EFFICIENCY—assures minimum error in power measurement.

REPLACEABLE ELEMENT—simplified maintenance for the user.

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SPERRY MICROWAVE ELECTRONICS COMPANY, CLEARWATER, FLORIDA • DIVISION OF SPERRY RAND CORPORATION

Microline Instruments • Radar Test Sets • Systems Instrumentation • Solid State Devices and Materials • Microwave Components and Antennas

CIRCLE 213 ON READER-SERVICE CARD



Tunable-X Band Filters

**MAXIMUM REJECTION • LOW INSERTION LOSS
• DELIVERY FROM STOCK**

Now, Frequency Engineering Laboratories, world leader in microwave filter technology, introduces a new series of precision tunable bandpass filters covering the range of 7 to 12.5 Gc— assembled and delivered from stock in two weeks or less!

These filters feature a bandwidth of 8 to 12 mc at 3 db and 60 mc at 30 db with 2 db insertion loss... VSWR of 1.5 max. at F_0 ... temperature stability of 3 cps/Mcs/°C maximum drift over wide temperature range... two direct-coupled TE_{111} mode cylindrical cavities with single tuning control... counterdial and calibration chart or slotted shaft adjustment. Price: \$398.00 each (less quantity discount).

Frequency Engineering Laboratories' 14 years of experience in the development and production of high performance microwave filters is available to you without obligation. Look into our capabilities for special preselectors with balanced mixer as well as low bandpass and band rejection filters for both high and low power applications. Write for Bulletin P-26102 or send specific bandwidth and other requirements to Department KF.

FREQUENCY ENGINEERING LABORATORIES

***** formerly FREQUENCY STANDARDS
A DIVISION OF HARVARD INDUSTRIES, INC
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Center for new ideas in microwave technology — Discriminators, Antenna Couplers, Diplexers, Wavemeters, Reference Cavities, Signal Sources, Directional Couplers, Antennas, Cavities

CIRCLE 214 ON READER-SERVICE CARD



MICROWAVES PRODUCTS

Waveguide Switches

449



Mechanical, three- and four-port waveguide switches are for use in RG/96/u, RG/98/u, RG/99/u and RG/138/u waveguides. Loss is about 0.3 db over entire waveguide band; isolation is greater than 40 db between ports; vswr is 1.15 or less. Hardened steel alignment shaft sets rotor.

Technical Research Group, Antenna and Microwave Dept., Dept. ED, 9 Union Square, Somerville, Mass.

Dual Polarized Adaptor

676

Circular waveguide feed parabolic antennas can be adapted to polarized transmission with the model DPA-6000 dual polarized adaptor. Device has two inputs, one for each polarization, with 35 db isolation. Frequencies from 5,800 to 7,750 mc are covered.

Mark Products Co., Dept. ED, 5439 W. Fargo Ave., Skokie, Ill.

P&A: \$225.00; from stock.

Frequency Multiplier

584



Output frequencies from 1 mc to 40 Gc are provided by a line of parametric frequency multipliers. Varactors are active elements. Power output ranges from microwatts to tens of watts, with bandwidths from 0.1% to greater than microwave passbands. Efficiency at lower frequencies is as high as 85%.

General Electronic Laboratories, Inc., Dept. ED, 18 Ames St., Cambridge 39, Mass.

P&A: \$580 fob Cambridge; six weeks.

Dual-Polarized Horns**583**

All standard waveguide sizes from WR-430 through WR-2300 are available. These dual-polarized horn antennas have either waveguide or coaxial inputs. The vswr is less than 1.2 for 30% for the frequency band. Decoupling between inputs is greater than 30 db. Standard aperture is between 0.35 and 0.5. Units are weatherized, and can be pressurized and anti-iced.

Antenna Systems, Inc., Dept. ED, Hingham, Mass.

Waveguide Circulator**446**

Four-port waveguide circulator model CBX-205, for communication-link applications, covers 5.925 to 6.425 Gc with 20-db minimum isolation. Power handling capability is 300 w avg; operating temperature range is -55 to +71 C. Standing-wave ratio is low.

Rantec Corp., Dept. ED, Calabasas, Calif.

Klystron Oscillators**382**

Wide-range klystron oscillators of series KL-280 provide 10 mw min. Three models cover 1 to 6-Gc; pulsed and cw versions are made. A tuning mechanism which tracks dc tuning voltage and piston position to a linear tuning dial is optional. Size is 10-1/2 x 2 x 3 in. Type TNC female rf output connectors are standard.

Empire Devices, Inc., Dept. ED, Amsterdam, N. Y.

Microwave Sweep Oscillators

with

FLAT OUTPUT

NEW in Alfred Series 620 Oscillators:

• BUILT-IN FEEDBACK LEVELER

Holds power output constant to $\pm 3/4$ db over these ranges... 1 to 2, 1.4 to 2.5, 2 to 4, 4 to 8, 7 to 11 Gc. Feedback Leveler unique in holding output variation to approximately ± 0.1 db over any 100 Mc interval. Feedback method makes RF flatness independent of RF level or microwave tube aging. Components being developed for leveling above 11 Gc.

• SYMMETRICAL NARROW BAND SWEEP

Up to $\pm 5\%$ of band width; about any center frequency. A significant time saver for component testing.

PLUS ALL THESE FEATURES, STILL EXCLUSIVE WITH ALFRED

- **Drift**—less than $\pm 0.02\%$ per hour.
- **Residual FM**—less than 0.0025% peak.
- **Adjustable Frequency Markers**—time-saving indicators of band limits or intermediate frequency values.
- **Quick Look Readout**—shows frequency range, markers and sweep time at a glance.
- **Ten Frequency Ranges, 1 to 26 Gc**—covering 1-2; 1.4-2.5; 2-4; 4-8; 6.5-11.5; 8-12.4; 8.2-12.4; 10-15.5; 12.4-18; 15-22; 18-26.5 Gc. (Internal leveling 1 to 11 Gc only.)
- **0.5 microsecond rise and fall response to AM**—equivalent to a 2 megacycle band pass.
- **Frequency accuracy $\pm 1\%$ unswept or swept.**
- **Direct coupled external sweep connection**—response dc to 10 kc. Ideal for external frequency programming.

GET COMPLETE DETAILS—Alfred's policy is to publish specifications—not to withhold them. All specifications are guaranteed as stated. For detailed information on Series 620 oscillators, contact your Alfred engineering representative or write to:

ALFRED ELECTRONICS

3176 Porter Drive, Palo Alto, California • Phone: DAvenport 6 6496

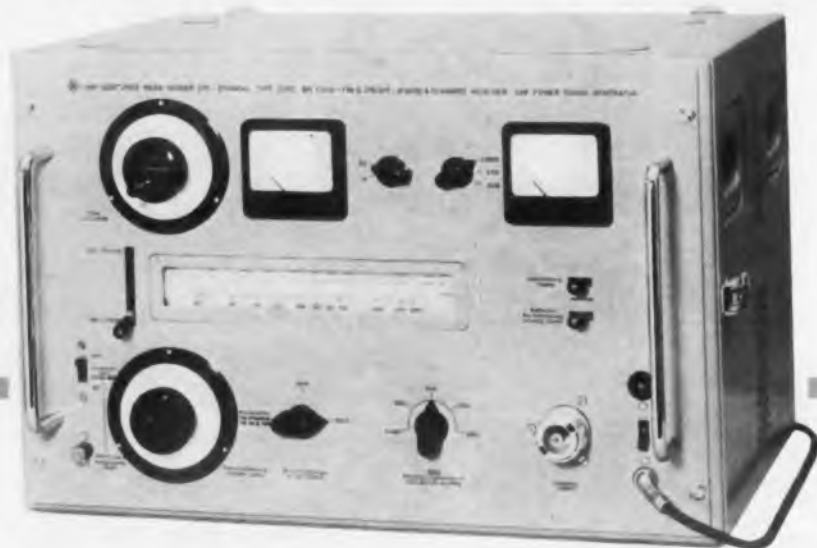


Alfred Model 623BK Microwave Oscillator, featuring built-in leveler, drift less than $\pm 0.02\%$ per hour, adjustable frequency markers and Quick Look Readout.

20-WATT OUTPUT

UHF Power Generator

TYPE SLRD



with INCREASED FREQUENCY RANGE

275 to 3000 mc

Unique Features

- Output more than 20 watts from 500 to 1700 mc, at least 1 watt from 275 to 3000 mc.
- Calibrated output meter plus 80 db attenuator.
- Direct-reading frequency scales.
- Band switch without interchangeable cavities.
- Short-time stability, better than 5×10^{-5} .

AVAILABLE FROM STOCK

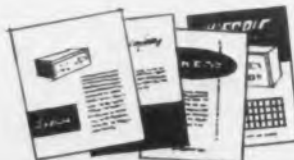


ROHDE & SCHWARZ

ELECTRONIC MEASURING EQUIPMENT FOR THE UNCOMPROMISING
111 Lexington Ave., Passaic, N. J. • PRescott 3-8010

APPLICATIONS

The Type SLRD Generator will accomplish many tasks for which several instruments have been necessary in the past. Its high output power makes it ideal for antenna measurements. It can also be used as a generator for impedance, VSWR and attenuation measurements, and for calibration procedures for which a known power is necessary.



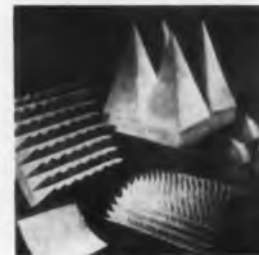
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DESCRIPTIVE LITERATURE



MICROWAVES PRODUCTS

Absorbers

671



For anechoic chambers. The Series VHP absorbers eliminate the need for baffles. Typical reflection level at X-band is down 60 db for normal incidence, down 40 to 50 db for both polarizations at angles 60 to 65 deg from normal, and attenuation through the material over 50 db.

B. F. Goodrich Sponge Products, Dept. ED, Shelton, Conn.

Coaxial Hybrid Rings

575



Operating over a 15% bandwidth from 950 to 6,000 mc, type CJ hybrids have a 0.2-db insertion loss and a 25-db isolation. Devices consist of a circular coaxial line with four branch arms. Input and output impedance is 50 ohms.

Microlab, Dept. ED, 570 W. Mount Pleasant Ave., Livingston, N. J.

P&A: \$120 to \$150; from stock.

Ferrite Switch

384



V-band switch model R-227LS covers a frequency range of 3% at 70 Gc. The 2.5-in. long device has isolation greater than 20 db, insertion loss of 1 db max, and vswr of less than 1.30:1. Switching time is less than 1μsec. The four-port switch is one of a line of ferrite components for K and V bands.

Ferrotec, Inc., Dept. ED, 217 California St., Newton 58, Mass.

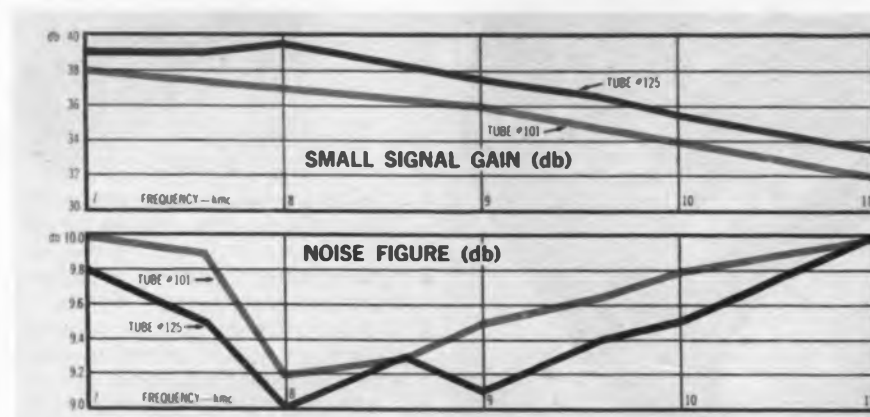
Availability: 45 days.

Low Noise TWT's with PPM Focusing

■ **S, C and X-Band,
Metal-Ceramic, PPM Focused,
Magnetically Shielded,
10 mw Output and 30 db Gain
with Maximum Broadband
Noise Figure of 10 db.**

Typical of MEC's advanced family of metal ceramic low noise traveling-wave tubes is the new M2105. Rugged and reliable, this tube is the result of engineering skill and manufacturing care appropriately combined to form a production tube with truly reproducible characteristics.

Shielding of the tube and its focusing structure, an advantage of the PPM format, eliminates the effect of stray magnetic fields and permits use of tubes in close proximity to magnetic materials or to each other. Elimination of the focusing solenoid and power supply reduces power consumption to less than 3 watts, including heaters, and does away with auxiliary cooling.



REPEATABILITY MEANS RELIABILITY. Notice how closely the small signal gain and noise figure characteristics for the first M2105 (#101) compare with those of the last member in the first lot (#125).

Reliability— A Built-in Feature of MEC Tubes

Metal-ceramic construction gives MEC tubes a headstart on reliability. They are evacuated at higher temperatures (650°C), producing a higher vacuum and cleaner environment for long cathode life.

Inherently rugged, they provide superior performance over environmental extremes. (The M2105 withstands 15 g shock and 15 g vibration between 5 and 2000 cycles with no degradation in performance. Temperature compensation work is now being completed.)

MEC construction features also include a stacked ceramic gun and a helix rigidly supported by three ceramic rods. Critical turn spacing is accurately maintained to assure uniform gain characteristics from tube-to-tube. The tube can be operated in any position without change in characteristics.

TYPICAL LOW NOISE TWT TUBES IN PRODUCTION

PPM FOCUSED TUBES	Frequency Range	Small Signal Gain	Saturation Power	Noise Figure
M2103 Series (Family)	2 - 4 kmc	30 db	10 mw	10 db
	(over 0.5 kmc portion of the band)	30	10	8
	2.3 - 4.4	30	10	10
	2 - 4	30	10	15
M2112 Series	4 - 8	30	10	10
	4.3 - 7.4	30	10	10
	4 - 8	30	10	15
M2105 Series	7 - 11	30	10	10
	7 - 11	30	10	15
	8 - 12.4	30	10	15
M2114	12.4 - 18	30	5	14
SOLENOID FOCUSED TUBES				
M2103 Series	2.0 - 4.0 kmc	30 db	5 mw	8 db
	(over 0.5 kmc portion of the band)	30	5	6
M2107	4.0 - 8.0	30	5	10
M2101 Series	7.0 - 11.0	30	10	9
M2114	12.4 - 18.0	30	5	12



Model M2105 Low Noise TWT weighs 5 pounds and is 12 1/2" long.

Ask for your copy of our new catalog....



MEC's new short form catalog with complete information on our production engineered line of traveling-wave tubes is available now. In addition to low noise types, the catalog covers medium and low power, serrodyne, and special purpose tubes. For your free copy, call your nearest MEC engineering representative or write to us.



**MICROWAVE
ELECTRONICS
CORPORATION**

4081 Transport Street
Palo Alto, California
DAvenport 1-1770

the first complete line of
TRANSISTOR
VOLTMETERS . . .



6 ALL-TRANSISTOR MIL TRVMs

- miniature, panel-mounting, for build-in applications
- power supplies included—no battery replacement or checks needed
- isolated inputs • low power consumption
- compact (as small as 2.85" diameter by 6" deep including terminals)
- lightweight • longer life

Model	Meter	Description	Price
301-1 AC TRVM	3½"	zero-left, from 10MV range	\$250.00
302-1 AC TRVM	3½"	zero-center, phase sensitive, from ± 10MV	275.00
303-1 AC TRVM	2½"	50% less panel area than Model 301-1	275.00
304-1 AC TRVM	2½"	zero-center, phase sensitive, from ± 10MV	300.00
305-1 DC TRVM	3½"	zero-center, no zero-set, ± 100MV range	225.00
305-2 DC TRVM	3½"	zero-left version of 305-1, 250MV range	225.00

Note: Due to heavy demand, present delivery of most models is 6-8 weeks. For complete literature, write to Dept. ED-10

when ordinary instruments are too big or inadequate.

trio

TRIO LABORATORIES, INC.
Plainview, Long Island, New York
Overbrook 1-0400 • TWX HKVL 1166

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CIRCLE 218 ON READER-SERVICE CARD



MICROWAVES

Waveguide Arc Detector

359



Optical sensing device operates in the L-band, 1.12 to 1.7 Gc. The detector, model S61-1, can be used as a protective device on high-power radar systems. Prisms in the waveguide direct light from arcs to photo diodes. Reaction time is 5 to 10 μ sec. System includes waveguide section, arc detector assembly, amplifier, power supply, and test light source.

FXR, Inc., Microwave Div., Dept. ED, 25-26 50th St., Woodside 77, N. Y.
P&A: \$1,600; 60 to 120 days.

Millimeter Waveguide Switches

572



Operation in 7 msec is provided by these waveguide switches. Devices handle frequencies from 18 to 40 Gc. Switching power is 28 v dc, 0.25 amp. Units measure 1.42 x 1.3 x 1.56 in., weigh 2 oz, and meet MIL-E-5272 specs.

Quantatron, Inc., Dept. ED, 2520 Colorado Ave., Santa Monica, Calif.

Coaxial Mechanical Switch

581



Switching speed is 10 msec. Model C115LCS coaxial mechanical switch operates up to 6 Gc. Insertion loss is 1.3 max; isolation is 25 db min, and vswr is 1.3 max. Actuation requires 8 w. E & M Laboratories, Dept. ED, 15145 Califa St., Van Nuys, Calif.

Availability: 30 days.

HOW
ARE
YOUR

CON
NEC

L

ION

S?

If they aren't what they should be, then you ought to be specifying Coaxial Connectors by

Automatic

METAL PRODUCTS CORPORATION
323 Berry St., B'klyn 11, N. Y. • Evergreen 8-6057

CIRCLE 219 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 25, 1961

specify...

ENGLISH ELECTRIC

Wave
Tubes

EEV TYPE	6861	
Frequency Range (Gc/s)	2-7 to 3-5	
Typical conditions at centre frequency	Output Power (mW)	1-0
	Noise Factor (db)	6-5
	Gain (db)	25
	Heater Voltage (V)	375
	Collector Voltage (V)	400
Collector Current (mA)	0-15	
Focusing Field (Gauss)	525	
R. F. Connections	Coaxial Straight	
Base	Int. Oct.	
Recommended Solenoid	N4004	

- ★ LESS TUNING EFFORT
- ★ PLUG-IN REPLACEMENT

WARRANTY
1000 HOURS
and/or TWO YEARS

FOR ADDITIONAL INFORMATION
AND SPECIFICATIONS WRITE
FOR DATA BOOK FB...

SOLE U.S. AGENTS

Calvert
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536 BROADWAY • NEW YORK 12, N. Y.
CAnal 6-7400 Cable • CALVERTRON

CIRCLE 220 ON READER-SERVICE CARD
ELECTRONIC DESIGN • October 25, 1961

MICROWAVES

Ferrite Isolators

448



Cover L to X bands. Broadband coaxial ferrite isolators operate from 1 to 11 Gc using three units instead of four as previously required. Isolation is 10 db, maximum insertion loss is 1 to 1.4 db; vswr is 1.25 max. Frequency bandwidths closely fit the requirements of test equipment.

Sylvania Electric Products Inc., Dept. ED, 730 Third Ave., New York 17, N. Y.

Availability: 4 weeks.

Measuring System

447



Phase and amplitude of the electro-magnetic field over an antenna aperture are measured by model APA-1 measuring system. Operating frequency is 2 to 40 Gc with a sensitivity of -80 dbm at 13 Gc. Phase accuracy and stability are better than ± 5 deg over 40-db dynamic range. Amplitude is measured to ± 0.5 db.

Scientific-Atlanta, Inc., Dept. ED, 2162 Piedmont Road, N. E., Atlanta 9, Ga.

Corner Reflector Antenna

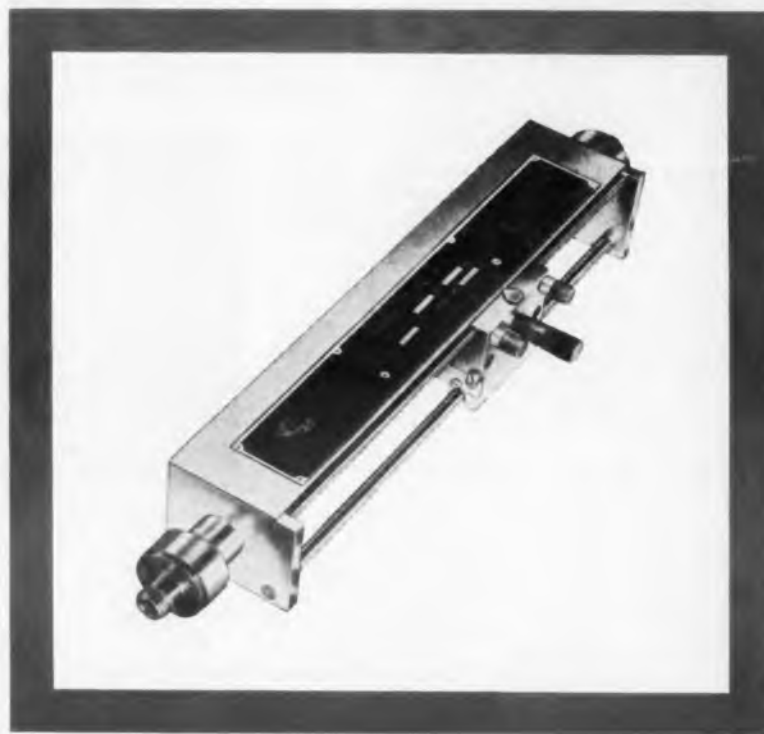
580



Frequency range is 0.4 to 1 Gc. Corner reflector antenna, model RA-105, is said to have a gain 10 db greater than a dipole antenna. Unit meets MIL-STD-449 requirements.

Empire Devices, Inc., Dept. ED, Amsterdam, N. Y.

PRECISE *MicroMatch* COAXIAL TUNERS TUNE TO VSWR 1.000 200-4000 MCS.



MAKES YOUR LOAD A REFLECTIONLESS TERMINATION

DESIGNED FOR USE whenever extremely accurate RF power terminations are required. This laboratory type Coaxial Tuner will tune out discontinuities of 2 to 1 in coaxial transmission line systems or adjust residual VSWR to 1.000 of loads, antennas, etc. May also be used to introduce a mismatch into an otherwise matched system.

M. C. JONES COAXIAL TUNER is designed for extreme ease of operation, with no difficult laboratory techniques involved. Reduces tuning time to a matter of seconds. Graduations on carriage and probe permit resetting whenever reusing the same termination.

SPECIFICATIONS

Impedance	50.0 ohms
Frequency Range	Model 1.51N 200-1000 Mcs. Model 1.52N 500-4000 Mcs.
RF Connectors	E1A 7/8" 50.0 ohm Flange plus adapters to N female connector
Power Rating	100 watts
Range of Correction	VSWR as high as 2 may be reduced to a value of 1.000

FOR MORE INFORMATION ON TUNERS, DIRECTIONAL COUPLERS, R. F. LOADS, Etc., PLEASE WRITE TO:



M. C. JONES ELECTRONICS CO., INC.

185 N. MAIN STREET, BRISTOL, CONN.

SUBSIDIARY OF



CIRCLE 221 ON READER-SERVICE CARD

183



MICROWAVES PRODUCTS

Electronically-Primed Tube 443



Rated at 20 w, model T48V4 broadband plug-in type TR tube has a peak power of 10 kw. Operating frequency is 200 to 600 mc; recovery time is 100 μ sec at 3 db. It is for 7/8-in. coaxial-line use. Tubes for 1-5/8 and 3-1/8-in. lines and for L-band waveguide cavities can also be furnished.

Tucor, Inc., Dept. ED, 59 Danbury Road, Wilton, Conn.
Availability: 60 days.

Standing-Wave Indicator 435

Pen-sized, external standing-wave indicator permits calculation of standing-wave ratios by moving the indicator probe along the transmission line. The indicator is calibrated glass, gas filled, which glows in direct proportion to standing-wave value.

Control Technology Corp., Dept. ED, 6255 Industrial Court, Greendale, Wis.

Direct-Reading Wavemeters 659



Accuracy within $\pm 0.05\%$ is provided by the Data-Dial direct-reading wavemeters. Model 3102, with integral crystal detector output, covers frequencies from 0.9 to 2.1 Gc, while the model 3103 has a range from 2.35 to 3.75 Gc. Compensation for residual nonlinearity is provided in the readout.

General Communications Co., Dept. ED, 677 Beacon St., Boston 15, Mass.



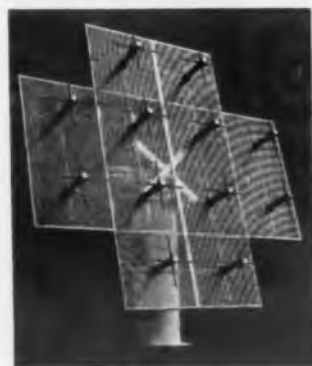
Airborne antennas for communication, beacons and radar augmentation



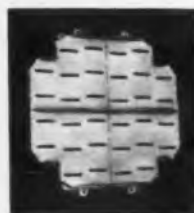
Helix array for telemetry tracking systems

Antennas

Rantec tracking antennas are currently in operation at missile ranges throughout the free world. In addition, Rantec's airborne antennas are in quantity production for major missile and airframe programs.



Dipole array for telemetry tracking systems



Two-dimensional "flat plate" slot array for missile tracking and guidance - monopulse or electronically conical scan applications

3-channel, high isolation, low insertion loss multiplexer



Telemetry Antenna Multiplexers

Rantec multiplexers are used on a large number of missile and space programs, including Mercury, Titan, Polaris, Discoverer, Midas, Nike Zeus, Nike Hercules, Subroc, Samos, X-17, Centaur, etc.



5-channel, high isolation, low insertion loss multiplexer - 225-260 Mc

rantechnology

Over the years, a company normally becomes "pegged" into one or two specific categories of interest. Rantec has variously been described as "those people who make antennas" or "they're in ferrites."

We would like to take this opportunity of outlining Rantec's broad level of design, development and production capability.



S-Band monopulse tracking feed, integral L-band monitoring dipole

Antenna Feed Systems

Rantec feed assemblies are used on parabolic tracking and acquisition antennas ranging in size from 10 to 85 feet.



Circularly polarized simultaneous lobing feed - 890 Mc and 960 Mc



400 Mc remotely controlled rotatable linearly polarized tracking feed - hybrid assembly - drive

X-band single sideband modulator



X-band high speed switch



X-band amplitude modulator



Airborne
4-channel multiplexer



Coax. diplexing filter,
2300 Mc and 2900 Mc



Strip line diplexing filter,
L-band and S-band



X-band
multiplexing filter



Filters

In addition to the units shown,
Rantec has developed many other
filters for special applications. An impressive staff
of engineers is available to handle
complicated "state-of-the-art" problems.

Airborne
3-channel multiplexer



600 Mc-960 Mc, high power,
diplexing filter



Precision microwave phase
measurement system with
automatic frequency swept display



Ks-band monopulse
radar simulator



Special Test Equipment and R-F Sub-Systems

From the number of essential microwave components
available in Rantec's standard line, considerable
flexibility exists for designing special test
equipment, simulators and radar sub-systems.

Radar
sub-system, X-band



High power, broadband,
S-band isolator



20% bandwidth S-band
Y-junction circulator



Ferrite Devices

Wide variety of advanced ferrite devices
is available in frequency ranges
from below L-band through K-band.



C-band high power,
low VSWR circulator.

C-band doppler simulator,
using ferrite single sideband modulator



Band pass filter, 15 watt
CW unpressurized, 2200-2300 Mc



Dual channel C-Band
parametric amplifier system



Parametric Amplifiers

Rantec's line of broadband, low insertion
loss, ferrite devices and filters assure
optimum performance of complete parametric
amplifier systems. A variety of stable,
low noise parametric amplifiers is available.

Stabilized parametric
amplifier power supply



These products are "typical" of Rantec's know-how, but represent only a part of the total picture. Write or call Rantec for complete product information in any of the above categories.

r a n t e c

RANTEC CORPORATION
CALABASAS, CALIFORNIA

MICROWAVES

Ferrite Circulators 458



Operation from -30 to $+70$ C without temperature compensation is provided by these three-port circulators. Devices for 5.4 to 12.7 Gc operation are available. Units have 20 db min isolation, 0.5 db max insertion loss, and 1.2 max vswr. Up to 10 w cw or average power are handled. Typical bandwidth is 0.5 Gc.

Sylvania Electric Products, Inc.,
Dept. ED, 1100 Main St., Buffalo
9, N. Y.

Availability: 30 to 45 days.

Swept Oscillator 437

Sweep rates from 0.01 to 1 sec in four ranges, continuously variable. Model 64 swept oscillator provides for external sweep and dc coupling for frequency programming. Sweep may be low to high or high to low. It is offered in three units covering S, C and X bands.

Sperry Microwave Electronics
Co., Dept. ED, Clearwater, Fla.
P&A: \$2,750; stock.

Glass Seal Connectors 662



Both TNC and TM connector types are available in this series of glass seal connectors. Configurations include bulkhead jacks, panel receptacles, bulkhead receptacles, and adapters.

General RF Fittings, Inc., Dept.
ED, 702 Beacon St., Boston 15,
Mass.

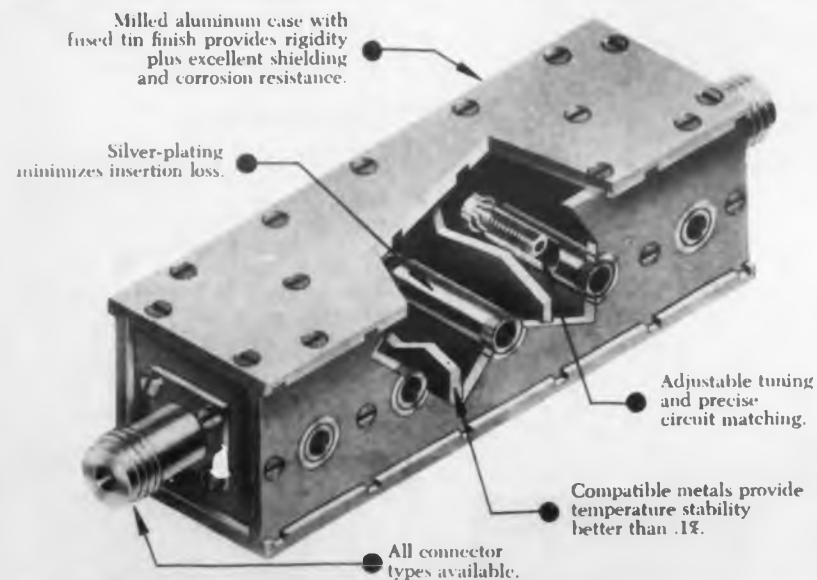
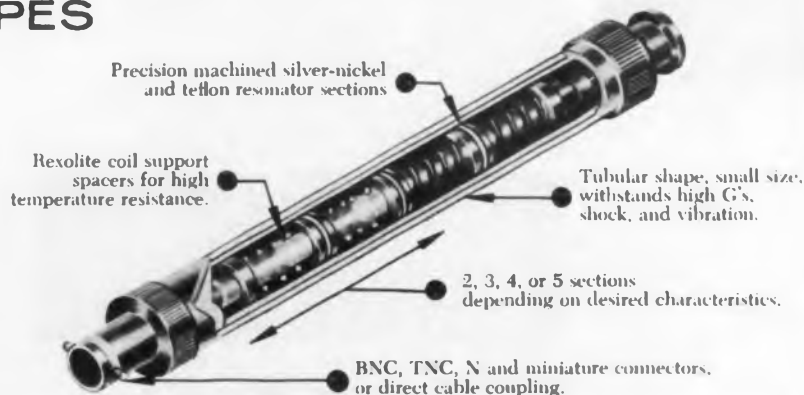
◀ CIRCLE 222 ON READER-SERVICE CARD

Telonic[®] BAND PASS FILTERS

Precision Built — Maximum Ruggedness And Accuracy

MINIATURE TYPES Series TBP

Covering frequencies from 200 mc to 1000 mc, Telonic TBP filters may be selected with pass band widths from 2.5% to 25% of center frequency. Insertion loss is extremely low for a miniature type. Sectional style of construction allows fast design and delivery of units to meet your exact requirements.



CAVITY TYPES Series TCF

Telonic Cavity Band Pass filters are available with center frequencies ranging from 300 mc to 2500 mc. Bandwidth is determined by cavity coupling and may be specified from .25% to 25% of center frequency. TCF filters consist of 1 to 12 capacity-loaded sections enclosed in a slotted aluminum case to provide maximum protection in areas of environmental stress.

Get this same precision and durability in all Telonic filters — LOW PASS Types with cut-off from 200 to 1200 mc every 5 mc — and TUNABLE FILTERS in four models covering 50 to 2500 mc — and custom filters for special military and commercial applications, audio to 2500 mc.

Data File 157 includes complete specifications on all four types as well as the new Telonic Filter Design Guide. The Guide consists of nomographs, curves and charts, so that in a few minutes time, knowing frequency, bandwidth, and slope of the filter needed, the engineer can "design" his own filter — arriving at size, shape, model number and even price. Saves days of valuable communication time.



TELONIC ENGINEERING CORPORATION, LAGUNA BEACH, CALIF.

CIRCLE 223 ON READER-SERVICE CARD



Waveguide Switches 585

High speed waveguide switches, type MA-3470, are available as spst units from 5.4 to 9.8 Gc. Typical switching time is 2 nsec. Driving power required is about 75 mw. Insertion loss is 0.5 db; isolation is 20 db. Units handle up to 4 w cw, 150 w peak. Switches are all-solid-state.

Microwave Associates, Inc., Dept. ED, Burlington, Mass.

Coaxial Attenuators 582



Up to 7 w of microwave power can be attenuated, modulated, or switched by the series SMA coaxial switch-modulator-attenuators. Amplitude modulation over 70% up to 100 mc is possible. Attenuation range is 20 db. Model N400 operates from 7 to 12 Gc, and model N401 from 5.5 to 10 Gc. Typical insertion loss is 1.5 db. Switching time is 10 nsec.

Somerset Radiation Laboratory, Inc., Dept. ED, 192 Central Ave., Stirling, N. J.

P&A: \$135 and \$195 for N400 and N401; from stock.

Lens Antenna 450

X-band lens antenna model ALXN-1A radiates a circular polarization with a hemispherical radiation coverage. Two units installed on any airborne vehicle provide complete tracking coverage for yaw, pitch or roll. The ellipticity ratio is better than ± 1.5 db over a hemisphere; the signal is constant to ± 2.4 db over hemispherical coverage.

Canoga Electronics Corp., Dept. ED, P. O. Box 550, Van Nuys, Calif.

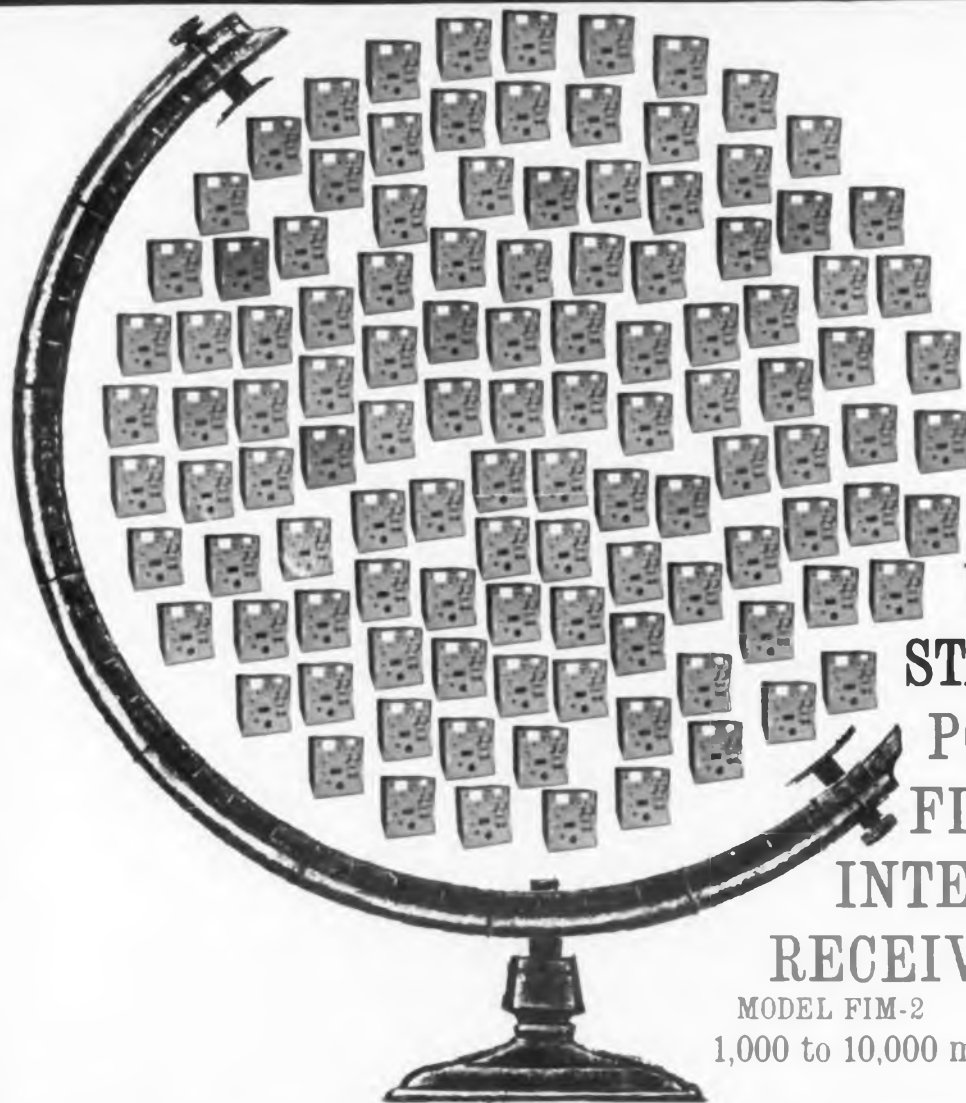
Parametric Amplifiers 453

S-band, single-knob tunable parametric amplifiers have a stable 20-db gain at 15 mc or up to 30 db gain with the same bandwidth product. With one knob it can be tuned over 200 mc of the 500-mc range with gain at band edges of 18 to 20 db; with two knobs it can be tuned over 500 mc. Noise is 3 db max.

Sylvania Electric Products Inc., Dept. ED, P. O. Box 997, Mountain View, Calif.

P&A: \$10,000; 90 days.

CIRCLE 224 ON READER-SERVICE CARD >



A
WORLD
WIDE
STANDARD
POLARAD
FIELD
INTENSITY
RECEIVERS

MODEL FIM-2
1,000 to 10,000 mc

Hundreds of Polarad Calibrated Field Intensity Receivers are in use today throughout the world. **Why?**

...because the FIM series, in production since 1956, offers ± 1 db accuracy because of its self-contained signal generator.

...because the Model FIM-2 is the only single unit microwave system capable of measuring rf interference and susceptibility. It has been designed for measurements in accordance with all military RFI specifications.

...because the FIM-2 is an integration of two instruments in one, it is always available in your laboratory as either a sensitive microwave receiver or an accurate signal generator.

...because UNIDIAL® tunes both the receiver and signal generator simultaneously; and, the front-panel meter indicates average, peak, slide-back peak or quasi-peak value of rf signals, the Polarad of FIM-2 is the most convenient instrument in use today.

MODEL FIM-2 FEATURES

FREQUENCY RANGE: 1 gc to 10 gc in 4 tuning units; 2 more tuning units under development will extend frequency to 20 gc.
FREQUENCY DIAL ACCURACY: $\pm 1\%$
SENSITIVITY: 20 microvolts
MAXIMUM RF INPUT: 3 volts
IMPULSE BANDWIDTH: 5 mc
IMAGE AND SPURIOUS RESPONSE REJECTION: 60 db
OUTPUTS: Video, audio, recorder
SIGNAL GENERATOR OUTPUT POWER: 0.223 volts to 5 microvolts (for susceptibility measurements)
SIGNAL ATTENUATION: 0 to 80 db in 1 db steps

**FREE LIFETIME
SERVICE**

POLARAD
ELECTRONICS CORPORATION
43-20 34th Street, Long Island City 1, N. Y.

Representatives in Principal Cities (See your yellow pages)

MAIL THIS CARD FOR SPECIFICATIONS

1 2 3 4 5 6 7 8 9 10 11-12

POLARAD ELECTRONICS CORPORATION:



Please send me information and specifications on:

- Model FIM-2 Calibrated Microwave Field Intensity Receiver
 Model R Microwave Receiver (see reverse side of page)
 Notes on Microwave Measurements

My application is _____

Name _____

Title _____ Mail Station _____ Dept. _____

Company _____

Address _____

City _____ Zone _____ State _____

84,200 mc



is now
the top
frequency
that can
be detected
by the

POLARAD MODEL R MICROWAVE RECEIVER 400 to 84,200 mc

Now the *most complete* Microwave Receiver has the *highest* frequency coverage (if we are permitted the redundant superlative).

As microwave work advances into higher and higher frequencies, the Model R keeps pace. Now Polarad has added frequency coverage from 45.3 to 84.2 gc. It's done, by the way, with a unique set of mixers incorporating integral crystals; and a local oscillator. Polarad's development engineers have designed the Model R Receiver with the most capabilities that can be put



in a single box. The Model R is an AM-FM receiver; a pulse receiver; and a sensitive microwave power meter all rolled into one. It has a direct reading frequency dial, UNIDIAL® tuning control, AGC and AFC, as well as audio, video, recorder and trigger outputs. Hundreds and hundreds of Model R users know Polarad will continue to keep their basic microwave test receivers as advanced as their own research. Have you checked the many jobs a Model R can do for you? Ask your local Polarad representative.

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BUSINESS REPLY CARD

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POLARAD ELECTRONICS CORP
43-20 34th St., Long Island City 1, N. Y.

SPECIFICATIONS

FREQUENCY RANGE: 400 to 84,200 mc covered in 9 plug-in tuning units. A broadband tuning unit covering 2000 to 75,000 mc is available for antenna pattern measurements.
SENSITIVITY: To -85 dbm depending upon frequency range.
FREQUENCY DIAL ACCURACY: ±1%.
RANGE OF LINEARITY: 60 db with AGC.
I-F BANDWIDTH: 3 mc.
VIDEO BANDWIDTH: 2 mc.

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POLARAD

ELECTRONICS CORPORATION

43-20 34th Street, Long Island City 1, N. Y.

Representatives in Principal Cities (See your yellow pages)

©PEC

MICROWAVES

Shielded Ferrite Isolators 457



For use in compact systems, these ferrite isolators are magnetically shielded. Devices are custom designed. They operate from 1 to 11 Gc, with typical bandwidths of 1 or 2 Gc. Isolation-to-insertion-loss ratio is 10 to 1, and vswr is 1.3 max.

Sylvania Electric Products, Inc., Dept. ED, 1100 Main St., Buffalo 9, N. Y.

Availability: custom designed, four weeks.

Gold-Plated Thermistors 438

Precision gold-plated thermistors series 111 are housed in crystal-diode type cartridges and fit all detector mounts and holders designed for types 1N21 and 1N23.

Microwave Semiconductor & Instruments Inc., Dept. ED, 116-06 Myrtle Ave., Richmond Hill 18, N. Y.

Price: \$10 up.

Pulse Magnetron 653



For airborne radar systems, the model BLM-071 pulse magnetron is rated at 100 kw peak power for a duty cycle of 0.001 max. The device provides a fixed frequency between 15.9 and 16.1 Gc. Input and output terminals may be pressurized to 30 psia. Pulse duration is 0.06 to 1.2 μ sec; Efficiency is about 30%. Unit measures 6-3/4 x 5-7/8 x 4 in. and weighs 8 lb.

Bomac Laboratories, Inc., Dept. ED, Salem Road, Beverly, Mass.

◀ CIRCLE 224 ON READER-SERVICE CARD

Advertisement

Microminiature Coaxial Connectors



Microdot's microminiature connectors—including the world's smallest 50-ohm coax connectors—are available in over one million combinations. Plugs are available in straight or angle screw types and slide-on versions. Receptacles include printed circuit and bulk-head feed-thru types. Only highest quality materials are used. Conductors are of silver-plated copperweld or cadmium bronze, center contacts are of gold-plated coin silver. Housings are silver-plated brass to assure minimum electrolysis with aluminum panels. "Teflon," "Kel-F," polyethylene, and neoprene are used as dielectrics, jackets, bend relief caps, and pin protectors.

Microdot Inc., 220 Pasadena Avenue, South Pasadena, California

Circle 751 on Reader Service Card

Crimp-type Connectors

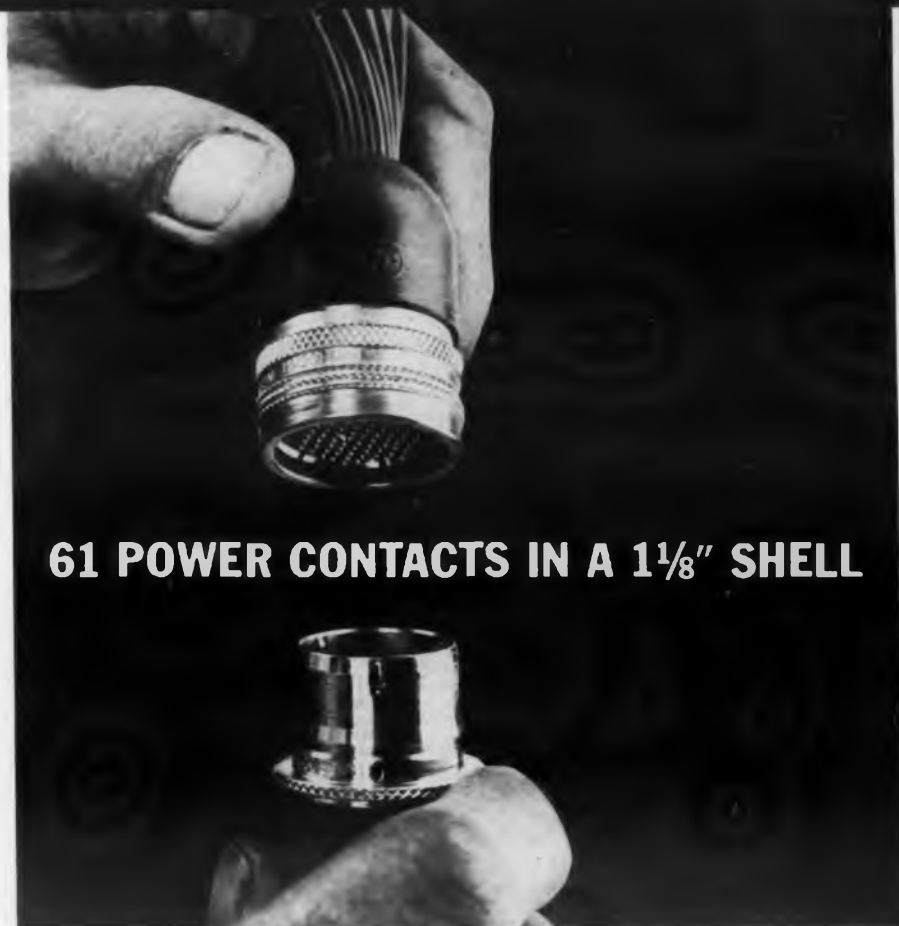


These solderless, coaxial connectors are available in a variety of mounting configurations, including snap-locking versions. Male and female connectors may be mounted interchangeably. Mated length is 1 $\frac{3}{16}$ ". Working voltages: 1,000 V. maximum, at sea level; 500 V. maximum, at 60,000 feet. VSWR; less than 1.2 up to 2,000 mc. Life; 5,000 matings, minimum, without electrical deterioration. Tensile strengths of the crimps exceed the breaking strength of the cable. Hard gold plated Beryllium copper and TFE plastic are extensively used to assure optimum reliability.

Microdot Inc., 220 Pasadena Avenue, South Pasadena, California

Circle 752 on Reader Service Card

Circle 753 on Reader Service Card ▶



61 POWER CONTACTS IN A 1 $\frac{1}{8}$ " SHELL

NEW MICRODOT MICROMINIATURE MULTI-PIN CONNECTORS

These rugged, reliable "43" Series Microdot Microminiature Multi-pins are only $\frac{1}{4}$ " the size, $\frac{1}{2}$ the weight of previously available miniature multi-contact connectors. Yet performance equals or exceeds MIL-C-26482 and applicable paragraphs of MIL-C-26500. Ready now for advanced applications, these connectors pack up to 61 power contacts—or 19 coaxial contacts—or a combination of both—into a shell the diameter of a quarter.

Improved three-keyway design of the "43" Series prevents pin engagement with insert face, permits 14 alternate positions for each insert layout by "clocking" shell keyways rather than inserts. Inserts come in a variety of straight power, straight coaxial, and combination power-coaxial layouts. The Multi-pin design accommodates a mix of male and female contacts in either plug or receptacle without changing inserts, allowing hot or cold leads to either side. Closed-entry, crimp or solder contacts are gold-plated pure coin silver to resist wear, maximize ampere ratings and conductivity, minimize temperature rise and resistance. Positive, push-pull, quick-disconnect coupling eliminates need for safety wire. Operating force is always in direction of plug travel.

With all parts interchangeable, the "43" Series Microdot Microminiature Multi-pins are available now in disassembled kit form (for bench assembly or on-the-spot field circuit design), or factory assembled (as basic connectors) or as complete assemblies (with Microdot cable). Write today for illustrated, detailed Bulletin MP-0.



Microdot Multi-pin Connector Kit

SIZE DESIGNATION	PLUG O.D.	NO OF COAXIAL CONTACTS	NO OF POWER CONTACTS
A	$\frac{1}{8}$ "	up to 10	up to 28
B	$\frac{3}{16}$ "	up to 12	up to 31
C	$\frac{1}{4}$ "	up to 16	up to 41

MICRODOT INC.

220 Pasadena Avenue, South Pasadena, Calif

MURray 2 3351 SYcamore 9 9171





NEW COAXIAL DIRECTIONAL COUPLERS

from 0.3 to 11 kmc; high directivity; coupling variation 0.2 to 0.4 DB maximum; main line VSWR 1.10 to 1.25 maximum; coupling 10 to 30 DB; forward power 50 watts to 1 kw, 10 kw peak. Send for data on new PRD 430 Series!

PRD ELECTRONICS, INC.: 202 Tillary St., Bklyn. 1, N. Y., ULster 2-6800; 1608 Centinela Ave., Inglewood, Calif., ORegon 8-9048. A Subsidiary of Harris-Intertype Corp.



CIRCLE 226 ON READER-SERVICE CARD



BROAD BAND CAVITY WAVEMETERS

—gas filled for sustained accuracy

Accuracy is so high these instruments may be used as secondary standards. Units are unaffected by changes in humidity, altitude or barometric pressure. Only 12 sizes serve from 2.6 KMC to 140 KMC. You save budget money on the number of sizes needed. Literature on request.



DE MORNAY-BONARDI

780 SOUTH ARROYO PARKWAY • PASADENA, CALIF.

CIRCLE 227 ON READER-SERVICE CARD



Antenna Mount

444



Servo controlled, model 28 antenna mount is for use in telemetry reception and tracking of aircraft missiles and satellites in shipboard and ground applications. Features include gyro stabilization, solid-state ac servo system and automatic-beam crossover switching from 3 to 9 db. Azimuth rotation is 710 deg.

TEMEC, Inc., Dept. ED, 7833 Haskell Ave., Van Nuys, Calif.

Ferrite Isolators

451

For missile and aircraft use, lightweight ferrite isolators can be furnished in any frequency from 4 to 11 Gc. They are designed for severe environments. A typical unit, an X-band isolator, has an isolation to insertion-loss ratio of 20, 10% bandwidth, weighs 4 oz and is 2-11/16 in. long.

Sylvania Electric Products Inc., Dept. ED, 730 Third Ave., New York 17, N. Y.

Antennas for 6 to 8.5 Gc

469

Diameters of 4, 6, 8, and 10 ft are available on these antennas. Operating frequencies range from 5,925 to 8,500 mc. Feed is flange-mounted, permitting continuous polarity rotation through 360 deg. Feed may be inserted in either front or rear of antenna.

Technical Appliance Corp., Dept. ED, Sherburne, N. Y.

Coaxial Switches

352



Ten-nsec switching speeds are provided by these solid-state coaxial switches. The series, designated No. MA-3464, have spst or multiple-pole, multiple-throw configurations and operate from 150 to 4,700 mc. Driving power is

more usable sensitivity 10 mc to 44,000 mc IN ONE TUNING HEAD



PANORAMIC'S SPA-4a SPECTRUM ANALYZER

Band	RF SENSITIVITY*
1. 10 - 420 MC	-100 to -110 dbm
2. 350 - 1000 MC	-95 to -105 dbm
3. 910 - 2200 MC	-100 to -110 dbm
4. 1980 - 4500 MC	-90 to -100 dbm
5. 4.5 - 10.88 KMC	-90 to -100 dbm
6. 10.88 - 18.0 KMC	-85 to -100 dbm
7. 18.0 - 26.4 KMC	-70 to -90 dbm
8. 26.4 - 44.0 KMC	-60 to -85 dbm

*Measured when signal and noise equal 2X noise.

Using one tuning head which contains one triode and two Klystron oscillators. Model SPA-4a offers more exclusive advantages for applications demanding extreme sensitivity, stability, versatility, accuracy.

- Exceptionally low distortion. • Highly resolved & calibrated analysis. • Three precisely calibrated amplitude scales—40 db log, 20 db linear, 10 db power. • Two independent frequency dispersion ranges—continuously adjustable—0-70 mc and 0-5 mc. Negligible internal frequency modulation permits narrow band analysis of FM problems. • Variable I. F. bandwidth from 1 kc to 80 kc. • Push-button frequency selector. • Synchronoscope output with 40 db gain. • Accurate measurement of small frequency differences. A self-contained marker oscillator, modulated by a calibrated external generator, provides accurate differential marker sign as close as 10 kc.

Tremendous flexibility and many unique advances of Panoramic's compact SPA-4a make it unsurpassed for visually analyzing FM, AM and pulsed signal systems; instabilities of oscillators; noise spectra; detection of parasitics; studies of harmonic outputs; radar systems and other signal sources.

Write, wire or phone today for detailed SPA-4a bulletin.



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CIRCLE 228 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 25, 1961

143290

Core
Driver

Pacific Semiconductors, Inc.
A SUBSIDIARY OF THOMPSON RAMO WOOLDRIDGE INC.
12955 CHADRON AVE., HAWTHORNE, CALIFORNIA



143291

Combination of electrical characteristics never before possible!
500mA @ .9V • RECOVERY 2 μsec • 7 pf CAP @ .9V
This remarkable silicon diode exhibits a forward spike of only 1.3V when subjected to a 500mA rise time pulse.
Ask for detailed specifications!

CIRCLE 229 ON READER-SERVICE CARD
ELECTRONIC DESIGN • October 25, 1961

MICROWAVES

10 to 100 mw. Insertion loss is 1 db max closed and 35 db min open. Eleven switches in the series handle 150-w peak power, and two operate at 10 kw at 1,100 mc.

Microwave Associates, Inc., Dept. ED, Burlington, Mass.

Clamp-On Probe 351

Rf interference in power leads is measured without direct connection to leads. Model RA-105 probe clamps onto the leads. Unit has flat response, and has the same transfer impedance as the firm's noise and field-intensity meters.

Empire Devices, Inc., Dept. ED, Amsterdam, N. Y.

Variable Attenuators 673



Precision variable attenuators offer interference-free operation even at low rf levels in high exterior fields. Attenuation range is 35 db min, calibrated at 5-db intervals at a single frequency. Insertion loss is 0.3 db max. Models 611, calibrated, and 613, uncalibrated, operate from 8.2 to 12.4 Gc; model 711, calibrated, operates from 12.4 to 18 Gc.

Waveline, Inc., Dept. ED, Caldwell, N. J.

Broadband RF Switch 445



Range is 200 to 400 mc. Model RFS-LU broadband rf switch has 0.2-μsec switching time. Insertion loss is 1 db max, closed; 60 db, open. Impedance is 50 ohms. Control pulse requirements are 6 v, closed; 400 ma, open. Applications include in-gating receivers at rf to remove high-level, pulse-type interference.

RMS Engineering, Inc., Dept. ED, P. O. Box 6354, Atlanta 8, Ga.

P&A: \$60; 2 to 4 weeks.

TRANSISTOR HEAT SINK COOLING UNIT



0.025° C/WATT

This Cooling Unit will dissipate 1,000 watts and keep the heat sink temperature at 25° C above ambient. In addition to the unit illustrated, a rack mounted cooling unit is available to mount at the bottom of a standard equipment rack and requires 10½" of panel height. Ambient air is drawn in through the front and hot air is exhausted from the rear. Flexible tubing carries the cooling liquid to the heat sink within the rack.

COOLING UNITS



These packaged cooling units are completely self-contained and consist of a liquid circulator, a liquid to air heat exchanger, a reservoir, and flow and temperature interlocks as required. They transfer the heat from congested locations, where high temperature is detrimental to the operation of other components, to remotely located locations where the heat can be dumped conveniently and where it will not affect the operation of other equipment.

MODEL CU-20,000

(illustrated) dissipates 20,000 watts and sells for \$700.00.

MODEL	CAPACITY	PRICE
CU-1,500	1,500 watts	\$ 300.00
CU-2,500	2,500 watts	350.00
CU-5,000	5,000 watts	395.00
CU-10,000	10,000 watts	495.00
CU-20,000	20,000 watts	700.00
CU-50,000	50,000 watts	1,050.00
CU-100,000	100,000 watts	2,000.00

**WRITE TODAY
FOR COMPLETE
INFORMATION!**

Electro IMPULSE LABORATORY INC.

208 RIVER STREET • RED BANK, NEW JERSEY

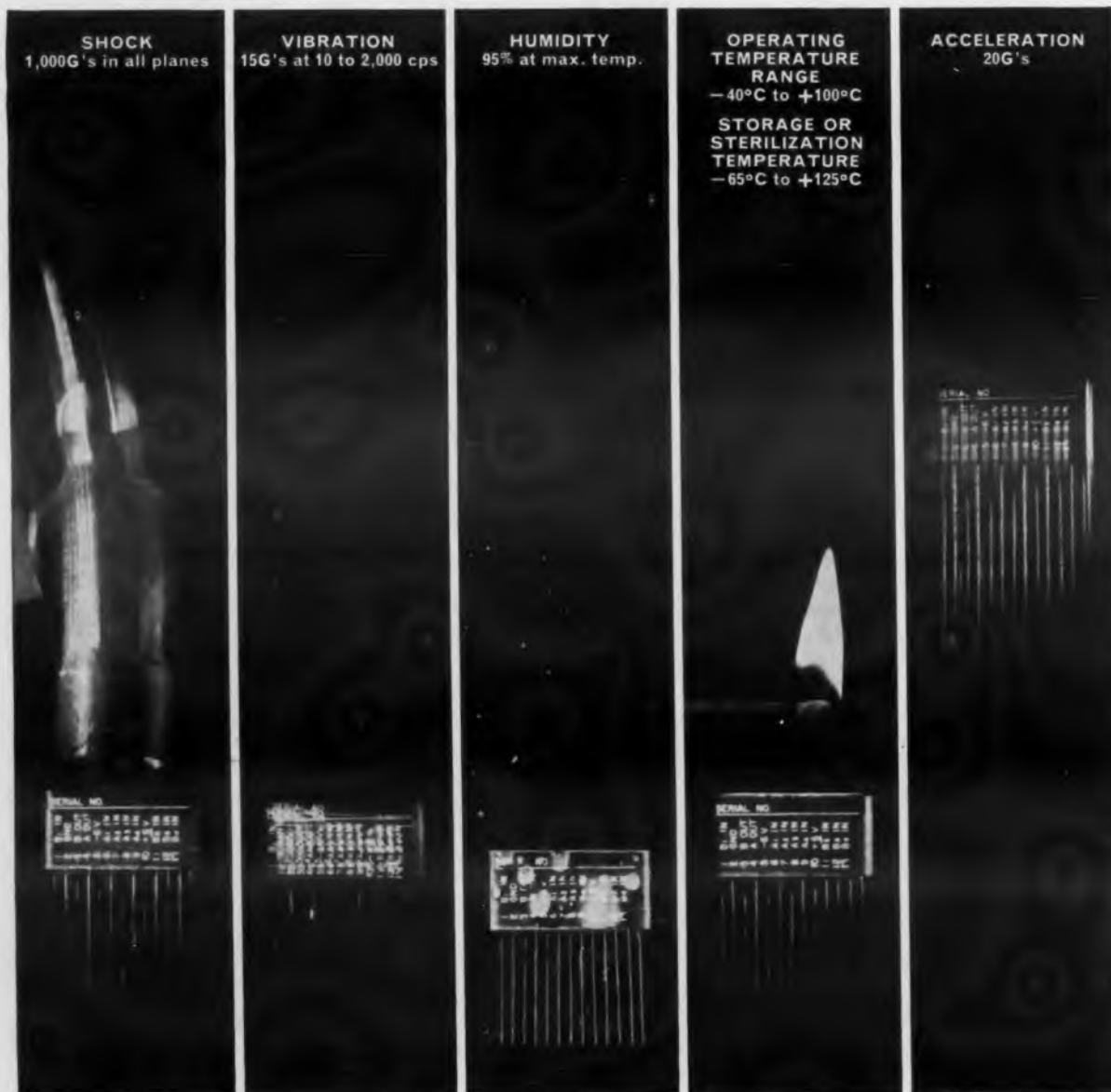
Phone: SHadyside 1-0404

CIRCLE 230 ON READER-SERVICE CARD

LOW POWER SILICON DIGITAL MODULES

ENVIRONMENTALLY PROVED . . . AVAILABLE NOW!

Delco Radio's new silicon digital modules operate on less than 4 mw. of power per logic stage. They are rugged enough to withstand extreme environmental conditions and are small and lightweight. Encapsulated in light foamy epoxy, each module weighs less than 12 grams and occupies less than one-half cubic inch. The basic set of modules includes a bistable multivibrator, a diode NOR gate, a power driver, a monostable multivibrator and an astable multivibrator. From these basic units larger computer subassemblies can be assembled, such as shift registers, adders, binary counters, decimal counters and timing devices. A range of applications—from small scale switching circuits to large computers can be satisfied with these modules. Environmentally proved to:



Data sheets are available. Just write or call our Military Sales Department.

Physicists and electronics engineers: Join Delco Radio's search for new and better products through Solid State Physics.

PIONEERING ELECTRONIC PRODUCTS THROUGH SOLID STATE PHYSICS

Division of General Motors • Kokomo, Indiana

CIRCLE 231 ON READER-SERVICE CARD

DELCO
RADIO
RELIABILITY

NEW LITERATURE

Potentiometers 260

Four-page brochure No. 7 on adjustment pots summarizes key information on 20 basic models. Includes resistances, terminal types, power ratings, operating temperatures, dimensions and prices. Cutaway drawings of 4 models illustrates internal construction and outstanding design features. Bourns, Inc., Trimpot Div., 6135 Magnolia Ave., Riverside, Calif.

Connector Plugs 261

Four-page illustrated folder features the KPT/KSP series Cannon plugs, designed to meet the requirements of MIL-C-26482. Contains all pertinent information in quick reference and tabular form to aid buyers and engineers in the selection of these plugs. Handy section on ordering nomenclature is included. Schweber Electronics, 60 Herricks Road, Mineola, L. I., N. Y.

Insulation Papers 262

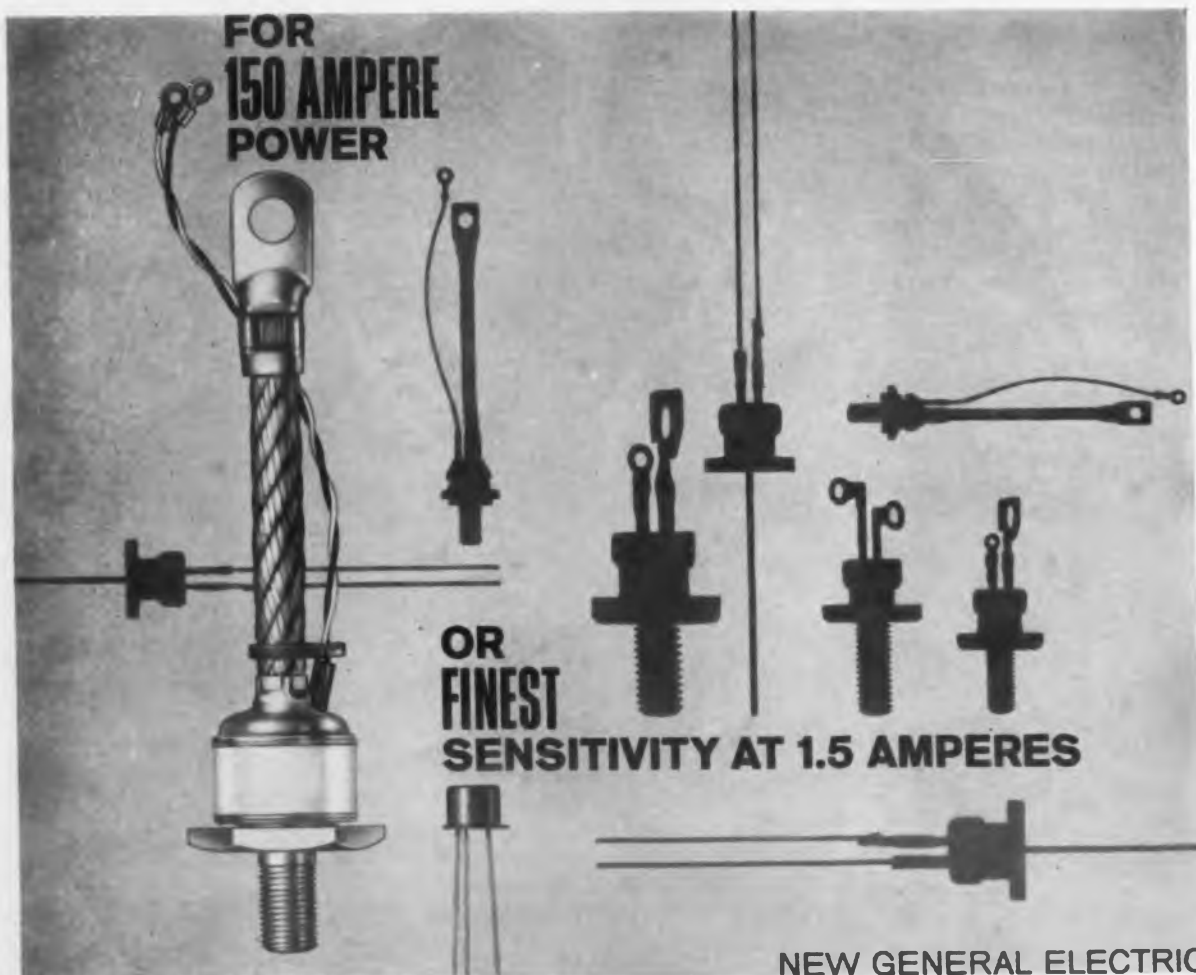
Specification sheets and a listing of physical and chemical test methods for kraft and glassine electrical insulating papers show caliper, density, conducting articles, moisture content, dielectric strength, ash content, pH water extract, basic weight and coverage. Physical and chemical test methods sheet lists formulas used in calculating specs. Minnesota Mining and Manufacturing Co., 900 Bush Ave., Saint Paul 6, Minn.

Silicone Rubber 263

Eight-page illustrated technical bulletin S-4 describes various silicone rubber compounds for use as wire and cable insulation. Typical properties of silicone rubber are shown in tables. Illustrations also show typical silicone rubber and wire and cable constructions and applications. General Electric Co., Silicone Products Dept., Waterford, N. Y.

X-Ray Analytical Instruments 264

Twenty-eight page catalog titled "X-ray Analytical Instrumentation" contains specifications and operating data on seven key instruments for research and production control. Text illustrates applications in the fields of atomic energy, chemicals, electronics, medicine, metallurgy, mining, petroleum, plastics, rubber and railroads. Philips Electronic Instruments, 750 S. Fulton Ave., Mount Vernon, N. Y.



NEW GENERAL ELECTRIC Silicon Controlled Rectifiers

More power capability than any SCR on the market today... that's the new 150 ampere 6RW56. And another new type with gate sensitivity so high you can turn it on with a photocell... that's the 1.5 ampere C5 controlled rectifier. They're the two newest in the General Electric SCR line, and they provide you with important design advantages!

For extra high power consider this: Type 6RW56 offers 500 volts PRV; 3000 ampere 1 cycle surge current. Truly the highest powered SCR you can get in production quantities... and it's available from stock!

For lowest power switching and control applications consider this: Type C5 requires typically 50 microamperes gate current to fire. All-diffused and all-welded in a TO-5 package, it blocks up to 400 volts repetitively, can take a surge of 18 amperes. And we guarantee holding current at a maximum of 2 ma at room temperature!

Like every General Electric low, medium and high current SCR, they're thoroughly characterized and tested... tightly spec'd... and the C5 gives you transient PRV ratings.

For complete technical information, call your Semiconductor Products District Sales Manager. Or write Rectifier Components Department, Section 23J37, General Electric Company, Auburn, New York. In Canada: Canadian General Electric, 189 Dufferin Street, Toronto, Ont. Export: International General Electric, 150 E. 42nd Street, New York 17, New York.

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C5 RATINGS AND CHARACTERISTICS

	V _{BO} and PRV	Transient PRV	Max. Peak forward blocking voltage	500 volts
CSU	25	40	Max. RMS forward current rating	1.6 amperes
CSF	50	75	Peak 1-cycle surge current rating	18 amperes
CSA	100	150	Peak gate power rating	0.1 watt
CSG	150	225	Peak gate current rating	0.1 ampere
CSB	200	300	Storage temperature	-65°C to 150°C
CSH	250	350	Max. Gate current to fire @ 25°C	200 µAdc
CSJ	300	400	Max. Gate voltage to fire @ 25°C	0.8 Vdc
CSK	350	450	Forward voltage drop @ 4 amps	2.2 volts (max.)
CSL	400	500	Turn on time	1.4 µsec. (typ.)
			Turn off time	20 µsec. (typ.)
			Max. leakage current @ 25°C	10 µa

6RW56 RATINGS AND CHARACTERISTICS

	V _{BO} and PRV	Max. RMS forward current rating	235A
6RW56AC	50	Peak 1-cycle surge current rating	3000 amperes
6RW56BC	100	Peak gate power rating	16 watts
6RW56CC	150	Peak gate current rating	4.0 amperes
6RW56DC	200	Storage and Operating Temperature	-40°C to +125°C
6RW56EC	250	Max. Gate current to fire @ 25°C	100 ma
6RW56FC	300	Max. Gate voltage to fire @ 25°C	2.1 volts
6RW56GC	350	Turn on time	0.5 - 4.5 µsec. (typ.)
6RW56HC	400	Turn off time	15 - 25 µsec. (typ.)
6RW56KC	500		

GENERAL ELECTRIC

CIRCLE 23J ON READER-SERVICE CARD

NEW LITERATURE

Capacitors

271

Eighty-six page catalog in nine sections includes a facilities brochure and eight tabulated divisions covering capacitor construction utilizing metalized paper, metalized Mylar, Mylar and foil, Kraft-Mylar interleaved, and high-stability capacitors. Details electrical and environmental data and application notes, plus sets of performance curves. Electron Products, 430 N. Halstead St., Pasadena, Calif.

Test Report On Relays

272

Environmental test report on relays is actually a compilation of test reports gathered from the company's Quality Assurance Program, which is conducted on a scheduled basis. Tests were conducted using instrumentation and test equipment that meets standards and tolerances set forth in the company's System of Procedure Specs. Control Dynamics Corp., 7420 Fulton Ave., North Hollywood, Calif.

Expansion Assembly Methods

273

Twelve-page booklet contains a full case history on expansion fitting, together with photos illustrating expansion fitting bearing raceways. Includes tables of expansion coefficients and nomograms for calculating rates of thermal expansion and determining temperatures required. Cincinnati Sub-Zero Products, 3932 Reading Road, Cincinnati 29, Ohio.

Industrial Cathode Ray Tubes

274

Revised and condensed catalog arranged in easy-to-read reference chart style provides data on the principal characteristics and ratings, as well as physical dimensions, for the complete line of industrial and government cathode ray tubes. Continental Electronics Corp. of California, Industrial and Government Div., 2724 Leonis Blvd., Los Angeles 58, Calif.

Control Cables

275

Thirty-page catalog gives complete data about multiconductor cables used in control circuits. First section describes extra flexible Bronco 66 certified 600-v line ranging from 5 to 60 conductors in sizes 18 through 10 awg. Shielded control cables for communication and telemetering circuits are covered, as are station control cables. Western Insulated Wire Co., Los Angeles, Calif.

ELECTRONIC DESIGN • October 25, 1961

Crystal Filter Technology 276

Illustrated 12-page brochure called "What Every Engineer Should Know About Crystal Filters At A Cocktail Party", relates crystal filter technology to typical cocktail party subjects. Includes log-log frequency vs bandwidth chart indicating the theoretical and practical limits of crystal filter design. Itek Electro-Products Co., 75 Cambridge Parkway, Cambridge 42, Mass.

Potcore and Toroidal Coils 277

Eight-page catalog includes information on typical Q vs frequency response curves, outline drawings, and specifications such as applicable MIL specs. Descriptions of a number of typical components are included, such as A-size and B-size potcore coils, and cherrio and wedding-ring toroidal inductors and transformers. Bulova Watch Co., Electronics Div., 40-01 61st St., Woodside 77, N. Y.

Semiconductor Product Guide 278

Ten-page catalog 60S16R2 includes data on the full line of silicon and germanium transistors for military, industrial, consumer and computer applications, silicon rectifiers, tunnel diodes, and photocells. Classification guide on pages 2 and 3 offers a quick device-finder, indexed by application, to save time. Radio Corp. of America, Semiconductor & Materials Div., Somerville, N. J.

Infrared Detectors 279

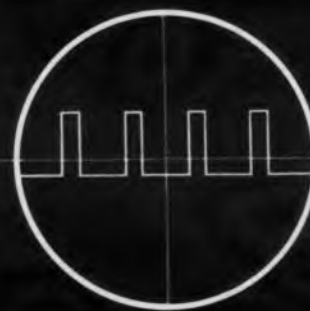
A state of the art report on the capabilities of ambient temperature indium antimonide photoconductive infrared detectors is available. The paper describes characteristic changes with ambient of parameters of single crystal indium antimonide together with information theory based on applications of 1- μ sec time constant detectors. Block Associates, Inc., 385 Putnam Ave., Cambridge, Mass.

Power Supplies 280

Precision resistance welding power supplies featuring solid-state design, dual watt-second ranges and optional voltage regulation are described in Catalog 101. A table of specifications is included along with a cross-reference of power supplies, welding heads and hand pieces. Unitek Corp., Weldmatic Div., 950 Royal Oaks Drive, Monrovia, Calif.

ALL-NEW... TRUE RMS VOLTMETER

now . . . measure
true RMS value
of virtually all
waveforms



FLUKE



MODEL 910A

ACCURACY 1%
BAND WIDTH:
(10 cps - 7 mc)

Accurate measurement of complex waves is now possible over a wide range of frequency with the NEW *if* MODEL 910A.

For the *first time* one instrument provides 1% midband accuracy, 10 cps to 7mc bandwidth, plus 100 μ v sensitivity. For added versatility an amplifier output is provided for simultaneous oscilloscope or recorder monitoring.

Model 910A employs a thermocouple located in the feedback loop of a sensitive DC amplifier to measure the actual heating effect of the input waveform. This circuit arrangement is the key to the rapid response and high calibration accuracy of the Model 910A and also prevents any error in reading due to ambient temperature variation. Isolation of the thermocouple from the input terminals by a high gain, ultra stable AC amplifier provides high input impedance and completely protects the thermocouple from burnout under any condition of overload.

Model 910A is ideal for measuring AC currents in non linear devices, total harmonic content of distorted waveforms, noise, average power of pulse trains, and other measurements that involve waveforms which are not necessarily pure sinusoids.

Prices and data subject to change without notice.

A more complete description
will be sent to you upon request.

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JOHN FLUKE MFG. CO., INC.
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Partial Specifications—*if* MODEL 910A

Voltage Range:	1 MV to 300V (full scale readings)
Decibel Range:	-72 to +52 dbm
Frequency Response:	10 cps to 7Mc
Accuracy:	\pm 1% of full scale 50 cps to 800 KC \pm 2% of full scale 20 cps to 2Mc \pm 3% of full scale 20 cps to 3.5 Mc \pm 5% of full scale 10 cps to 7 Mc
Input Impedance:	10 megohms shunted by 30 pf for 0.3 volt range and below. 10 megohms shunted by 15 pf for 1.0 volt range and above.
Crest Factor:	3 at full scale, proportionately higher for readings less than full scale.
Price:	Cabinet Model—\$545.00 Rack Model—\$565.00 Prices f.o.b. factory.

IDEAS FOR DESIGN

\$50 "Most Valuable of Issue" Award For Wide Band AC Amplifier

Peter Laakmann, project engineer with the American District Telegraph Co., New York, N. Y., has won ELECTRONIC DESIGN'S twelfth \$50 Most Valuable of Issue Award.

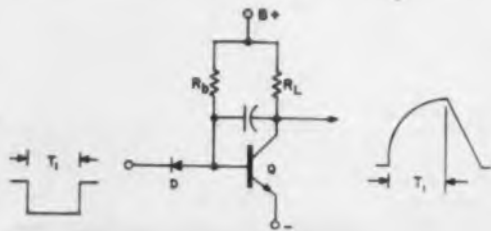
Mr. Laakmann receives the award for his Idea for Design, "AC Amplifier Is Wide Band, Less Bulky," which appeared in the August 2 issue. The idea described a method for reducing bulk and expense of a multistage transistor amplifier by ac coupling the stages.

Simple Transistor Circuits 746 Generate Phantastron Sweeps

Negative- or positive-going ramp voltage waveforms, similar to the output of a phantastron, can be generated by relatively simple transistor circuits.

In the circuit shown, an npn transistor is used in a simple common emitter connection to generate a ramp. The transistor is normally saturated by the current through R_b . Applying a negative pulse to the cathode of diode D cuts the transistor off and allows its collector to rise to the $B+$ supply. When the period, t_1 , of this pulse is over, the transistor will tend to saturate through R_b . However, the negative waveform coupled from the collector through C tends to cut Q off. The net result is a negative ramp voltage of good linearity. The slope is determined primarily by the value of C , R_b , and the dc current gain of the transistor.

Similar ramp waveforms of opposite polar-



Ramp output voltage is generated by this single transistor circuit.

ity can be generated by using a pnp transistor and making the necessary circuit changes.

The above technique was found extremely useful in designing economical driving and zero-set circuits for the Beam-X switch.

Arpad Somlyody, Circuit Design Analyst, Electronic Components Div., Burroughs Corp., Plainfield, N. J.

If this Idea is valuable to you, give it a vote by circling Reader-Service number 746.

Sequential Counter Stepper 744 Uses Error-Correcting Code

Here is a rather unconventional circuit we designed for a sequential scanning application that produces successive high-power pulses on 16 output leads. At the same time, these pulses are counted in a redundant binary code.

As shown in the figure by mirror symbols, the circuit has a seven-bit "address register" using two cores per bit. An output from each core feeds through a diode into a core matrix having 16 cores. Fourteen "selector wires" pass through each core in a different polarity combination, according to a modified Reed-Muller code.

When the clock pulse resets the address register, seven of the 14 selector wires carry

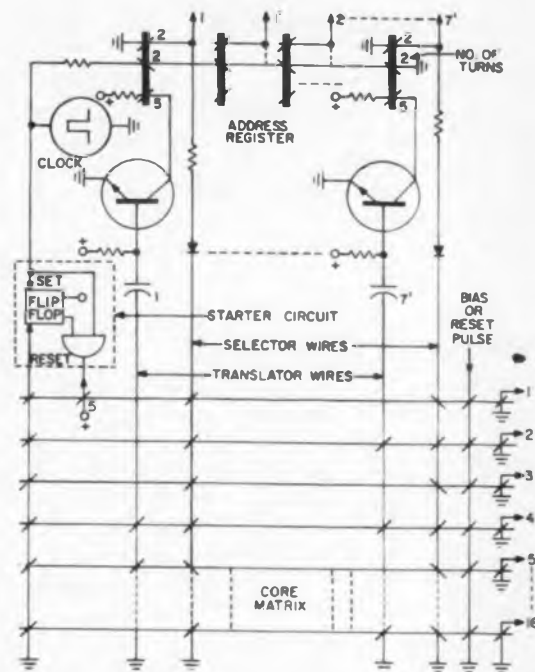
Vote for Ideas Valuable to You

Vote for the Ideas which are valuable to you. Other engineers will vote for the Ideas which are most valuable to them. The Idea which receives the most "Valuable" votes will be judged "Most Valuable of Issue." Its author will receive a \$50 award.

Choose the Ideas which suggest a solution to a problem of your own or stimulate your thinking or which you think are clever.

The Ideas chosen as the most valuable in each issue will be eligible for the \$1,000 Idea of the Year award.

So vote for the Ideas you find most valuable. And, after you've voted, why not send in an Idea of your own?



Successive pulses can be obtained on the 16 output lines of this ferrite-cored scanning circuit.

currents. In only one core will these currents combine to exceed the threshold and set the core.

The selected core is subsequently reset, either by a bias current or by a reset clock pulse. As a result, voltages are induced in seven of 14 translator wires; each core is threaded by seven wires and bypassed by the remaining seven.

The very first cycle is started by a three-transistor "starter circuit" which detects lack of response to the first clock pulse and routes the next one to core No. 1 of the matrix, thus forcing its selection.

The counter-stepper tolerates at least one component failure, and often several, with little degradation. Certain short circuit failures may cause marginal operation. The transistors must be capable of passing pulses of 200 to 300 ma, but their parameters are quite uncritical. Output currents of up to 3 amp have been obtained with 2-amp turn clock drives, while more typical operation calls for 1-amp turn drive. Typical advance time is 4 μ sec, using cores made of low-coercive force ferrite, having 1/4 in. OD, 1/8 in. ID and height.

Ernest R. Kretzmer, Member of Technical Staff, Bell Telephone Laboratories, Murray Hill, N. J.

If this Idea is valuable to you, give it a vote by circling Reader-Service number 744.

SEVENTH ANNIVERSARY AWARDS

IDEAS-FOR-DESIGN

Entry Blank

How You Can Participate

Rules For Awards

Here's how you can participate in Ideas for Design's Seventh Anniversary Awards: All engineer readers of ELECTRONIC DESIGN are eligible.

Entries must be accompanied by filled-out Official Entry Blank or facsimile. Ideas submitted must be original with the author, and must not have been previously published (publication in internal company magazines and literature excepted).

Ideas suitable for publication should deal with:

1. new circuits or circuit modifications
2. new design techniques
3. designs for new production methods
4. clever use of new materials or new components in design
5. design or drafting aids
6. new methods of packaging
7. design short cuts
8. cost saving tips

Awards:

1. Each Idea published will receive an honorarium of \$20.
2. The Idea selected as the most valuable in the issue in which it appears will receive \$50.
3. The Idea selected as the Idea of the Year will receive a Grand Prize of \$1,000 in cash.

The Idea of the Year will be selected from those entries chosen Most Valuable of the Issue.

Most Valuable of the Issue and Idea of the Year selections will be made by the readers of ELECTRONIC DESIGN. The readers will select the outstanding Ideas by circling keyed numbers on the Reader-Service cards. Payment will be made eight weeks after Ideas are published.

Exclusive publishing rights for all Ideas will remain with the Hayden Publishing Co.

Ideas-for-Design Editor
ELECTRONIC DESIGN
850 Third Ave.
New York 22, N. Y.

Idea (State the problem and then give your solution. Include sketches or photos that will help get the idea across.)

(Use separate sheet if necessary)

I submit my Idea for Design for publication in ELECTRONIC DESIGN. I understand it will be eligible for the Seventh Anniversary Awards—\$20 if published, \$50 if chosen Most Valuable of Issue, \$1,000 if chosen Idea of the Year.

I have not submitted my Idea for Design for publication elsewhere. It is entirely original with me and does not violate or infringe any copyrights, patents or trademarks or the property rights of any other person, firm or corporation.

Hayden Publishing Company, Inc. shall have the exclusive publication rights to these Ideas for Design selected for publication in ELECTRONIC DESIGN. This right extends to the subsequent use of the Idea for Design by Hayden in any of its other publications. Honorariums, if any, for subsequent publication shall be solely in the discretion of Hayden Publishing Company, Inc.

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For Additional Entry Blanks, circle 750 on Reader-Service Card.



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IDEAS FOR DESIGN

Temperature Monitor Uses 745 Silicon Transistor Sensor

A temperature-monitor circuit considered for one of NASA's satellites made use of the base-emitter voltage change with temperature of a silicon transistor. The complete circuit, shown in the figure, was compact and very reliable, was stable with age and was easily designed for various output voltages and temperature ranges.

The primary design equation is:

$$I_c = \alpha \frac{V_b - V_{be}}{r_e - R_c} \quad (1)$$

where V_b is the base voltage set by the base-biasing resistors,

V_{be} is the base-emitter voltage

To design the circuit, the cold-end point is determined and used in the expression for V_{be} . This is equal to V_b at the cold-end point,

$$V_b = 0.6 - 0.002 (T - 20) \quad (2)$$

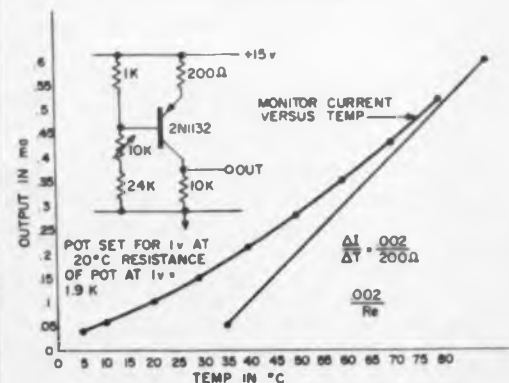
The base-biasing resistors are then chosen to give the voltage found by Eq. 1. The slope of the current vs temperature curve is found to be, neglecting the effects of r_e :

$$\frac{\Delta I_c}{\Delta T} = \frac{0.002}{R_c}$$

Actually r_e is inversely proportional to emitter current, causing the nonlinearity at the low temperature end. Thus,

$$R_c = 0.002 \frac{\Delta T}{\Delta I_c} = 0.002 R_c \frac{\Delta T}{\Delta V_o} \quad (2)$$

where R_c is the collector resistor
 V_o is the output voltage.



Temperature monitor makes use of the base-emitter voltage change with temperature of a silicon transistor. Plot shows circuit output-current dependence on the temperature.

This circuit can easily be used with a current readout device simply by putting the readout device in the collector instead of R_c . The first part of Eq. 2 is then applicable.

W. H. Follett, *Electronic Engineer, Ball Brothers Research Corp., Boulder, Colo.*

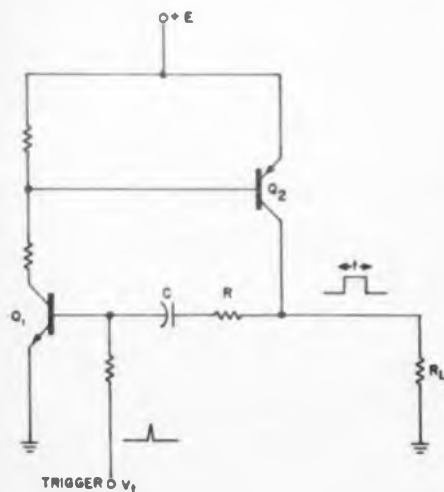
If this idea is valuable to you, give it a vote by circling Reader-Service number 745.

Complementary-Pair Multi 736 Has Long Pulses, Small Capacitor

Built around a pair of complementary transistors, a one-shot multivibrator was designed which:

- required no power until triggered
- handled large load currents
- sustained long pulse periods with a relatively small-sized capacitor.

The circuit's transistor pair is regeneratively coupled by resistor R and capacitor C . Since the output current is $\beta_1\beta_2$ -times



Complementary transistors are used in this one-shot multivibrator. Effective value of R is increased to allow a relatively smaller value of C to be used.

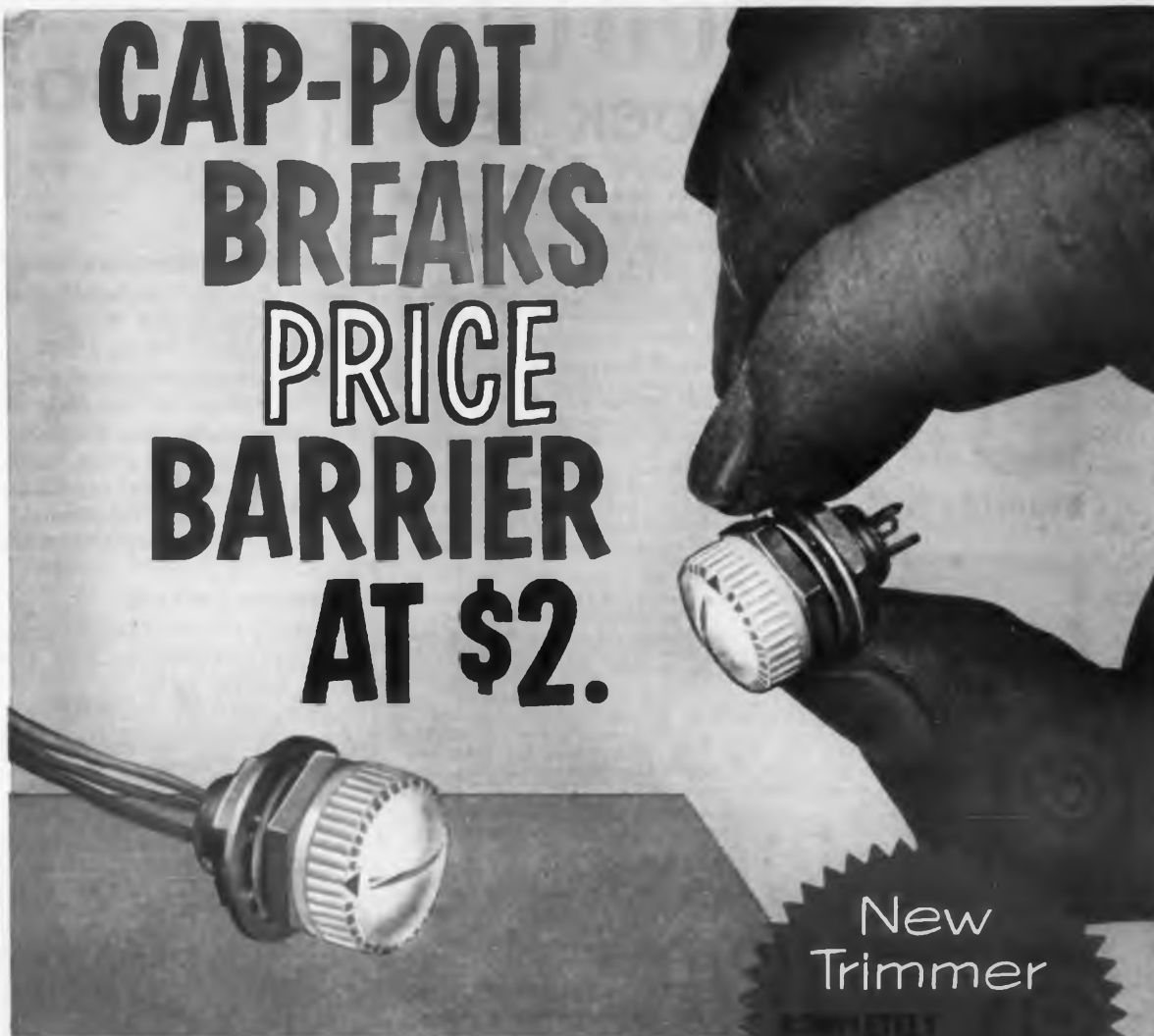
the base current required to saturate Q_1 , timing capacitor C can be approximately β_1 -times smaller than would be possible in a conventional multivibrator.

More precisely, if the "ON" period is chosen to be $t = R_{eff}C$, R_{eff} can be calculated to be: $R_{eff} \cong R \beta_1\beta_2 (1-0.63)$. And, of course, $C = t/R_{eff}$.

Kermit Norris, *Technician, Jordan Electronics, Alhambra, Calif.*

If this idea is valuable to you, give it a vote by circling Reader-Service number 736.

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The high-performance, miniaturized potentiometer with the plus advantage of sealed assembly now available at only \$2.00, in production quantities. The Cap-Pot is the ideal trimmer, offering excellent resolution, unique and ideal configuration, extra-high reliability, and low cost. Unit measures $\frac{1}{2}$ " in diameter maximum. Element and wiper are entirely self-contained within combination knob and screwdriver-slot control. Choice of wire or solder lug terminals. Color-coded knobs are available for function call-out. Your best buy in high performance trimmers!

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Resistance tolerance $\pm 10\%$ or closer on specification
Effective rotation300° $\pm 5^\circ$
Dielectric strength900 V rms at sea level for 1 minute
Torque0.2 to 8.0 oz-in
Mechanical rotation310° $\pm 5^\circ$

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BOOKS

Time-Harmonic Electromagnetic Fields

Roger F. Harrington, McGraw-Hill Book Co., Inc., 330 W. 42 St., New York 36, N. Y., 480 pp, \$13.50.

Presents graduate-level mathematical techniques for handling electromagnetic engineering problems. Topics covered include plane, cylindrical and spherical wave functions, perturbational and variational techniques, and microwave networks.

Operational Electricity

Charles I. Hubert, John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., 530 pp, \$8.50.

Designed for nonelectrical engineering undergraduates, this text introduces the theory and characteristics of electrical circuits and machines.

Proceedings of the Sixth Conference On Magnetism and Magnetic Materials

American Institute of Electrical Engineers and American Institute of Physics, McGraw-Hill Book Co., Inc., 330 W. 42 St., New York 36, N. Y., 395 pp, \$10.00.

Introduction To The Statistical Dynamics Of Automatic Control Systems

V. V. Solodovnikov, translation edited by John B. Thomas and L. A. Zadeh, Dover Publications, Inc., 180 Varick St., New York 14, N. Y., 318 pp, \$2.25.

Information Processing

Proceedings of the International Conference On Information Processing, UNESCO, Paris, June 15-20, 1959, Columbia University Press, 2960 Broadway, New York 27, N. Y., 520 pp, \$25.

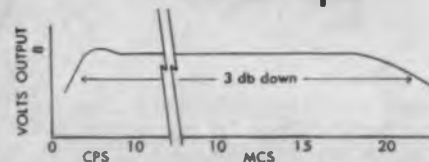
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Advanced Euclidean Geometry (Modern Geometry)

Roger A. Johnson, Dover Publications, Inc., 180 Varick St., New York 14, N. Y., 340 pp, \$1.65.

Elements of Projective Geometry

Luigi Cremona, Dover Publications, Inc., 180 Varick St., New York 14, N. Y., 320 pp. \$1.75.

Basics of Analog Computers

Thos. D. Truitt and A. E. Rogers, John F. Rider Publisher, Inc., 116 W. 14 St., New York 11, N. Y., 396 pp. \$12.50.

Engineering and Technical Conventions —1961

Deutsch & Shea, Inc., Industrial Relations News, Inc., 230 W. 41 St., New York 36, N. Y., 42 pp. \$4.

Spectra and Analysis

A. A. Kharkevich, Consultants Bureau Enterprises, 227 W. 17 St., New York 11, N. Y., 224 pp. \$8.75.

Transistors—Principles, Design, and Applications

Wolfgang W. Gartner, Ph. D., D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J., 675 pp. \$12.50.

Fun With Electricity

Tom Kennedy, Jr., Gernsback Library, Inc., 154 W. 14 St., New York 11, N. Y., 128 pp, \$2.65.

Laplace Transformation

William T. Thomson, Prentice-Hall, Inc., Englewood Cliffs, N. J., 260 pp, \$10.

Fundamentals of Signal Theory

John L. Stewart, McGraw-Hill Book Co., Inc., 330 W. 42 St., New York 36, N. Y., 350 pp, \$9.

Water Hammer In Hydraulics and Wave Surges In Electricity

Louis Bergeron, John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., 293 pp, \$15.00.

Management Models and Industrial Applications Of Linear Programming, Vol. 1

A. Charnes and W. W. Cooper, John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., 470 pp, \$11.75.

Aimed at persons interested in managerial applications of linear programming. Material is based on research made on actual managerial problems.

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BOOKS

Error-Correcting Codes

W. Wesley Peterson, *The MIT Press, Mass. Institute of Technology and John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., 285 pp., \$7.75.*

Error-detecting and error-correcting codes are described and implemented in practical information storage and transmission systems.

International Dictionary of Physics and Electronics, Second Edition

D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J., 1,400 pp. \$27.85.

Presents terms from seventeen major subject divisions, including thermonuclear research, magnetohydrodynamics, nuclear physics, astrophysics, etc. A multilingual index in French, German, Russian and Spanish is also included.

Ceramics

P. William Lee, *Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y., 210 pp., \$5.95.*

Covers the applications of ceramics in industry, including their history, raw materials, basic chemistry and applications in electronics.

Electronic Equipment Reliability

G. W. A. Dummer and N. Griffin, *John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., 274 pp., \$7.50.*

Digest of Military Electronics

RCA Service Company, *Government Services, Camden 8, N. J., 210 pp., \$3.95.*

Atoms For Industry World Survey

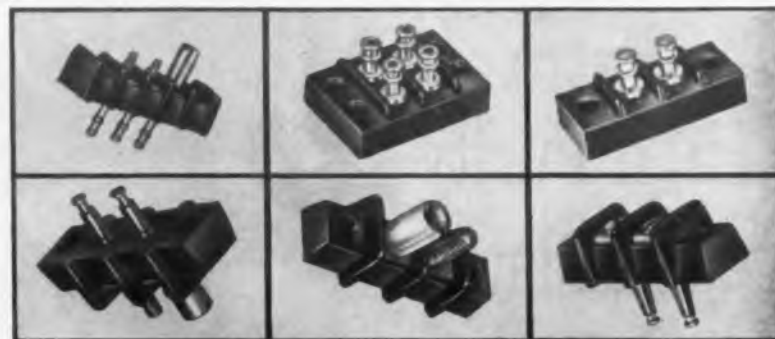
Atomic Industrial Forum, Inc., *International Publications, Inc., 801 Third Ave., New York 22, N. Y., 160 pp., \$3.*

Large Radiation Sources In Industry, Vol. 2

Conference Proceedings, Warsaw, Sept. 8-12, 1959, International Atomic Energy Agency, Vienna; International Publications, Inc., 801 Third Ave., New York 22, N. Y., 448 pp., \$4.50.

Instrumentation and High-Speed Photography, Vol. I, Series II

Articles reprinted from the SMPTE Journal, Society of Motion Picture and Television Engineers, 55 W. 42 St., New York 36, N. Y., 188 pp., \$4.



Kulka

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Magnetic Control of Industrial Motors, Part 1, 2

Gerhart W. Heumann, John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., 275 pp, \$9.

Treats magnetic devices and accessories as used for control of industrial motors. Part 1—AC Control Devices and Assemblies; Part 2—AC Motor Controllers.

Prediction and Optimal Decision

C. West Churchman, Prentice-Hall, Inc., Englewood Cliffs, N. J., 416 pp, \$9.

Considers the question of whether "science" can verify recommendations to managers and, if so, in what way. Discusses the extent to which the scientist can assist the executive in making decisions.

Managerial Performance Standards

Virgil K. Rowland, American Management Association, 1515 Broadway, New York 36, N. Y., 194 pp, \$5.25.

Adaptive Control Systems

Eli Mishkin and Ludwig Braunn, Jr., Editors; McGraw-Hill Book Co., Inc., 330 W. 42 St., New York 3, N. Y., 533 pp, \$16.50.

Iterative Arrays of Logical Circuits

Frederick C. Hennie III, The Technology Press, Mass. Institute of Technology, and John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., 240 pp, \$4.95.

Examines the behavior of one- and two-dimensional iterative networks, pertinent to information processing, switching theory, and computer design.

Lectures On Communication System Theory

Elie J. Baghdad, Editor; McGraw-Hill Book Co., Inc., 330 W. 42 St., New York 36, N. Y., 620 pp, \$12.50.

Theoretical discussions are presented with emphasis on methods of applying mathematical models and techniques to the design, analysis and evaluation of reliable systems. Sections are written by authorities in the field.

Transistor Logic Circuits

Richard B. Hurley, John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., 365 pp, \$10.

A discussion of binary arithmetic, Boolean algebra and minimization techniques leads to the application of diodes and transistors in logic circuitry.



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- Data Instrumentation Engineering

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YOUR CAREER

Congress Urged to Increase Aid for Postgraduate Study

The need for postgraduate education and fellowships, rather than undergraduate scholarships, has been pointed out to a Senate education subcommittee. We need to "expand and stimulate graduate education," Paul H. Robbins, executive director of the 56,000-member National Society of Professional Engineers, said. He feels the administration's proposed undergraduate-scholarship program would stress quantity, rather than quality, of college students.

Mr. Robbins also recommended support for technician education, pointing out the need for technicians who can relieve the engineers of routine, repetitive tasks.

President Kennedy's proposal to establish a loan program for improving classrooms, laboratories and equipment met with Mr. Robbins' approval.

High-speed computing facilities at University of California at Los Angeles have been more than tripled with the installation of an IBM 7090 data-processing system. The first of its kind on a university campus, according to UCLA, the system will be used for scientific, medical and engineering research.

Engineers plan to study automatic control, as well as the development of computer hardware, thus using the computer to help design computers.

Chemists will analyze giant molecule crystals with the help of the 7090.

Prof. Magnus R. Hestenes, head of the UCLA computing facility, says the time is near when "any university will find it very difficult to maintain any major program of research without the use of a high-speed computer."

UCLA conducts 20 courses in numerical analysis and computer programming and design. Last year 700 students were involved in computer education, use or design at the university.

Engineering and medicine have united in a series of research projects conducted jointly by doctors from Highland View Hospital in Cleveland and professors from Case Institute of Technology.

Two Case computers will be used for medical diagnosis—to record, store, describe and analyze the electrical signals obtained from muscles, brain and the heart.

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ELECTRONIC DESIGN's Confidential Career Inquiry Service helps engineers "sell" themselves to employers—as confidentially and discreetly as they would do in person. The service is fast. It is the first of its kind in the electronics field and is receiving high praise from personnel managers.

To present your job qualifications immediately to companies, simply fill in the attached resume.

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

ELECTRONIC DESIGN will act as your secretary, type neat duplicates of your application and send them to all companies you select—the same day the resume is received.

The standardized form permits personnel managers to inspect your qualifications rapidly. If they are interested, they will get in touch with you.

Painstaking procedures have been set up to ensure that your application receives complete, confidential protection. We take the following precautions:

- All forms are delivered unopened to one reliable specialist at ELECTRONIC DESIGN.
- Your form is kept confidential and is processed only by this specialist.
- The "circle number" portion of the form is detached before the application is sent to an employer, so that no company will know how many numbers you have circled.
- All original applications are placed in confidential files at ELECTRONIC DESIGN, and after a reasonable lapse of time, they are destroyed.

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Name _____ Telephone _____

Home Address _____ City _____ Zone _____ State _____

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Position Desired _____

Educational History				
College	Dates	Degree	Major	Honors

Recent Special Training _____

Employment History				
Company	City and State	Dates	Title	Engineering Specialty

Outstanding Engineering and Administrative Experience _____

Professional Societies _____

Published Articles _____

Minimum Salary Requirements (Optional) _____

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

Circle Career Inquiry numbers of companies that interest you

900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924
925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949

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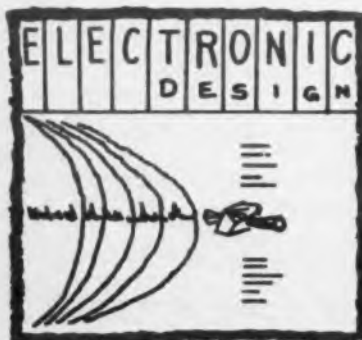
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YOUR CAREER

A team of physicists from Radio Corp. of America has received the Journal Award of the Society of Motion Picture and Television Engineers.

Edwin C. Hutter, John A. Inslee and Thomas H. Moore of the Astro-Electronic Div. of RCA are co-authors of a paper on "Electrostatic Image and Recording." It was designated the outstanding paper originally published in the monthly SMPTE Journal during 1960.

The paper describes a method of image recording using a transducer for the simultaneous pickup and electrostatic storage of optical instrumentation.

ENGINEER-IMPROVEMENT COURSES AND SEMINARS

One-Day Seminars

The Industrial Education Institute, Nov. 8-16

The Industrial Education Institute of Boston is presenting a one-day seminar on Systematic Retrieval and Correlation of Information and Technical Data. The seminar schedule is as follows: Chicago, Hotel Sheraton-Blackstone, Nov. 8; Cincinnati, Hotel Sheraton-Gibson, Nov. 13; Cleveland, Hotel Pick-Carter, Nov. 16.

The seminar will be conducted by Freeman H. Dyke, Jr. The individual registration fee, which includes attendance, luncheon, coffee break, supplies and reference material, is \$50. A 10 per cent team discount is extended to companies having three or more men attending. For information, write Industrial Education Institute, 221 Columbus Ave., Boston 16, Mass.

Controlling Costs of Industrial Experimentation New York, Nov. 20-21; Philadelphia, Dec. 18-19

A two-day seminar on Controlling and Reducing Costs of Industrial Experimentation will be presented by the Industrial Education Institute of Boston. It will be offered in New York, Hotel Belmont Plaza, Nov. 20-21 and in Philadelphia, Hotel Sheraton, Dec. 18-19.

Dr. William Mendenhall will conduct the seminar. The registration fee, which includes attendance, luncheon, coffee break, supplies and a package of reference material, is \$100. A 10 per cent team discount is extended to companies that have three or more men attending. For information, write Industrial Education Institute, 221 Columbus Ave., Boston 16, Mass.

Engineering and Management UCLA, Jan. 22-Feb. 1

A ten-day course on Engineering and Management will be offered by the University of California at Los Angeles Extension, beginning Jan. 22.

Designed for engineering and management personnel, the course will stress design, installation, and administration of systems. Emphasis will be on oral communication and understanding of human relationships.

The Fourteenth Annual Industrial Engineering Institute, featuring lectures by noted industrial engineers, will follow the course. There are no formal educational requirements. For further information write: Reno Cole, University Extension, UCLA, Los Angeles 24, Calif.

Automation, Computers, and Instrumentation at Georgia Tech, Feb. 12-16

Georgia Institute of Technology and the Instrument Society of America will sponsor a one-week course on Automation, Computers, and Instrumentation, Feb. 12-16, 1962, on the Georgia Tech campus, Atlanta.

The course is designed to orient technical personnel in the latest concepts of instrumentation, analog computers, digital computers and automation. Special emphasis will be placed on problems dealing with the replacement of human effort by the appropriate automatic equipment.

Tuition, including supplies and textbooks, will be \$125. Contact Director, Short Courses and Conferences, Georgia Institute of Technology, Atlanta 13, Ga.

PAPER DEADLINES

Nov. 1: For the 1962 International Solid-State Circuits Conference to be held Feb. 14 - 16 at Philadelphia. The conference, sponsored jointly by the University of Pennsylvania and the IRE, will stress circuit design in such advanced areas as solid-state memory; storage and logic; solid-state microwave amplification, oscillation and conversion; solid-state devices performing an integrated circuit function; unconventional power supplies, and cryogenic and optoelectronic applications.

Papers should be sent in abstract (300 to 500 words) along with pertinent illustrations to Richard H. Baker, Room C-237, MIT Lincoln Laboratory, Lexington, Mass.

Nov. 15: Deadline for 100-word abstracts and 500-word summaries to be presented at the 1962 National Winter Convention on Mil-

Project Surveyor engineering openings

Hughes Space Systems Division has immediate openings for Electronic Engineers, Mechanical Engineers, Physicists and Aeronautical Engineers to work on Project Surveyor—a spacecraft which will soft land on the moon. Once there, Surveyor instruments will perform a variety of scientific tests: drills will pierce and analyze the moon's surface; high quality television pictures will be transmitted to earth; other instruments will measure the moon's magnetic and radiation characteristics. ■ To accomplish this step into space, Project Surveyor requires the talents of imaginative junior and senior engineers and scientists to augment its outstanding staff. Experience is preferred but not required. A few of the openings include:

control engineers

Concerns hydraulics, airborne computers, and other controls related areas for: missiles and space vehicles, satellites, radar tracking, control circuitry, controls systems, control techniques, transistorized equalization networks and control servomechanisms.

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Involves analysis and synthesis of systems for: telemetering and command circuits for space vehicles, high efficiency power supplies for airborne and space electronic systems, space command, space television, guidance and control systems, and others.

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YOUR CAREER

itary Electronics. This will be held at the Ambassador Hotel, Los Angeles, Calif., on Feb. 7, 8, and 9.

Subjects include: system and technical management, instrumentation, reliability, undersea warfare and sonar systems, radar and fire control systems, aerospace ground equipment, reconnaissance and electronic warfare, missile and space systems and subsystems, tracking, telemetry and command systems, military equipment design and product engineering, military systems requirements and environments, information and data handling systems, and navigation and air traffic control systems.

Authors are requested to send abstracts and summaries plus short biographies to *Matthew E. Brady, Space Technology Laboratories, P. O. Box 95001, Los Angeles 45, Calif.* Confidential papers must be cleared by authors and sent to *Major James L. Blilie, USAF, U. S. Air Force Systems Command, Regional Office, 6331 Hollywood Blvd., Los Angeles 28, Calif.* These will be considered for publication.

Dec. 1: Deadline for 800-1,200-word summaries of papers for the **Symposium on Electromagnetic Theory and Antennas** to be held **June 25-30th, 1962**, at the **Technical University of Denmark, Copenhagen**. As announced by the IRE, the international symposium will encourage papers on: electromagnetic fields in anisotropic media (plasmas and ferrites), diffraction theory, scattering in random media, quasi-static electromagnetic problems, theory of broad-band antennas, and antenna pattern synthesis. *Write to: H. Lottrup Knudsen, secretary, Symposium on Electromagnetic Theory and Antennas, Oster Volgade 10 G, Copenhagen K, Denmark.*

Jan. 1: Deadline for 200-word abstracts of papers for the **Symposium on Cleaning and Materials Processing for Electronics and Space Apparatus** to be held during the **Fourth Pacific Area National Meeting of the American Society for Testing Materials, Sept. 30 to Oct. 5, 1962**, at the **Statler-Hilton Hotel, Los Angeles**. The symposium, sponsored by ASTM Committee F-1 on Materials for Electron Tubes and Semiconductor Devices, will deal with materials and processing problems in electronic device fabrication. Send abstracts with titles to: *Dr. D. E. Koontz, Bell Telephone Laboratories, Inc., Murray Hill, N. J.*

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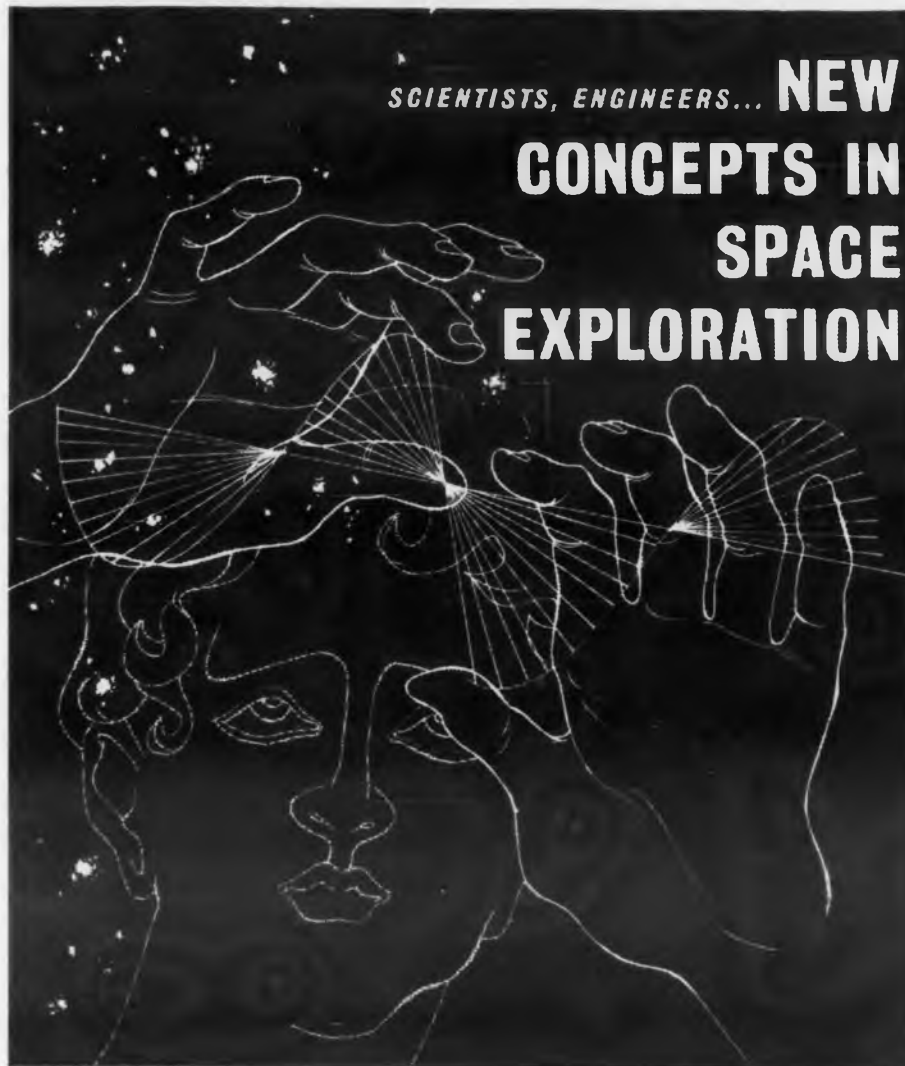
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*Manufacturers' catalog appears in 1960-1961 ELECTRONIC DESIGNERS' CATALOG.

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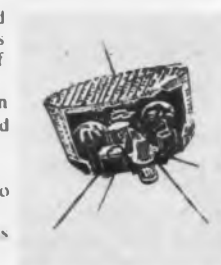
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- **ELECTRONIC SYSTEMS AND CIRCUIT DEVELOPMENT** / Communications / Video and digital data processing / TV camera and pickup tube design
- **INFORMATION PROCESSING** / Data systems analysis / Computer applications and programming research

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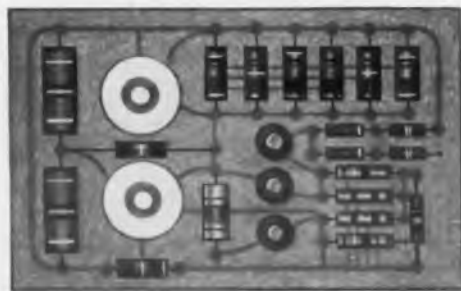


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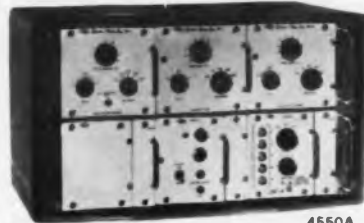
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Price:	\$2,300.00	\$2,300.00	\$2,900.00	\$2,900.00

Common Specifications

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Maximum rf Input:	100 mw
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	RCA 2N1708	
CHARACTERISTICS	TEST CONDITIONS	LIMITS
I_{CBO}	$V_{CB} = 15 \text{ volts}; I_E = 0$	025 μA max.
I_{CEX}	$V_{CE} = 10 \text{ volts};$ $V_{BE} = 0.35 \text{ volts};$ Free-air Temp. = 100° C	15 μA max.
$V_{CE}(\text{sat.})$	$I_C = 10 \text{ ma}; I_B = 1 \text{ ma}$.22 volts max.
$V_{BE}(\text{sat.})$	$I_C = 10 \text{ ma}; I_B = 1 \text{ ma}$.9 volts max.
t_c	$I_C = 10 \text{ ma}; I_{B1} = 10 \text{ ma};$ $I_{B2} = 10 \text{ ma};$	25 nano-seconds max.
t_{on}	$I_C = 10 \text{ ma}; I_{B1} = 3 \text{ ma};$ $I_{B2} = 1 \text{ ma}; V_{CC} = 3 \text{ volts}$	40 nano-seconds max.
t_{off}	$I_C = 10 \text{ ma}; I_{B1} = 3 \text{ ma};$ $I_{B2} = 1 \text{ ma}; V_{CC} = 3 \text{ volts}$	75 nano-seconds max.

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