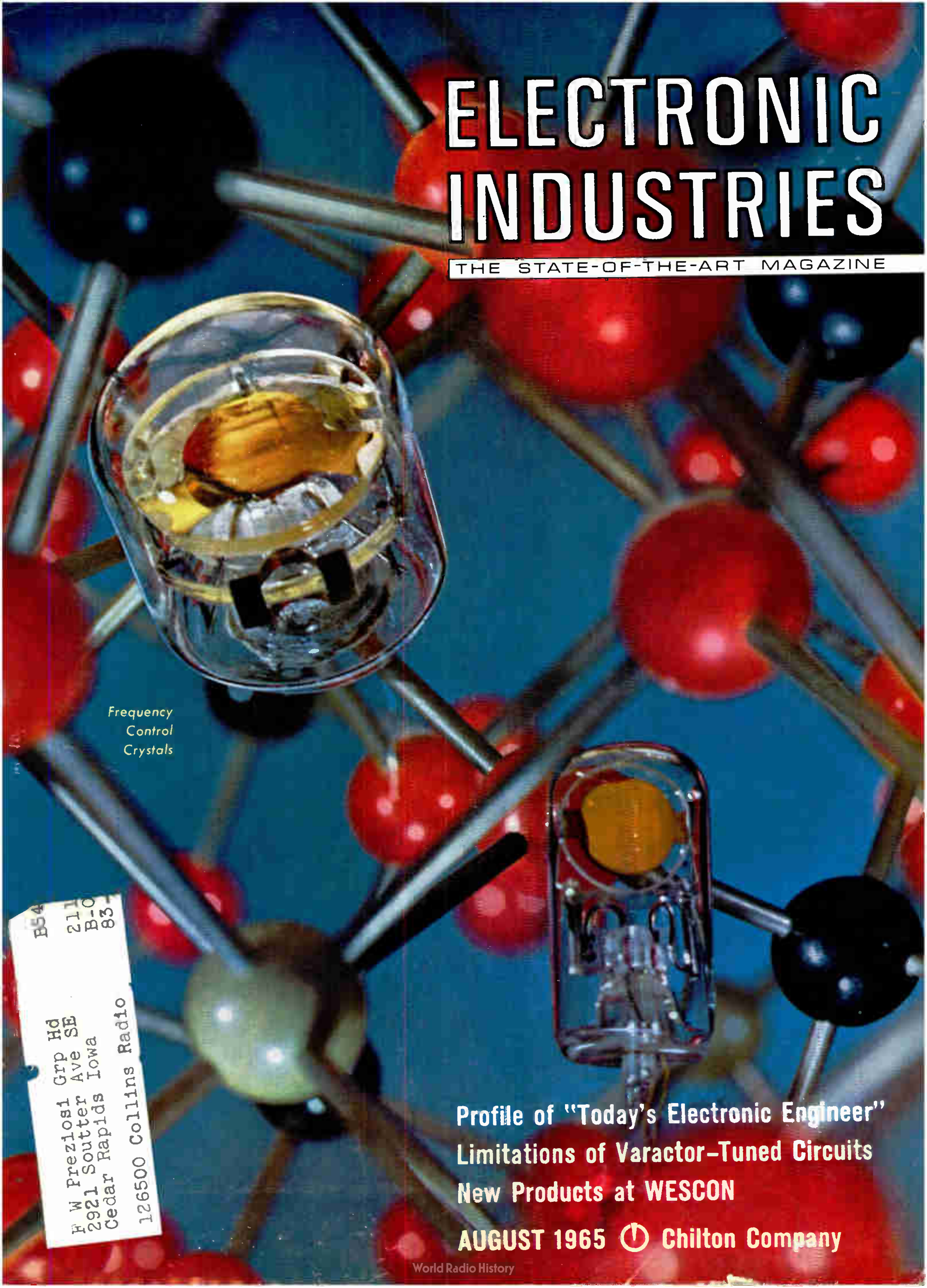
ELECTRONIC INDUSTRIES

THE STATE-OF-THE-ART MAGAZINE



Frequency Control Crystals

Profile of "Today's Electronic Engineer"

Limitations of Varactor-Tuned Circuits

New Products at WESCON

AUGUST 1965 Chilton Company

B54 211 B-O 83-
F W Preziosi Grp Hd
2921 Soutter Ave SE
Cedar Rapids Iowa
126500 Collins Radio

World Radio History

4 BONUS FEATURES! New G & HG resistors offer more versatility than any other wirewounds!

1. MORE POWER in MIL SPEC SIZE

G SERIES

DALE TYPE	MIL-R-26C TYPE	MIL-R-23379 TYPE	POWER RATING (WATTS)		RESISTANCE RANGE (OHMS)	
			Dale	Mil.	.05%, .1%, .25%	.5%, 1%, 3%
G 1	—	—	1.0	—	10 to 950	1 to 3.4K
G 3	RW 70	RWP 18	*2.25	1	1 to 2.7K	.1 to 10.4K
G-5C	RW-69	RWP-20	5	3	1 to 8.6K	.1 to 32.3K
G-15	RW-68	RWP 23	15	10	.5 to 73.4K	.1 to 273K

HG SERIES

DALE TYPE	MIL-R-18546C TYPE	POWER RATING (WATTS)		RESISTANCE RANGE (OHMS)	
		Dale	Mil.	.05%, .1%, .25%	.5%, 1%, 3%
HG 5	None	15		1 to 6.5K	1 to 24.5K
HG 10	RE 65	20	10	1 to 12.7K	.1 to 47.1K
HG 25	RE 70	35	15	.5 to 25.7K	.1 to 95.2K
HG 50	RE 75	50	20	.5 to 73.4K	.1 to 273K

Major Environmental Specifications: LOAD LIFE: 1% Max. ΔR in 1000 hours at full power. OVERLOAD: .5% Max ΔR at 3, 5, or 10 times momentary overload per applicable Mil Spec OPERATING TEMPERATURE: −55 C to +275 C

*G Series models are typical: 10 resistors in complete line

2. THE SAME POWER in LESS SPACE

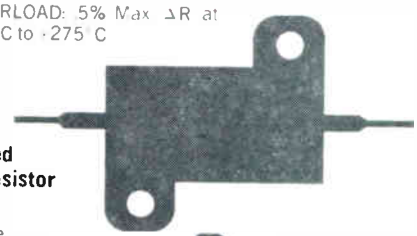
1 Watt Silicone Coated Resistor

Conventional MIL-R-26C and MIL-R-23379

DALE G-1

15 Watt Mil. Rated Housed Power Resistor

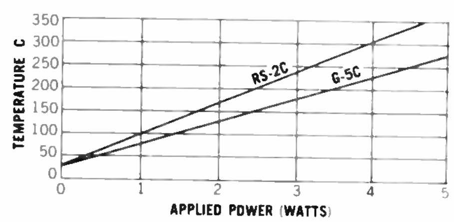
Conventional MIL-R-18546C Size



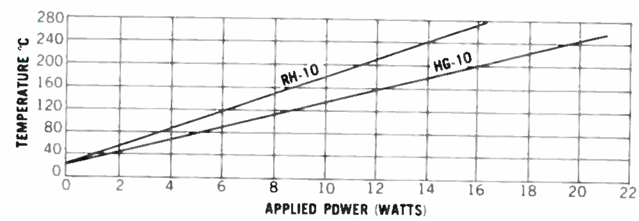
DALE HG-5

3. EXCEPTIONAL STABILITY at CONVENTIONAL RATINGS

Two RW-69, MIL-R-26C resistors (Dale G-5C and conventional silicone-coated wirewound) operated at Mil power levels.

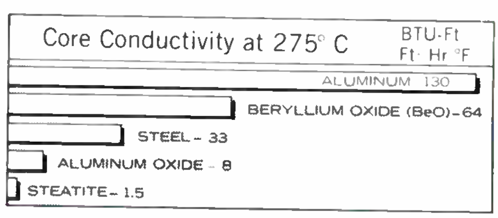


Two RE-65, MIL-R-18546C resistors (Dale HG-10 and conventional housed power wirewound, RH-10) operated at Mil power levels.



4. IMPROVED THERMAL EFFICIENCY

The chart at right shows the outstanding heat dissipation advantages which the beryllium oxide cores used in Dale G and HG resistors have over conventional core materials. To complement this advantage, Dale uses a special high temperature silicone coating on the G Series and a new extruded aluminum housing for the HG Series.



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Also Sold by Dale Electronics Canada, Ltd., Toronto, Ontario, Canada

DALE

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World Radio History

ELECTRONIC INDUSTRIES
The State-of-the-Art Magazine

COMING—A NEW WALL CHART!

Dear Reader:

Timely and convenient wall or desk reference charts have always been received with great favor by engineer readers. Last August, for example, we published a "Design Guide for Electronic-Optical Systems." More than 90,000 copies of this chart were distributed nationally. Our most popular chart is The Electromagnetic Spectrum Chart which we have up-dated and published every two to three years since 1945. The current 1965 version was included in our January issue and to date nearly 80,000 copies have been distributed.

As editors, we are acutely aware of the great reader interest in well organized reference charts. They have been a unique editorial feature of ELECTRONIC INDUSTRIES. More than twenty-five charts have been presented to our readers. We are constantly exploring new topics to determine whether the engineering information involved is "chartable" and if it will be of interest to the majority of our readers. Surprisingly, many topics fail to satisfy these two criteria when adequately researched. Only about one in six ever reaches the publishing stage.

Next month we shall publish our newest contribution entitled "Wire and Cable Reference Chart." This will list useful technical parameters on selected flexible coaxial cable types, common wire insulations, common conductor materials, bare copper wire table, conductor configurations, conductor coatings, temperature rise of conductors surrounded by still air at 25°C, correction factor for current capacity and a tabulation of cable-shielding qualities.

This reference chart has been six months in preparation. We made a comprehensive review of published literature to sift out the significant technical reference elements. It involved an extensive field contact program with manufacturers to coordinate its content and to assure that it would be fully representative of industry practice today.

We believe you will find the "Wire and Cable Reference Chart," in September, informative and useful.

Sincerely,
The Editors

World Radio History

1965-1966 EDITORIAL FEATURES

SEPTEMBER	• State-of-the-Art in Solid State Devices • Special Purpose Relays • Phototransistors & Silicon PNPN Light-Activated Devices • Wire and Cable Reference Chart
OCTOBER	• Potentiometers, part 1, Specification Chart • Survey of Microelectronic Devices
NOVEMBER	• Microwave, 13th Annual Issue • Potentiometers, part 2, Specification Chart
DECEMBER	• Switches, part 1, Specification Chart • Computers, State-of-the-Art
JANUARY	• 1966 Review & Forecast for the Electronic Industries • Potentiometers, part 3, specification Chart
MARCH	• 1966 IEEE Show Coverage

World Radio History

ELECTRONIC INDUSTRIES

The STATE-OF-THE-ART Magazine

Color TV's Exciting Implications

The recent decision by the Radio Corporation of America (RCA) to invest an additional $50 million out of current funds to increase its color-TV manufacturing capability is a most significant forward step. Some $36.4 million of this amount will be spent to nearly double production capacity for color tubes within the next three years. $13.3 million has been earmarked to more than double set production in the next two years.

Public acceptance of color-TV has been an uphill struggle for more than 12 years, with RCA as its singular champion. Now the industry belief is that color is at the same threshold of opportunity as black-and-white television was when introduced after World War II.

Recent announcements by the National Broadcasting Company (NBC) and the Columbia Broadcasting System (CBS) provide real support for this view. This fall NBC will have more than 95% of its prime-time programs in color and CBS will have 50%. The American Broadcasting Company (ABC) has indicated a programming factor of about 25% so far. The overall for the three major networks amounts to some 60% of prime-time programming. For 1966-67 a 100% factor has been projected.

The chicken-and-the-egg problem is being overcome. There will be programs for the public to see and manufacturers will have virtually a virgin market to supply. The more than 50 million households in the U.S. constitute the principal prospects who will need a color-TV as the "primary" set in the house.

While we have a yearly production capability of more than eight million monochrome sets a year, we will probably be able to produce only a little more than 2 million color sets this year. This is due to the limited availability of color tubes.

RCA, which had more than 90% of the total color tube output two years ago, will account for about 56% this year. Competitors have been putting up their own tube facilities. Those expanding color-tube output include Zenith, National Video Corp. of Chicago, and Sylvania Electric Products. General Electric Co., Ford Motor Co.'s Philco and Westinghouse are getting into production.

The "coming of color" this year will have important future industry implications and offers a host of new opportunities that we should be aware of and take advantage of. Here are some of these elements as we see them now:

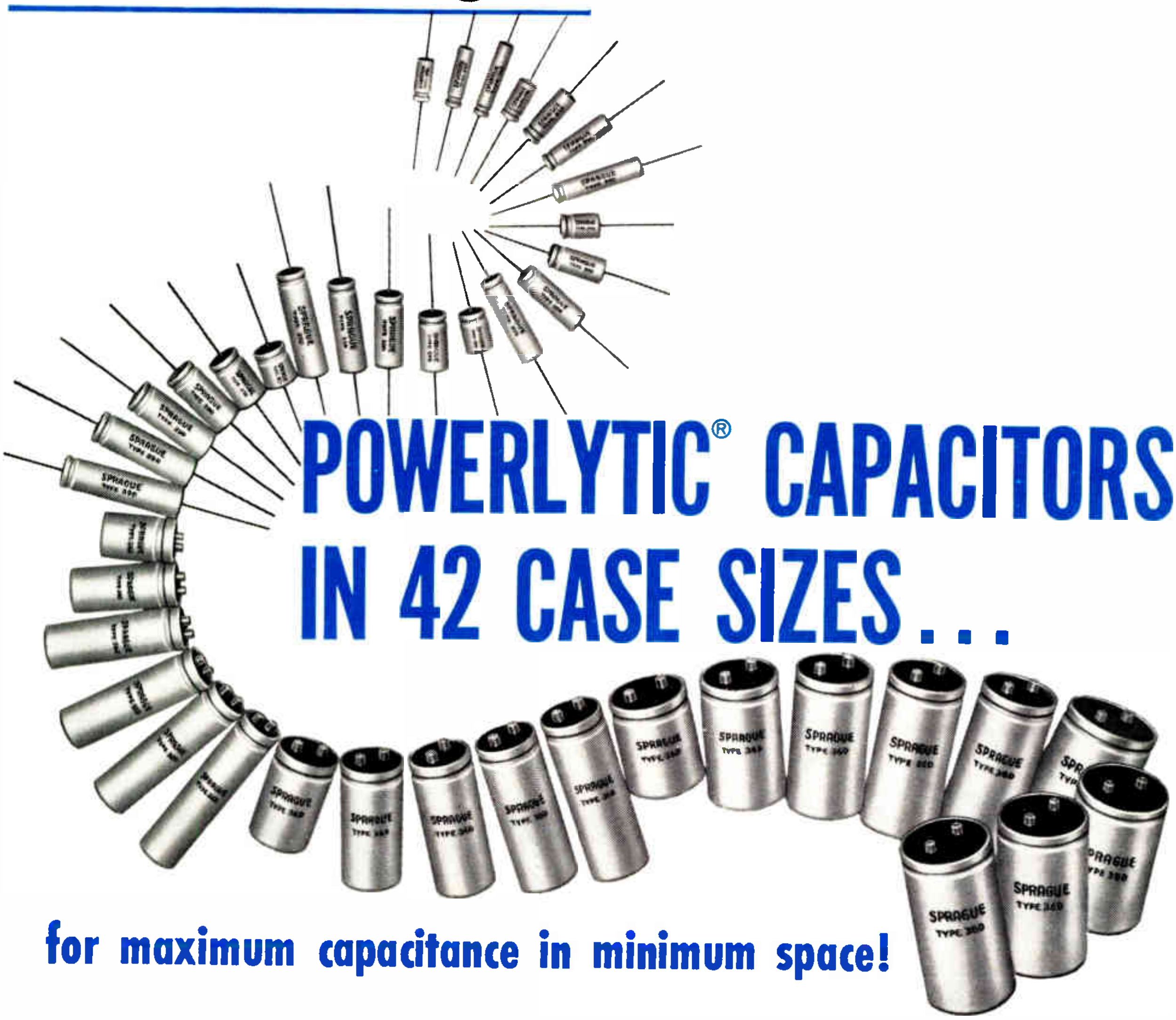
- With such an unsaturated growth market, more manufacturers will invest funds to either diversify or expand their capabilities for components, tubes, and sets.
- There will be new employment opportunities for engineers, technicians and production workers.
- There will be an even greater market for solid state devices as color sets become transistorized.
- There will be an increased market for color station-studio broadcast equipment.
- With complete VHF-UHF tuning now on all receivers there will be an added impetus for new UHF stations to come on the air . . . equipped for color.
- There will be a rising market for peripheral receiver equipment such as new outdoor and indoor antennas, couplers, transmission lines etc.
- As more broadcasters and manufacturers become involved with color, we can expect to see a continual stream of technical improvements in the color television system itself.
- With future technical improvements, it will probably become possible to further reduce color television receiver costs.
- Because of the all-out U.S. acceptance the possibility of our having the NTSC system adopted internationally becomes greatly enhanced.
- More future advertising commercials, television shows, and movies will be video taped directly in color.
- Home video tape recorders are coming on the horizon in increasing numbers and at more reasonable prices. When these can be made to accommodate color-TV, our whole concept of the entertainment world could change. We could have cartridges to permit video-tape off-the-air recording. We could also have pre-recorded sound movies, plays, and educational programs available in our home entertainment centers.

Future developments in color television are bound to bring new growth and profits to the consumer electronic industry.

Bernard F. Osbahr

World Radio History

Now from Sprague!



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Type 36D Cylindrical Case

Designed specifically for space economy, in applications such as computer power supplies, industrial controls, high gain amplifiers, etc. Case sizes from 1 ⅜" x 2 ⅛" to 3" x 5⅝". Improved temperature capabilities—may now be operated at 85 C. Low equivalent series resistance, low leakage current, excellent shelf life, high ripple current capability. Superior seal employs molded cover with recessed rubber gasket. Reliable safety vents. Solder lug or tapped terminals. Standard ratings from 3 to 450 VDC, capacitance values to 270,000 μF.

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Smaller companion to proven 36D capacitor, possessing same outstanding performance. Case sizes from ½" x 1 ⅛" to 1" x 3⅝". Designed for operation at temperatures up to 85 C. Unique construction—anode and cathode terminals are welded—no riveted or pressure connections—prevents open circuits, even in microvolt signal range. Improved molded phenolic end seals contribute to unusually long life (expectancy, 10 years or more). Low effective series resistance, low leakage current. Standard ratings include capacitance values to 18,000 μF, voltages from 3 to 450 VDC.

For complete technical data on Type 36D or Type 39D Powerlytic Capacitors, write for Engineering Bulletins 3431B and 3415, respectively, to Technical Literature Service, Sprague Electric Co., 233 Marshall Street, North Adams, Mass. 01248.

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World Radio History

AUGUST 1965, Vol. 24, No. 8

ELECTRONIC INDUSTRIES

The STATE-OF-THE-ART* Magazine

COVER: Two frequency control crystals developed by Bell Labs, against a background of a molecular model. Synthetic crystals have reached a highly advanced stage, where they now fill most of the requirements of electronic equipment. The story begins on page 81.

*STATE-OF-THE-ART: up-to-the-moment capability in each area of electronic technology

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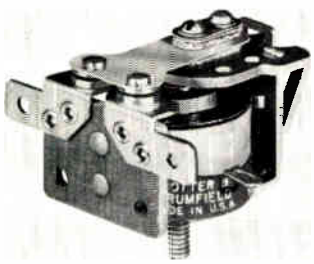
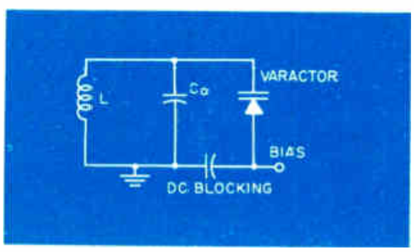
HIGHLIGHTS

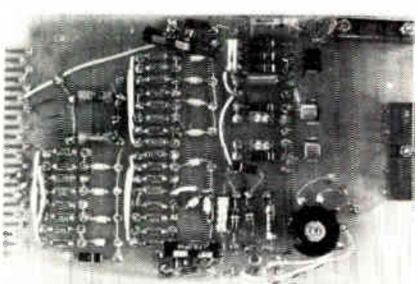
WESCON



Power Relays

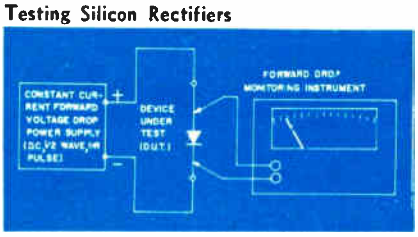


Varactor-Tuned Circuits



Electronic Correlator

Testing Silicon Rectifiers



• A REPRINT of ANY ARTICLE in this issue is available from ELECTRONIC INDUSTRIES Reader Service Department, 56th & Chestnut Streets, Philadelphia, Pa. 19139

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A better, less-expensive way to trigger SCRs. Will accommodate large SCR gate impedance differences. 3-winding or 2-winding designs for full-wave or half-wave applications.

ASK FOR BULLETIN 40,225.2

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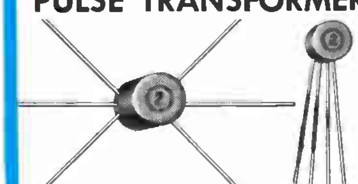

Miniature transformers in nanosecond, medium, and high-inductance designs. Tough molded cases for increased protection against physical damage and severe atmospheric conditions.

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Fully shielded, ultra-tiny, yet performance is comparable to that of larger units. Inductance values from 0.1 to 12,000 uH. Molded for positive protection against humidity and handling. Meet requirements of MIL-C-15305.

ASK FOR BULLETIN SERIES 41,800

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For complete technical data on any of these products, write for applicable Engineering Bulletin(s) to Technical Literature Service, Sprague Electric Company, 233 Marshall Street, North Adams, Massachusetts 01248.

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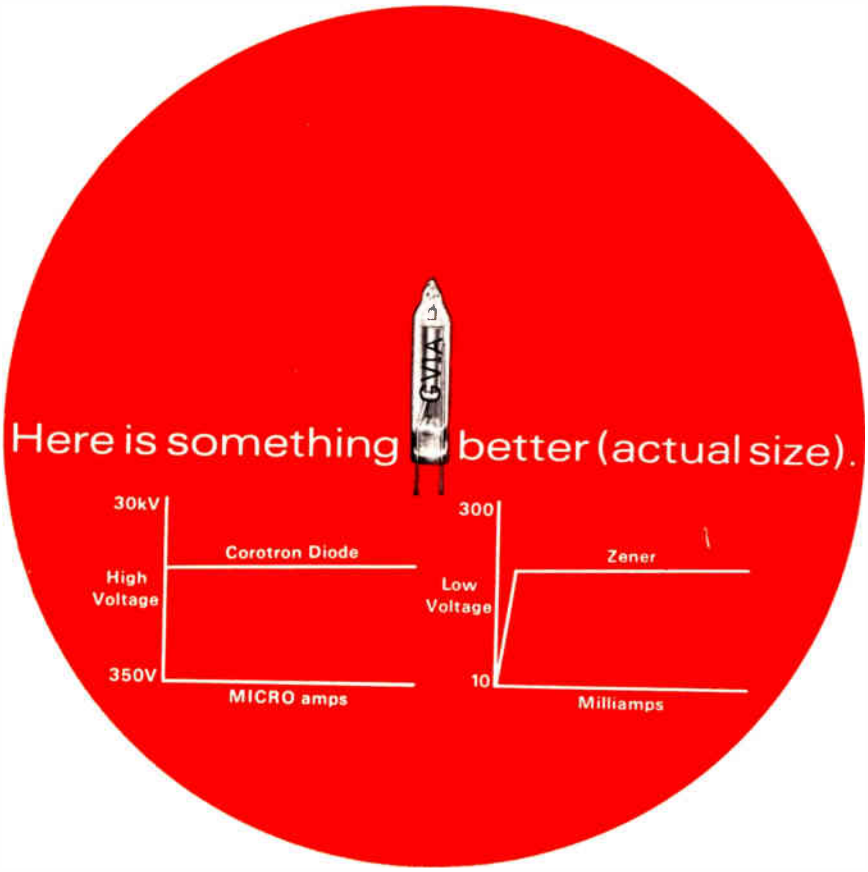
Who ever heard of a **kilovolt Zener?**



Other Zener-equivalent Victoreen diodes range from 350 to 30,000 volts

In low voltage power supply circuits, transistors and Zeners are OK. But what about high voltage supplies? Wish you could eliminate voltage dividers and dc amplifiers used with low voltage references?

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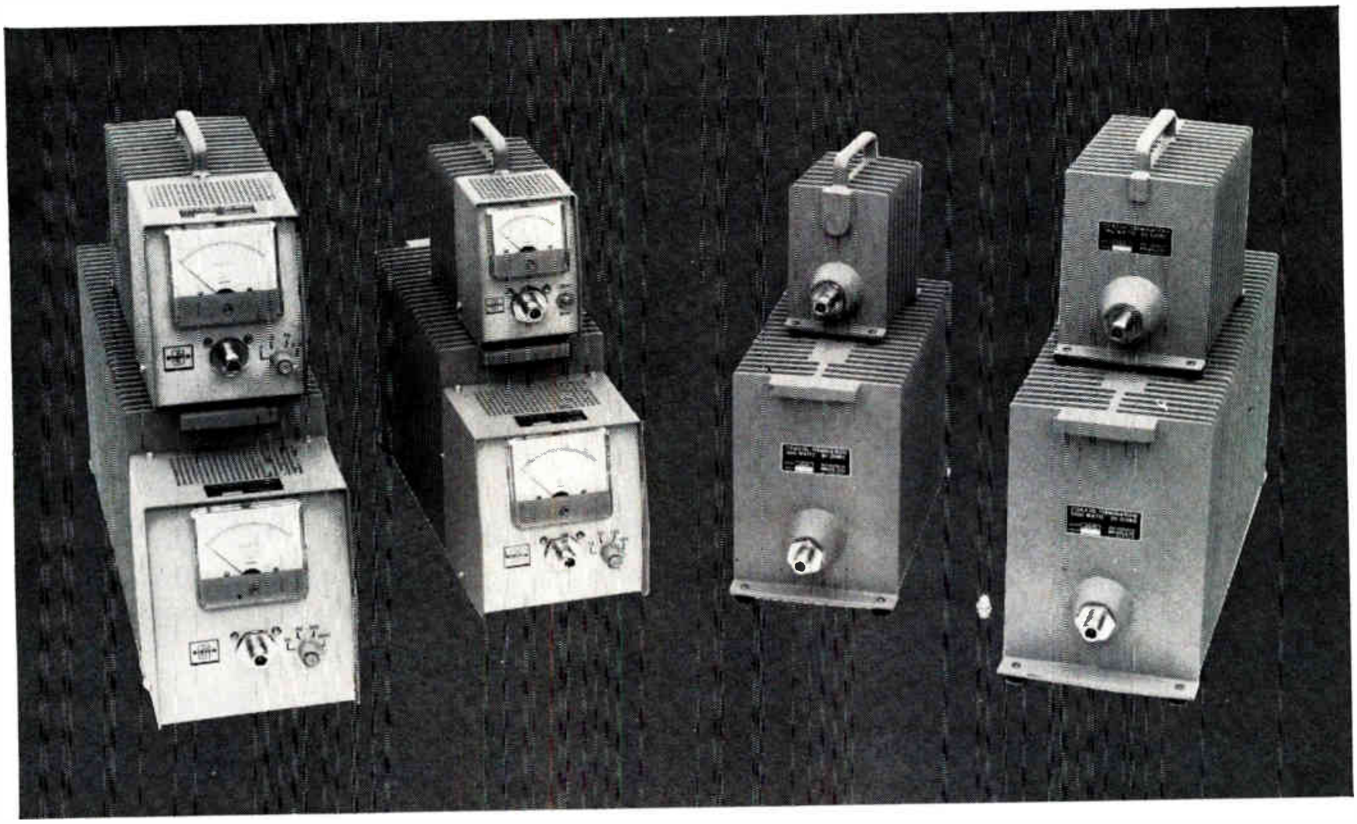
Sierra Wide-Range RF Wattmeters



and Low-VSWR Loads

Model 401A Termination Wattmeters, in four models (120, 250, 500, and 1,000 watts) offer unusually wide dynamic range. Single-knob switching of four power ranges (two ranges on 120-watt model) provides excellent versatility of application. For example, meter indications as low as two watts can be read on the 1,000-watt models. Terminations are sealed to prevent possibility of leakage. Eight different Twist-Off connector types (N, C, UHF, HN, LC, BNC, TNC, 1⅝" rigid line) can be fitted on in the field without factory calibration. Wattmeters require no external power or water connections.

401A-120 (watts) . . **$195** 401A-500 (watts) . . **$275**
401A-250 (watts) . . **$225** 401A-1000 (watts) . **$365**

Model 160B Coaxial Loads deliver average power dissipation ratings of 150, 300, 600, and 1,000 watts. The four models provide low-reflection termination of a 50-ohm flexible or rigid coaxial line. They are ideally suited as dummy loads for transmitters operating up to 5,000 Mc, or as terminations for use with bi-directional power monitors. Terminations are sealed to prevent possibility of leakage. Can be used with eight different Twist-Off connector types (N, C, UHF, HN, LC, BNC, TNC, and 1⅝" rigid line).

160B-150 (watts) . . **$ 70** 160B-600 (watts) . . **$140**
160B-300 (watts) . . **$ 95** 160B-1000 (watts) . **$265**

Sierra offers a complete line of power measuring instruments and devices, featuring high performance standards and economical prices. Complete catalog is available by writing to Sierra or to your Sierra sales representative.

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ELECTRONIC INDUSTRIES RADARSCOPE

Developments and trends affecting the State-of-the-Art of technologies throughout the electronic industries

IMPROVES RADAR PERFORMANCE

Original model of an optical correlator patented by Lockheed Electronics Co. is checked out by its inventors L. Slobodin (l), and A. Reich. Current units are ¼ this size with future versions to be even smaller. Correlator improves radar performance and also offers a new approach to multi-channel communications.

AUTOMATIC MEANS of detecting heart defects in individuals by listening to their heartbeats with a computer are being developed by researchers at the University of Iowa. A Scientific Data Systems SDS 92 computer will be used in the analysis of sounds from hundreds of hearts to develop a system to distinguish the sounds that may indicate problems.

SOLAR CELL panels built by The Boeing Co. for spacecraft provide about twice as much power from a given number of cells. Called V-ridge concentrators, they consist of thin aluminum panels which have solar cells in the valleys and highly reflective aluminum on 60-degree slopes which bounce extra sunlight onto the cells. A square foot of V-ridge concentrating panel weighs only half a pound.

LASER RANGE FINDER which will provide an accuracy of plus or minus two feet at ranges up to 10 miles will be installed at the Naval Ordnance Test Station at China Lake, Calif., by RCA. The laser, emitting 50 megawatt peak power pulses of light at a rate of 10/sec., will provide high-rate digital range data to a computer for computation of missile trajectory.

THE COLOR TV boom continues. RCA and Sylvania have both announced major expansion programs. RCA is spending $50 million to increase production facilities for color TV receivers and picture tubes. The program is designed to more than double the company's color TV set production capacity within two years and to double color tube output within three years. Sylvania is to double its color TV tube output in 1965 through expansion of its facilities in Seneca Falls, N. Y.

RADIO TELESCOPE SYSTEMS capable of "listening" to radio waves emitted by the sun are being developed by Airborne Instruments Laboratory. Three of the systems will be used by NASA scientists to study the sun to detect surface explosions which produce high energy proton radiation known to be harmful to man. These systems will be used together with conventional optical telescopes in a program designed to make the first moon explorers' journey a safe one.

POSITIVE IONS have been used to bombard substrates with beams of electrically-charged boron or phosphorus atoms. The method allows precise control of the number of ions implanted and their geometrical distribution in all three dimensions. The process permits working directly through the passivated oxide layer which is deposited on the substrate. Production rates of thousands of transistors per hour, with yields of 90%, and frequency responses greater than 1000 MC are possible with this method. The method, developed by Ion Physics Corp., can be used for diodes, FETs, solar cells, and passive components. The company is already marketing diodes and solar cells.

LOW FREQUENCY RADIO WAVES from the Milky Way galaxy have been successfully measured by University of Michigan radio astronomers. A four-stage Journeyman rocket was sent 1060 miles high in the NASA sponsored experiment. A 70-ft. long flexible copper beryllium antenna was unrolled after most of the earth's atmosphere had been passed. Also carried were instruments to measure electron density and to determine orientation of the antenna in the earth's magnetic field, both of which affect antenna readings.

ELECTRONIC FLASHING LIGHTS may become the lighthouse beacons of the future according to Dr. Harold E. Edgerton, Professor of Electrical Measurements at MIT. According to Dr. Edgerton, lighthouses of the future will be equipped with beacons that are basically xenon flashtubes, mounted in reflectors and operating on principles similar to those used in electronic-flash photography. A xenon-flash system (the LS-66 Dual Intensity Lighthouse Beacon), designed, developed and built by EG&G, Inc., is scheduled for installation and operation later this year in a Coast Guard light tower off Cape Henry, Va.

World Radio History

MICROCIRCUITS which need only 300 microwatts are being developed by General Instrument Corp. for use in NASA space experiments. The binary flip-flops will be used by the University of Chicago. The transistor and resistor chips are assembled in a package 3/8 x 5/8 x 1/10 inch. The low power needs are achieved by using special cermet resistors.

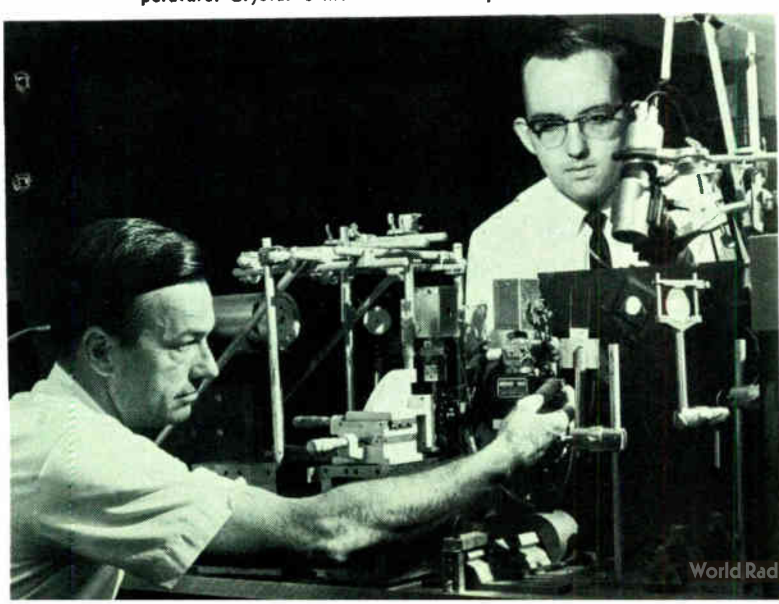
POTTING AND ENCAPSULATING are two uses for a new flame-proof silicon rubber developed by G.E. The material, called RTV-757 silicon rubber foam, foams and cures in place to form a lightweight thermal insulating blanket. RTV-757 is a thixotropic paste which cures from a tacky paste to a rugged sponge in minutes during the foaming process. The process is activated by passing a heat gun over the surface.

WELD DISTORTION, a significant factor in rising production costs, may soon be eliminated with electron beam welders, according to E. D. Baugh of Westinghouse Corp. Mr. Baugh, in a paper given at a recent conference of The American Society of Mechanical Engineers, said that new developments in the design of electron beam welders are solving many critical problems for manufacturers.

OPTICAL SCANNER designed to read documents in 16 fonts has been delivered to the Air Force by Philco Corp. The system can read several additional fonts not required by the contract. It can also read underlined copy and has an extended character set containing many Greek and mathematical symbols. The equipment uses a flying spot scanner to process the data. Operation is controlled by a program coded on a special auto-load sheet read as the first document of each batch. The scanner converts through internal memory to the output device.

COHERENT-LIGHT OSCILLATOR

R. C. Miller (l.) and J. A. Giordmaine of Bell Telephone Laboratories align lithium metaniobate crystal of coherent-light oscillator which has been tuned over most of the wavelength region between 9700 and 11,500 Å by changing the crystal temperature. Crystal is mounted in a temperature-controlled silver block.



BRIGHTER TV PICTURES

B. Tartaglio of Westinghouse monitors experiment in which light from a glowing phosphor is split to test its strength and purity. Object is a brighter, clearer TV picture. Light was reflected directly into the camera lens to show the split-apart beam as it would appear inside the light analyzing instrument at the right.

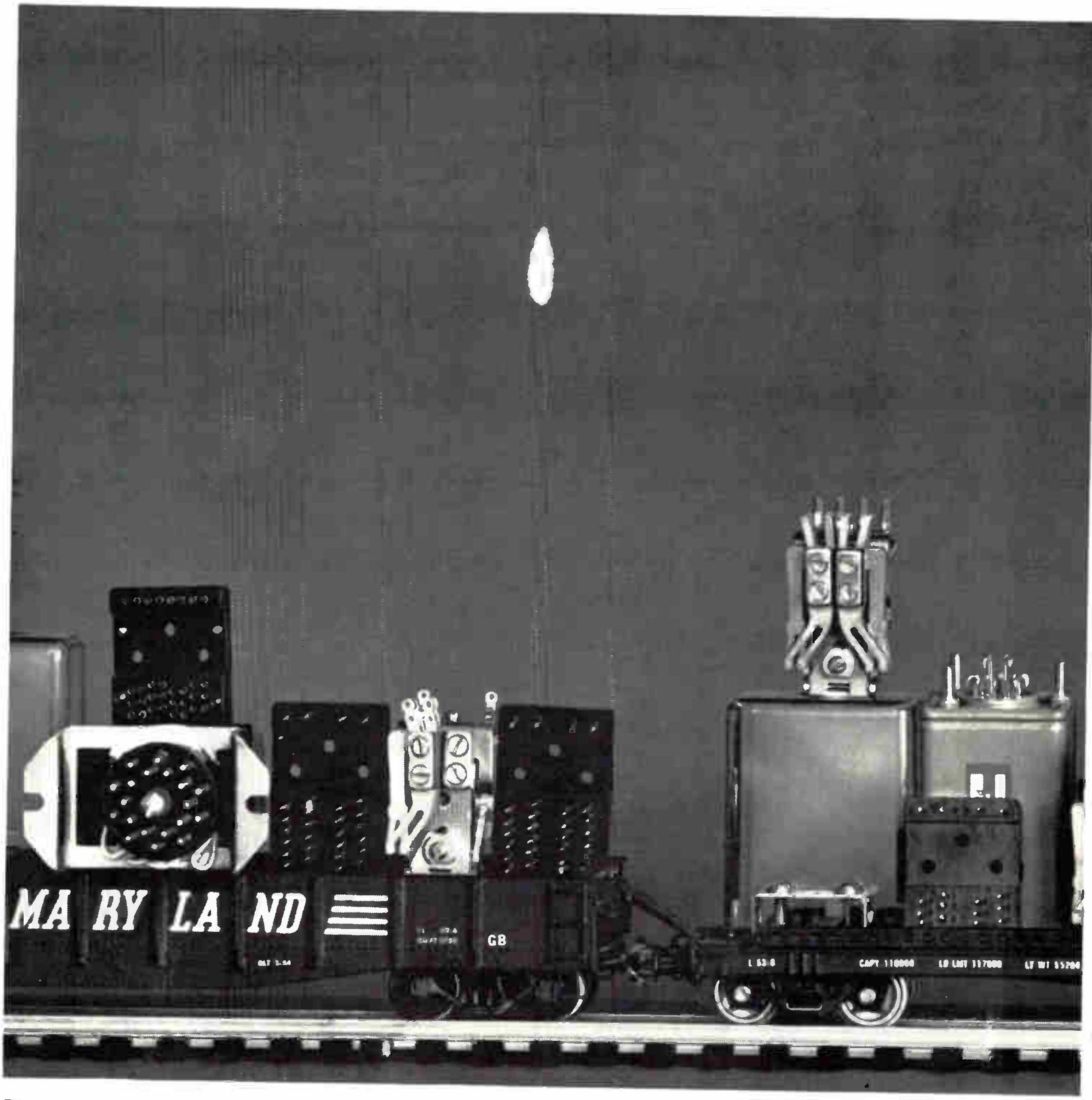
R-F SPUTTERING METHOD has been successful in making insulating films, from quartz, alumina, mullite, boron nitride, and a variety of glasses. The method, reported by IBM in Germany, is applicable to monolithic circuits. Using a radio frequency power supply as an energy source, an insulator surface is alternately bombarded with ions and electrons. The ions eject molecules that are able to diffuse to a substrate where they form a thin film. The electrons neutralize the positive charge build-up on the insulator surface. A 5 kw r-f generator was used at 13.56 MC.

NONDESTRUCTIVE TESTING TOOL that offers a satisfactory means for rapid testing of mounted miniature circuit components has been developed by Naval researchers. The high-speed infrared mapping system can reliably tell whether individual components of minature circuits are faulty at temperatures of 60 to 70°C. This is well below the temperatures considered to be destructive of electronic materials and parts. A thermal map of a 1-in.^{2} circuit surface can be made in a 30-minute period.

THE FCC has received a request from the Communications Satellite Corp. for authority to assemble a third Early Bird-type satellite from existing parts. The first Early Bird communications satellite is now in a stationary orbit over the Atlantic Ocean while a backup satellite is already assembled. Components for a third were completed early this year. Application before the FCC asked for permission to assemble these components. This satellite would be used for backup or for launch over the Pacific Ocean. All three units are built by Hughes Aircraft Co.

World Radio History

Try to find a connection



The growing popularity of AE's Class E Relay as the "workhorse of the industry" has set off a demand for a wide variety of mounting techniques.

Now AE can accommodate virtually every type of circuit connection or mounting used in electrical and electronic equipment designs.

Wherever designs call for "wiring in," AE Class E Relays are available with solder-type, wrapped-wire, taper-tab and printed-circuit terminals.

AE has also developed special sockets for chassis or printed-wiring board mounting, that accommodate Class E Relays with PC or taper-tab terminals. And prewired types with octal plug-in bases.

Where extra protection is required, AE Class

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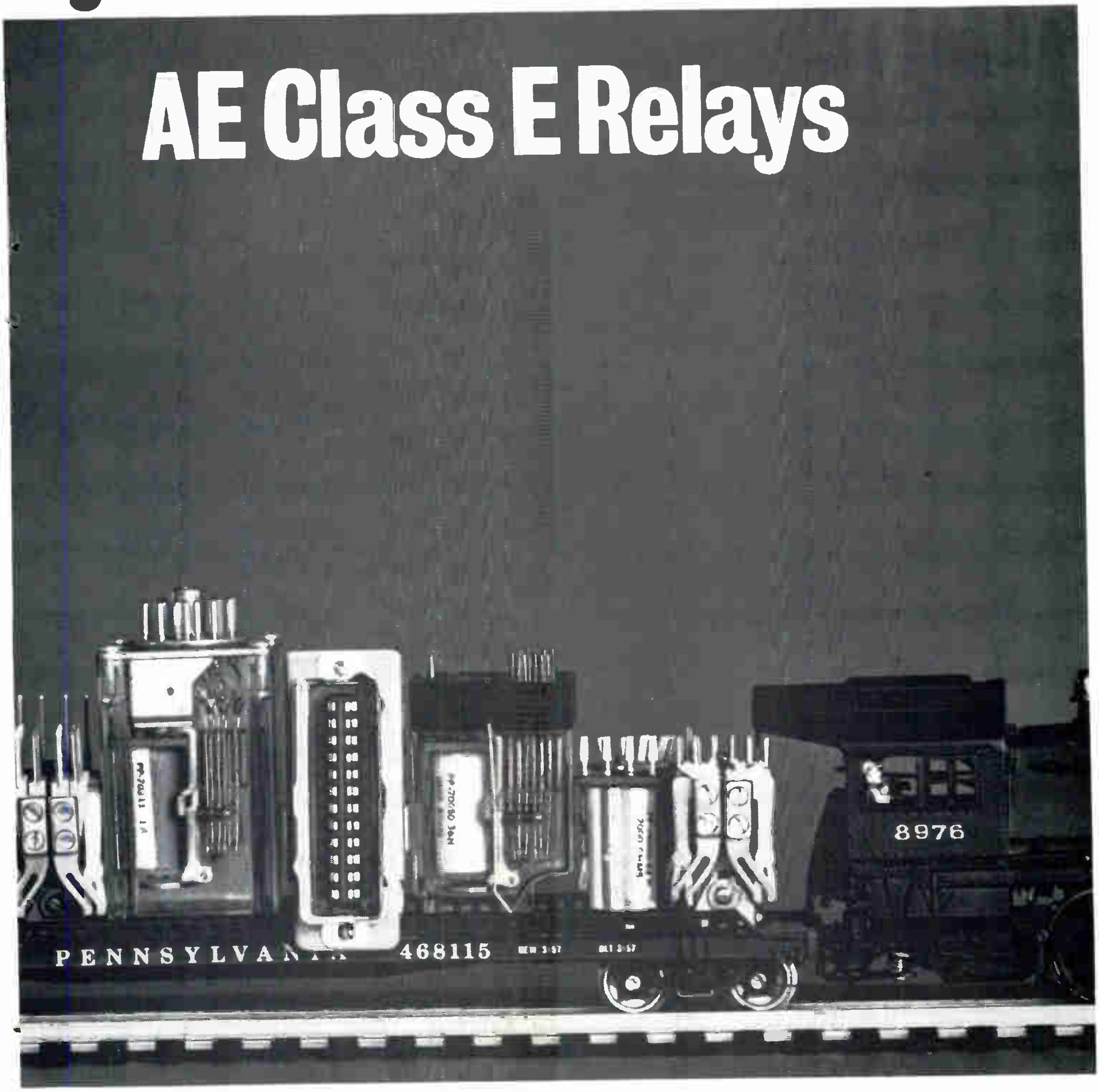
you can't make with



E Relays are available in hermetically sealed enclosures with either hook terminals or plug-in headers. Or plastic dust covers that snap on to the chassis- or printed-circuit type of socket.

For full information on the limitless variations in mounting and connections for AE Class E Relays, ask for Circular 1942-C. Write to the Director, Relay Control Equipment Sales, Automatic Electric Company, Northlake, Ill. 60164.

AUTOMATIC ELECTRIC

SUBSIDIARY OF
GENERAL TELEPHONE & ELECTRONICS GT&E

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high-speed

Tektronix Oscilloscope with general-purpose convenience

Type 585A / 82 unit features

- **Dual-Trace Operation** with 4 operating modes and independent controls for each channel—for individual attenuation, positioning, inversion, and ac or dc coupling as desired.
- **Passband typically DC-TO-85 MC** (3-db down) at 100 mv/cm (12-db down at 150 Mc), and typically DC-TO-80 MC (3-db down) at 10 mv/cm.
- **Calibrated Sensitivity in 9 steps** from 100 mv/cm to 50 v/cm, and in *10X Amplifier Mode*, from 10 mv/cm to 5 v/cm, variable between steps.
- **Internal and External Triggering** to 150 Mc.
- **Sweep Range from 10 nsec/cm** to 2 sec/cm.
- **Single-Sweep Photography** at 10 nsec/cm.
- **Calibrated Sweep Delay** from 2 microseconds to 10 seconds.
- **Bright, High-Resolution Display** with small spot size.
- **Conventional Passive Probes** for convenience.

plus

- **Compatibility with 17 Letter-Series Plug-Ins** to permit differential, multi-trace, sampling, other laboratory applications—when used with Type 81 adapter.

Type 585A Oscilloscope $1725
Type RM585A Oscilloscope . . . $1825
Type 581A Oscilloscope $1425
No sweep-delay capabilities, but other features similar to Type 585A.
Type 82 Dual-Trace Unit . . . . $ 650
Type 86 Single-Trace Unit . . . . $ 350
Type 81 Plug-In Adapter . . . . . $ 135
Allows insertion of 17 Tektronix letter-series plug-ins. Band-width (up to 30 Mc) and Sensitivity depend upon plug-in used.

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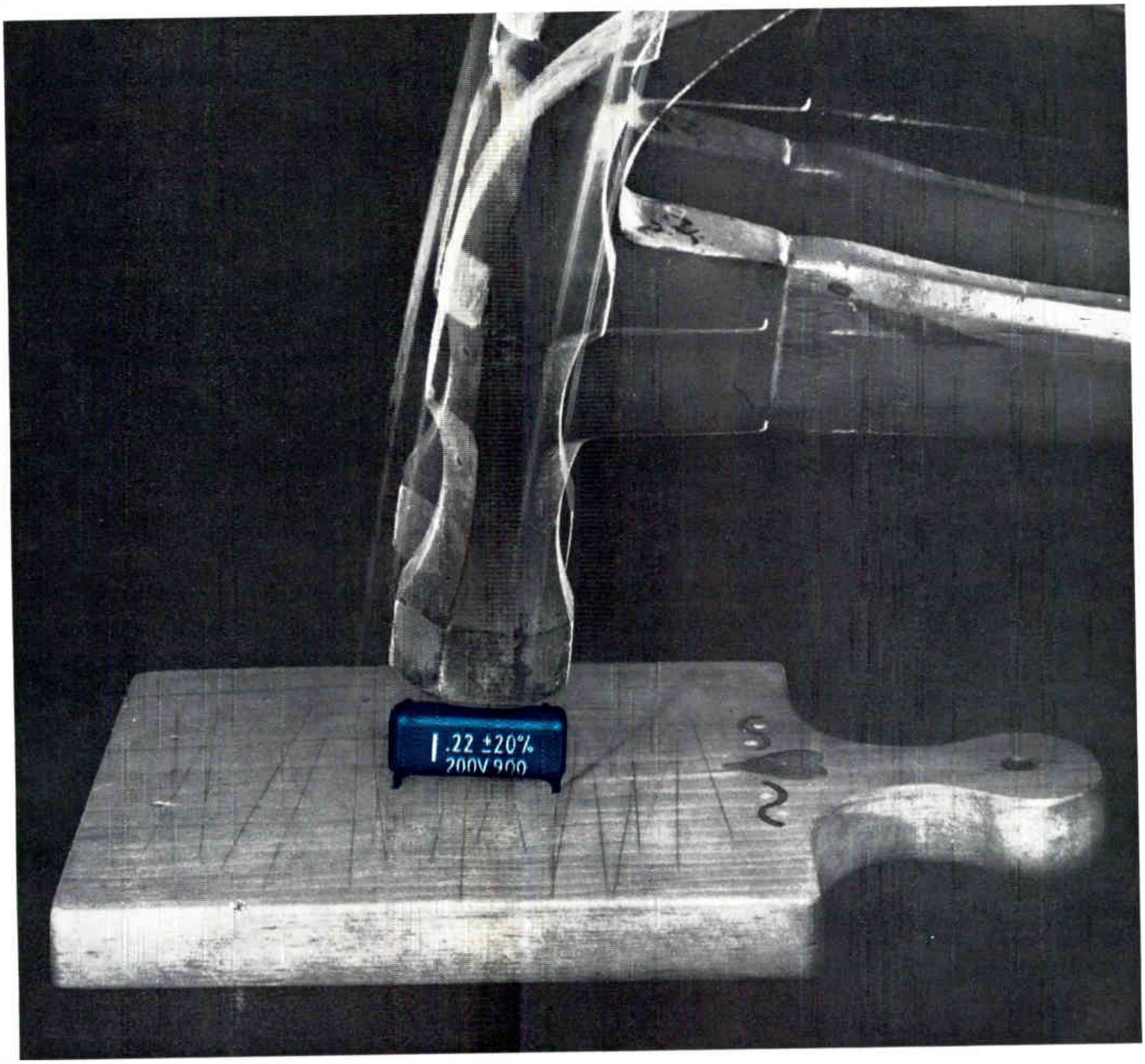

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To keep the project reliable . . . get PAKTRON® hi-blu T.M. capacitors on the breadboard. These miniature high performance polyester film capacitors meet the exacting needs of a wide range of industrial, commercial and military applications. PAKTRON hi-blu capacitors deliver working voltages, capacitance values, tolerances, and an operating temperature range you'd expect to find in much larger (and much more expensive) capacitors. They also look good. We'll be glad to send samples.

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- Working Voltages: 100 to 600 WVDC
- Tolerances: ±5% to ±20%
- Operating Temperature Range: −55°C to +125°C

MB-1180 Series
1.180 inches long, maximum. Capacitance values 0.5 mfd.

MB-800 Series
.800 inches long, maximum. Capacitance values to 0.1 mfd.

MB-550 Series
.550 inches long, max. Capacitance values to 0.015 mfd.

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DIVISION ILLINOIS TOOL WORKS INC.
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NEW ELECTRONIC NANOVOLT NULL DETECTOR

Keithley simplifies measurements using high accuracy potentiometers and bridges

Here's an all-new instrument created especially for sensitive potentiometers and bridges The 147 electronic null detector gives you resolution of 0.01 microvolt with a 300 ohm source resistance; 0.003 microvolt with 10 ohms. Zero shift of less than 1 x 10^{-10} volt per ohm; drift under 25 nanovolts per day; and high line frequency rejection make the 147 a remarkable, universal replacement for even the finest galvanometer systems.

Electronic circuitry provides up to 100 microvolts of zero suppression and makes the 147 immune to mechanical vibrations. Overloads of 60 million times, at maximum sensitivity, are shrugged off in 20 seconds. It's a rugged, easy-to-use package requiring no auxiliary devices and—it works on line or battery.

The 147 is an ultra-sensitive voltmeter, too, with 2% full scale accuracy, an output voltage of 1 volt and a noise level of less than 3 nanovolts, peak-to-peak, on the most sensitive range.

Write today for more information and your free copy of "The Use of Keithley Null Detectors with High Resolution Potentiometers and Bridges".

MODEL 147 FEATURES

5000:1 ac input rejection
<15 nv zero shift with source resistance to 300 ohms
30 nanovolts (0.03μv) full scale sensitivity
180 db ac line frequency rejection
10^{10} ohms input isolation shunted by 0.001 μfd
$1275

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for null detector or microvoltmeter applications

MODEL	SENSITIVITY (μv)	PRICE
148	0.01	$1275
149	0.1	$ 895
150A	1.0	$ 750
151	100	$ 490

KEITHLEY INSTRUMENTS
12415 Euclid Avenue • Cleveland 6, Ohio

electrometers / differential voltmeters / picoammeters / calibration devices

COMING EVENTS

August

Aug. 18-20: Nat'l Mtg. of American Astronautical Soc., AAS; Sheraton-Palace Hotel, San Francisco, Calif.

Aug. 23-27: 6th Int'l Conf. on Medical Elect. & Biological Eng'g, IFMEBE; Tokyo, Japan.

Aug. 24-27: Western Electronics Show & Conf. IEEE, WEMA; Cow Palace, San Francisco, Calif.

Aug. 30-Sept. 1: Antennas & Propagation Int'l Symp., IEEE; Sheraton Park Hotel, Washington, D.C.

September

Sept. 8-10: 13th Annual Indus. Elect. & Control Inst. Conf., IEEE; Sheraton Hotel, Phila., Pa.

Sept. 13-14: 13th Annual Joint Eng. Mtg. Conf., IEEE-ASME; New York Hilton Hotel, New York, N. Y.

Sept. 13-15: 12th Annual Petroleum Industry Conf., IEEE; Sheraton-Lincoln Hotel, Houston, Tex.

'65-'66 Highlights

WESCON, Western Electronic Show & Conv., Aug. 24-27, IEEE, WEMA; Cow Palace, San Francisco, Calif.

Nat'l Electronics Conf., Oct. 25-27; McCormick Place, Chicago, Ill.

NEREM, Northeast Research & Eng. Mtg., Nov. 3-5, IEEE; Boston, Mass.

IEEE Int'l Conv., Mar. 21-24, 1966; Coliseum, New York Hilton, New York, N. Y.

Sept. 13-17: 6th Int'l Elec'l Insulation Conf., IEEE; New York Hilton Hotel at Rockefeller Ctr., New York, N. Y.

Sept. 19-22: Nat'l Power Conf., IEEE, ASME; Shine-Ten Eyck Hotel, Albany, N. Y.

Sept. 22-24: Int'l Conv. on Military Electronics (Mil-E-Con 9), IEEE; Washington Hilton Hotel, Washington, D. C.

Sept. 23-25: 15th IEEE Broadcast Symp., IEEE; Williard Hotel, Washington, D. C.

Sept. 24-25: 13th Annual Comm. Conf., IEEE; Cedar Rapids, Iowa.

Sept. 28-29: 7th Biennial Heating Conf., IEEE; Hotel Carter, Cleveland, Ohio.

Sept. 29-Oct. 1: 12th Nat'l Vacuum Symp., Am. Inst. of Physics; Hotel Statler-Hilton, New York, N. Y.

October

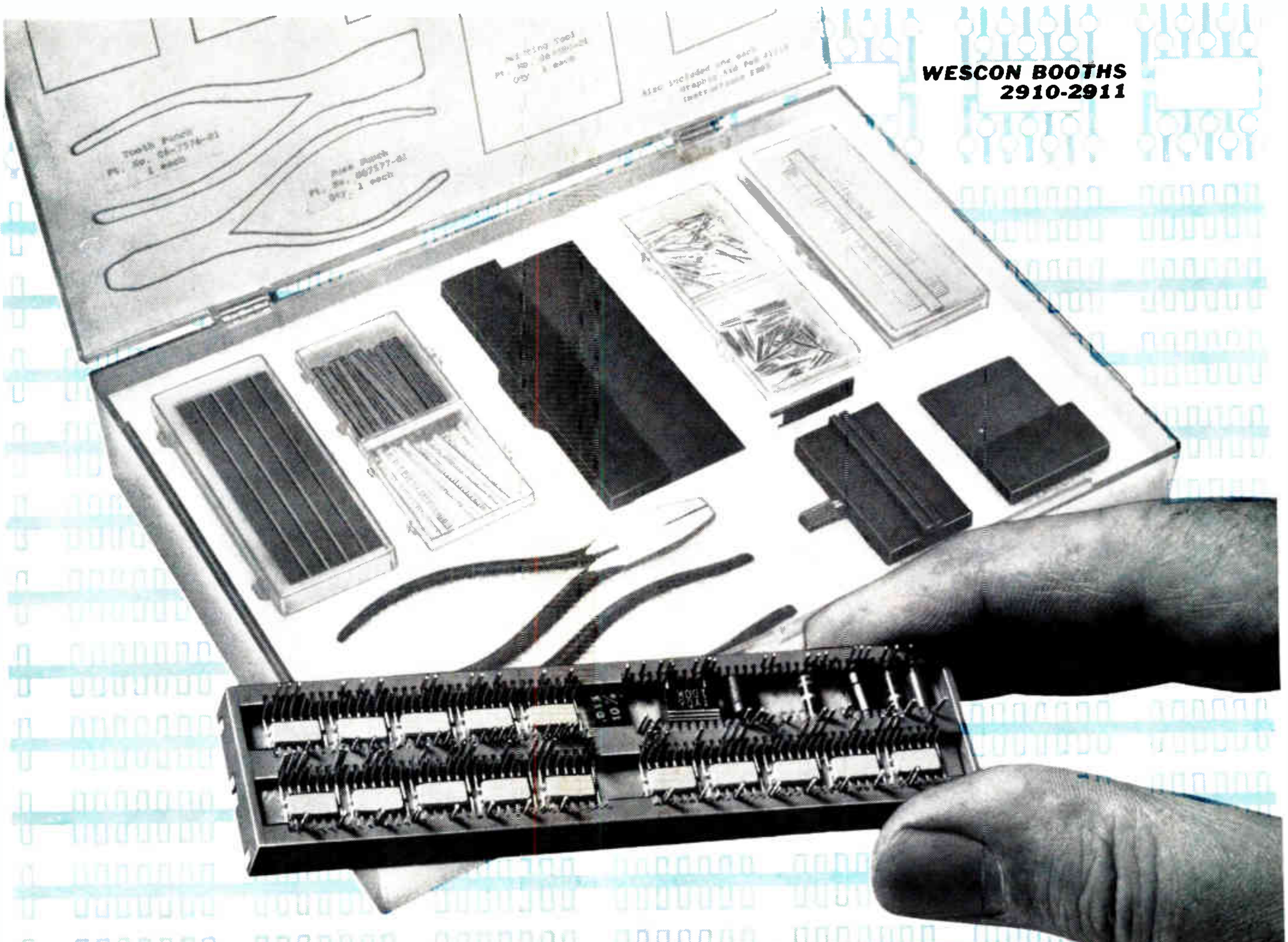
Oct. 4-6: Fall URSI-IEEE Mtg., IEEE; Dartmouth College, Hanover, N. H.

Oct. 4-6: 1965 Canadian Electronics Conf., IEEE; Automotive Bldg., Toronto, Canada.

Oct. 4-7: Instrument Soc. of America Conf. & Exhibit, ISA; Los Angeles Sports Arena, Los Angeles, Calif.

Oct. 12-13: 3rd Annual Product Maintainability Seminar, ASQC; Sheraton Motor Inn, Phila., Pa.

World Radio History



DO-IT-YOURSELF INTEGRATED CIRCUITRY?

YES! WITH THE NEP/CON-WINNING, ELCO OMNI-COMB* INTERCONNECTING CARRIER†. . . IN COMPLETE KIT FORM

You can now design, package and interconnect integrated circuits yourself—before everybody gets into the act, often with confusion, great expense and failure as the total output. Our Kit of just 5 component groups enables you to create 5 reliable packages, with up to 20 flat packs and 14 layers of interconnecting wiring, in just 1.2 cubic inches per package. How? Via our ingenious Universal System which allows you an endless variety of analog and digital sub-assemblies for prototype or production level. Kit contains Carriers; ELCO OMNI-COMB* Conductors; Retaining Clips; External Insulators (for up to 40 contacts on .050″ centers); and 2 types of contacts —reliability-proven ELCO BI/CON* contacts and square-nose, straight through type. Also included are all Tools and Instructions; as well as Graphic Aid Tablet to design your circuit the way you want it—before everybody gets into that act. Better send for all the details and prices at once. Right?

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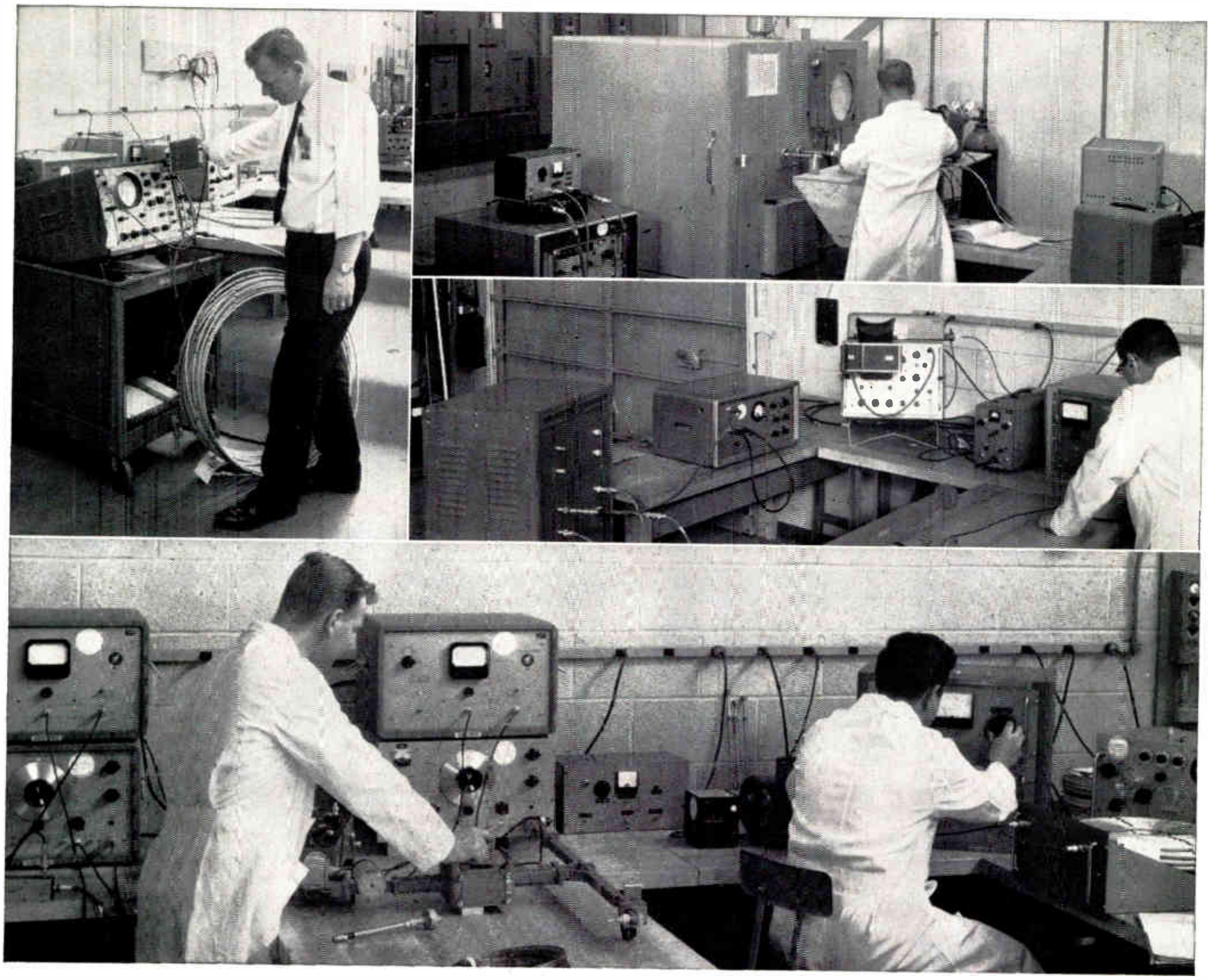

Have you been buying your coaxial cable by the twelve inch foot? Here is a new set of rules to specify by.

When you buy coaxial cable, by the mile or the foot, straight lengths or shaped, you buy a passive element for the transmission of a signal. Why settle for less than the *now available* in accuracy of electrical or mechanical length? Newly developed techniques in testing and measuring permit you to establish new parameters in coaxial cable performance, to a degree never before possible.

Whether you are considering standard Styroflex® coaxial cable, Helical Membrane, Foamflex or Corr-O-Foam. Or, if your application calls for an entirely fresh approach in cable design, we now establish these new extensions of the state-of-the-art: Delay Time: accurate to .02 ns. Phase Length: accurate to 0.4° relative. VSWR: accurate to 1.01. Insertion Loss: 0 to 40 db ± 0.5 db, 40 db to 60 db ± 1.0 db. Impedance: absolute value of average, 1%. Impedance Discontinuities: accurate to 0.2%.

Tell us about your requirements. Or request Bulletin SF-1 for full details.

PHELPS DODGE ELECTRONIC PRODUCTS
NORTH HAVEN, CONNECTICUT

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NOW 2 LITTLE DANDYS WITH 3 BIG DIFFERENCES

Newest Little Dandy Soldering Iron from American Beauty has higher wattage and larger tip than famous original, and has a green handle for easy identification by operators.

SAME FEATURES FOR BOTH

Combination of low price and American Beauty quality.

Ruggedness to stand production-line conditions. Working heat in 2 minutes. Longest-life heating element with non-ceramic insulators.

Molded handles, impervious to oil, perspiration. Unbreakable crystal, aerated fingertips, guaranteed cool. Unprecedented handling ease, balance. Non-roll design.

Plug-type tips. 30-second replacement of every major part, including heating element.

Three wattage options for each (No. 3110: 25, 30, 35—No. 3112: 40, 50, 60). 18 tip options each. 2- or 3-wire super-flex, melt-proof cords.

·Paragon·
QUALITY

TIPS RECOMMENDED

American Beauty's "Paragon" quality, clad tips bring same kind of advance to precision soldering that carbide bits brought to high-speed drilling work.

They have many times the life of old-style tips, re-tin themselves, are flake-proof, and remove easily for replacement. "Paragon" quality tips are optional at extra cost on most irons, including Little Dandys.

NEW, BIGGER LITTLE DANDY SOLDERING IRON INTRODUCED BY AMERICAN BEAUTY

In late 1964 American Beauty brought out a new kind of miniature soldering iron, combining unprecedented features and quality at an economy price. Called the Little Dandy No. 3110 it soon became the fastest selling miniature iron in the history of the industry.

Now a larger Little Dandy, the No. 3112, is available. The No. 3112 has wattage options up to 60W, a high-capacity ¼″ tip. It has a green handle so operators can easily tell it from the No. 3110 (which has a gray handle).

The new Little Dandy is now stocked by all American Beauty Distributors.

American Beauty Division, American Electrical Heater Company, Detroit, Michigan.

American Beauty

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World Radio History

WASHINGTON TRENDS

WAR CONTROL URGED—War Control Planners, Inc., is urging the Johnson Administration to "lead all nations out of the danger of war" by development and simultaneous operation of a world-wide complex of electronic surveillance and detection systems. The Defense Dept., refusing to either endorse or condemn the surveillance plan of WCP, ducks the issue by saying that this subject is primarily a political problem and therefore out of its bailiwick. Neither Pres. Johnson nor Vice Pres. Humphrey will publicly comment on the WCP proposal, which clearly indicates that they consider it impractical to the extent that it does not conform to existing Johnson Administration thinking of world peace and disarmament. Briefly, what WCP proposes is a global communications network feeding data into electronic computer centers. Sensing devices around the world would instantly detect radioactivity or bacteria concentrations. Some congressmen have reacted in favor, but most Senate and House members take their cues on national defense from the White House, and there is frankly no reason to believe at this time that any responsible official in the Johnson Administration will "buy" the WCP proposal.

ANTENNA FIGHT CONTINUES—Controversy over the height of radio and television antennas, and the grouping of tall ones in so-called "farms" isn't over yet despite proposed FCC rules. The Federal Aviation Agency still wants Congress to legislate a ban on towers over 2,000 ft., and lawmakers want to make sure that this limit is imposed. The FCC proposes to issue a regulation to set up antenna farms and reject all applications for antenna towers higher than 2,000 ft. except in the most special cases.

END OF THE EXCISE TAX

James D. Secrest, Executive Vice President of the Electronic Industries Association, with President Johnson at White House ceremonies for signing of the Excise Tax Repeal Law. EIA Consumer Products Division spearheaded campaign to bring repeal of manufacturers excise tax on electronic home entertainment products.

FCC AND INTERFERENCE RULES — Congressional leaders say there is a good chance that the FCC will finally get its requested legislation enabling it to adopt regulations governing the manufacture, import, or use of devices that may cause radio interference. The prospect stems from a change of heart by the Electronic Industries Association, which in the past has flatly opposed the measure as unnecessary government regulation of private manufacturing operations.

COMMERCIAL TV TO SATELLITES—Another satellite will carry commercial TV if plans at Communications Satellite Corp. (COMSAT) materialize. COMSAT is convinced that such a system is feasible. The vehicle would be able to transmit 12 channels at one time and thus could handle all domestic commercial TV needs. American Broadcasting Co. has disclosed its own project for a launching. COMSAT lawyers believe COMSAT has an exclusive franchise; they will oppose individual company efforts.

CATV SEEN AS THREAT—CATV (community antenna television) may be as big a threat to radio as it already is to TV broadcasting, NAB Pres. Vincent T. Wasilewski warns. There's nothing to prevent a CATV operator from carrying signals from major cities that offer heavily-financed programs, he points out. The FCC is willing—even eager—to extend its regulatory authority over the CATV industry. But Congress must write such authority into law.

GOV'T SCIENCE ROLE PROBED — Congress is taking a close look at the National Science Foundation. Object: Is the 15-year-old Foundation, with its multi-million budget, truly responsive to the current needs of industry and government? Nearly six weeks of public hearings by the House Science & Astronautics Committee have concluded. Goal of Committee Chairman Emilo Q. Daddario (D.-Conn.) is to find out—"What is the government omitting to do in the field of science that it should be doing? And what is it now doing that is no longer needed?"

INDUSTRY FIGHTS PATENT FEE—Industry is opposing a measure in Congress to impose a new patent maintenance fee designed to recover for the government some 75% of the cost of running the U. S. Patent Office. The Electronic Industries Association and industry complain that the fees would constitute a direct tax on patents. The proposal calls for regular "maintenance fees" for maintaining a patent over its full life. Industry favors higher initial fees instead of the maintenance fee. The proposal includes a $10 fee for each independent claim after the first one, higher fees for specs and drawings, and a $20 assignment fee.

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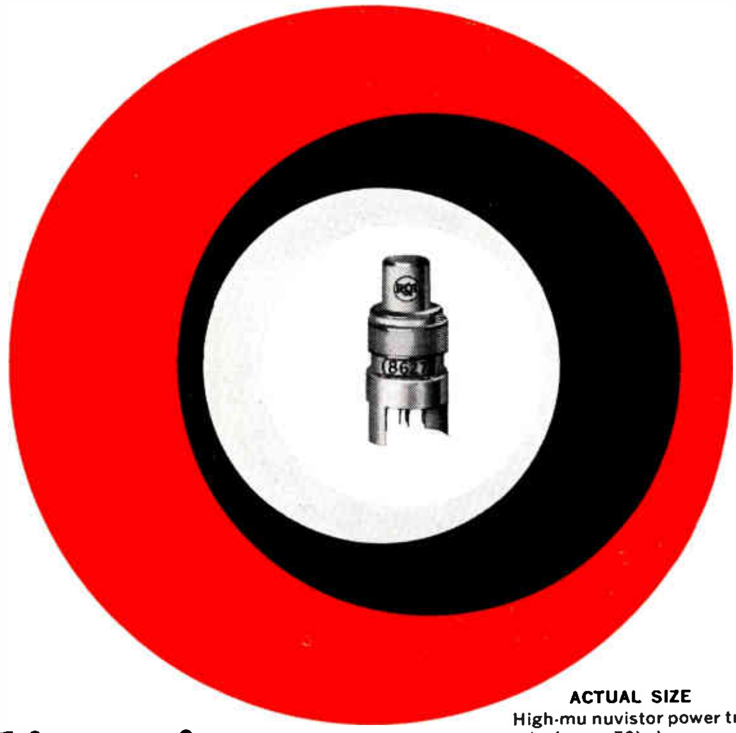
1.4w P_{OUT}, 10 db P_{GAIN}, at 1Gc



ACTUAL SIZE
High-mu nuvistor power triode (mu = 70); low-power cathode-drive Class C service in frequency range 400 to 1200 Mc; cw power amplifier, oscillator, frequency multiplier. Wt.—2.2 grams.

The new RCA-8627 nuvistor triode in 1000 Mc applications provides an overall output-to-input power efficiency of 33% and a plate efficiency of 40%.

Outstanding performance at a very attractive price...$8^{50} each.

Current equipment manufacturers' bulk price in quantities of 50 or more. (Subject to change without notice)

To the circuit designer, the new RCA-8627 nuvistor offers all the benefits of the unique nuvistor concept of electron tube construction: essentially constant transconductance over a very wide temperature range, dependable performance in the presence of both pulse and steady-state nuclear radiation, low RF noise, low sub-audio noise, 1000 g shock rating, high reliability and exceptional uniformity of electrical characteristics from tube to tube and throughout life. It also gives the designer the opportunity to assemble highly efficient, small-size and light-weight coaxial circuit configurations.

Be sure to evaluate the RCA-8627 nuvistor for any cathode-drive Class C 400-to-1200 Mc power amplifier, oscillator or frequency-multiplier applications. For more information, call your nearest RCA District Office or write RCA Commercial Engineering, Section H50DE Harrison, New Jersey 07029.

RCA-8627 cathode-drive amplification characteristics at 1 Gc		
Power Gain	10	db
Useful Power Output	1.4	watts
Driving Power (approx.)	0.14	watt
Plate Efficiency (approx.)	40	per cent
Heater Power (150 ma at 6.3 v)	0.95	watt

RCA Electronic Components and Devices, Harrison, N. J.

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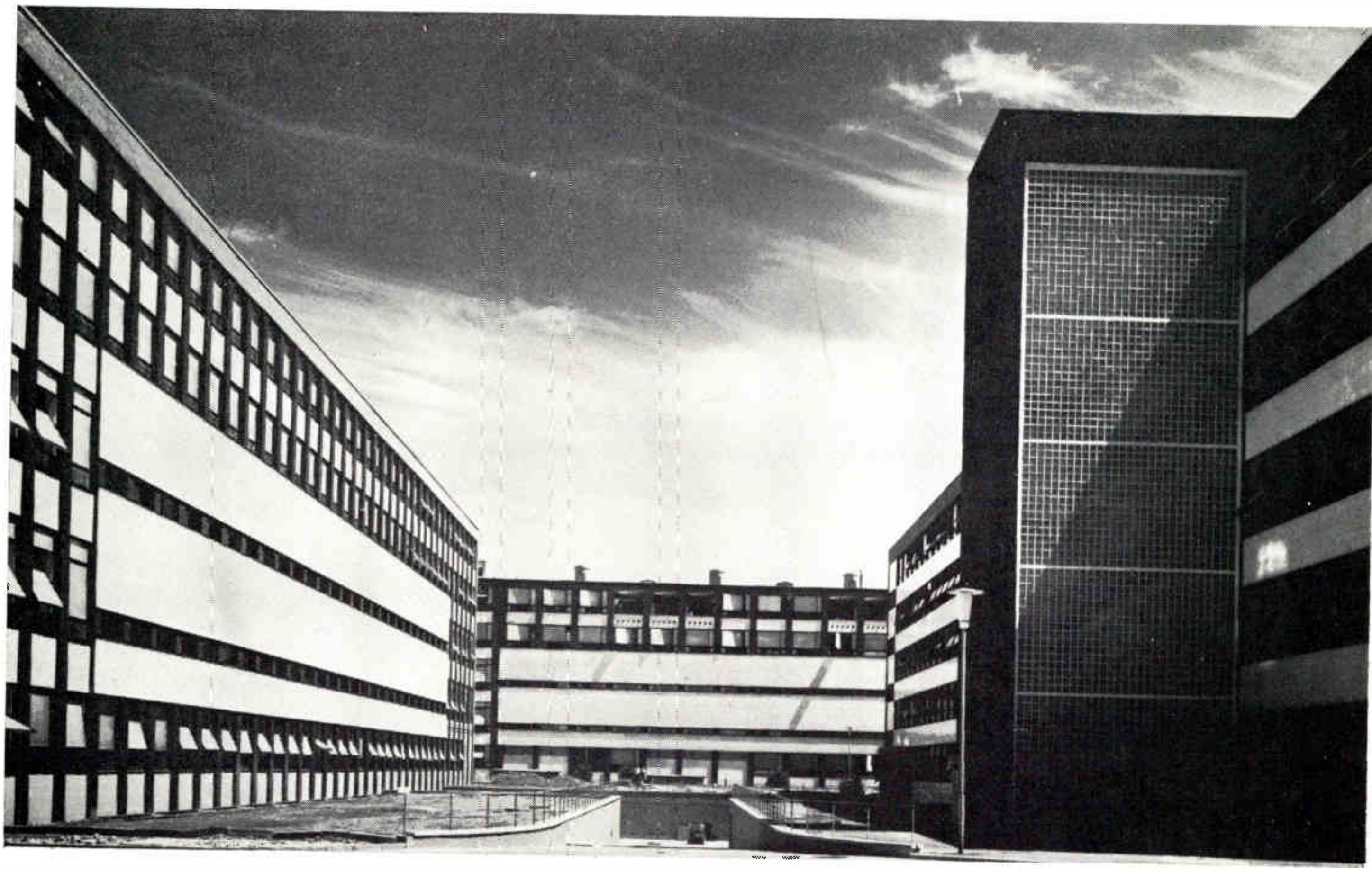
This is Siemens

Serving the entire field of electronics and nucleonics, the Siemens Group is one of the world's most diversified electrical engineering organizations.

The particular strength of the Siemens Group is in its all-round capabilities—both in the overall handling of large-scale technical projects, from planning to final delivery, and also in the quantity production of electrical components and electronics devices. Distribution companies and agencies in 80 countries, backed by Siemens factories and hundreds of depots maintained in all parts of the world, guarantee customers a maximum of service. In cooperation with their central offices, they provide or arrange for every conceivable form of service that may be required in connection with electrical installations.



Siemens & Halske AG
Components Division

World Radio History

SIEMENS

Siemens ferrite pot cores

Precision-engineered for adjustable, high-stability, high-Q coils

These pot cores meet the most critical requirements for filters used in multiplex and other carrier-frequency applications. They're unique in performance because of these built-in advantages—easy adjustment to precise inductance, high stability, high Q, low distortion, plus self-shielding that allows compact component density without regeneration or coupling.

Unique manufacturing controls Siemens pot cores offer uniform electrical characteristics month after month—complete dependability to close standards.

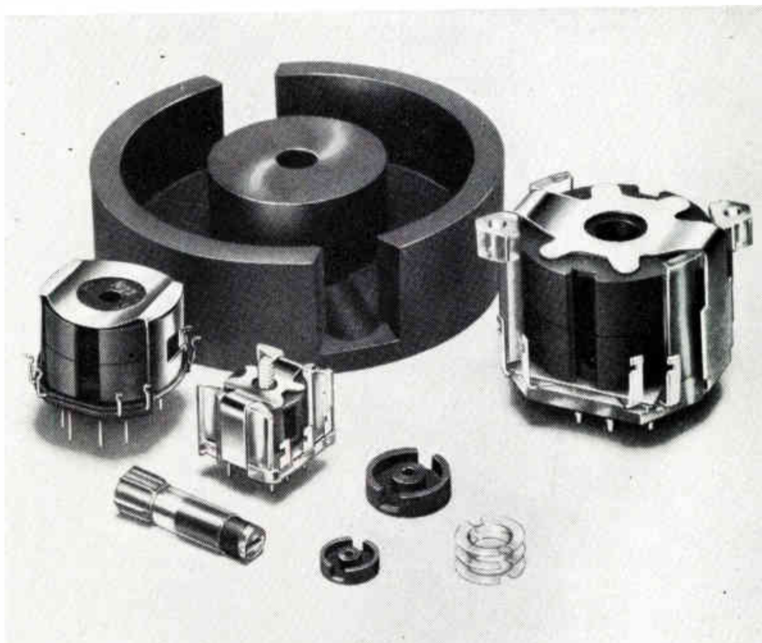
Wide range of materials 7 different types provide optimum properties for frequency ranges up to 40 mc/s for oscillating and filter coils—up to 400 mc/s for transformers.

Wide range of sizes Diameters range from 0.22″ to 2.75″ including all International Standard Sizes. Most of the listed pot core sizes, materials, and A_L values are stocked for immediate shipment from White Plains, N.Y.

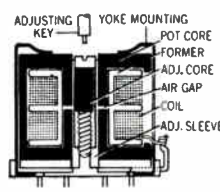
Stability Less than 0.2% change in permeability in 10 years at temperatures up to 70° for typically gapped cores used in filter coils.

Temperature coefficients are closely controlled.

High Q value with high stability is typical. For example, a 26 x 16 core of N22 or N28 material A_L 315 at 100 kc/s shows a Q value of approximately 950.



Complete line of "hardware" includes coil formers with one to four sections, mounting assemblies for chassis or printed circuits, adjustment devices and keys.



WRITE NOW for complete information on Siemens pot core application

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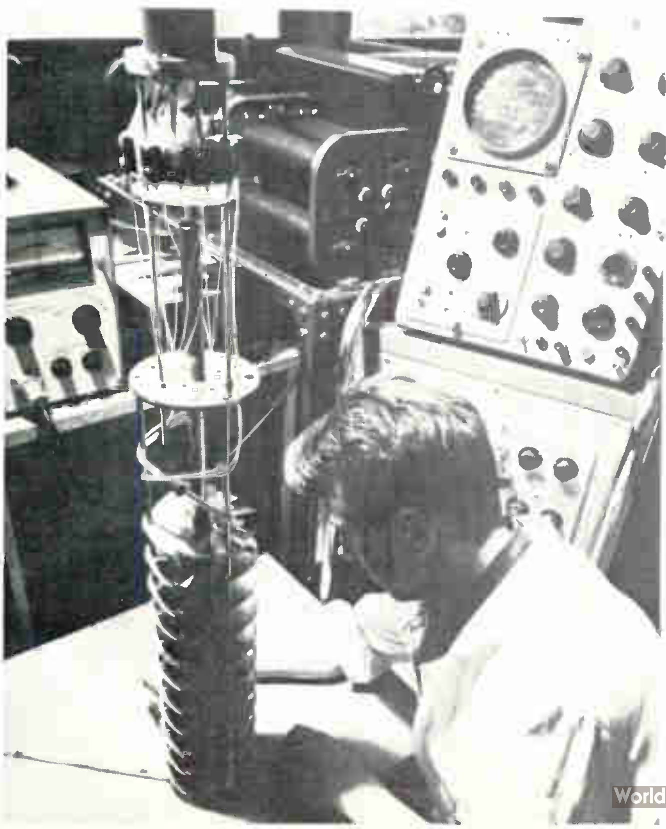
▲ TEMPERATURE READER

View from a basic oxygen steel furnace of new General Electric Jet-B.O.P. temperature reading device, which is dropped into molten steel from 45-foot height. Temperature is read/recorded in 10 sec. Jet-Temp disposable thermocouple is platinum-rhodium in quartz.



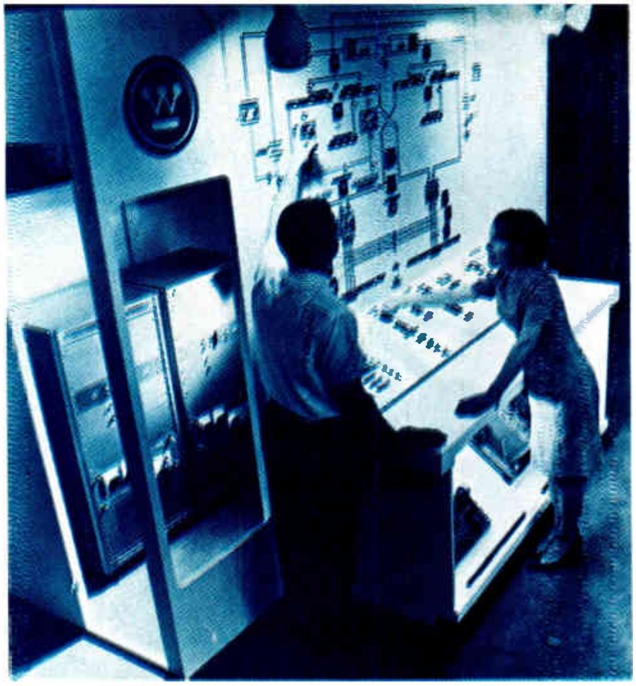
ELECTRONIC SNAPSHOTS

The changing STATE-OF-THE-ART in the electronic industries.

◀ COLD LEVEL IN FRANCE

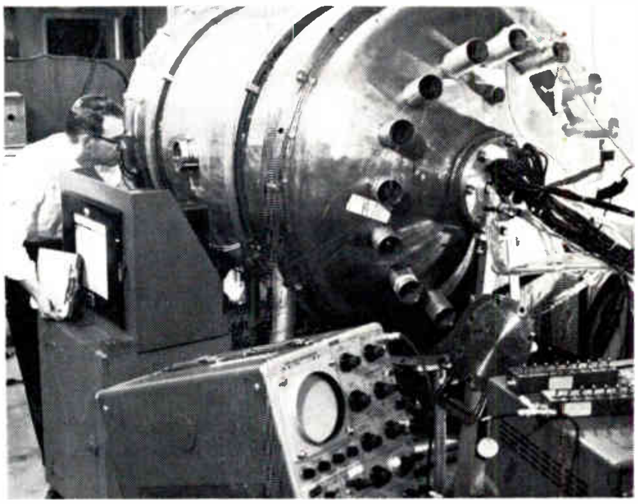
Engineers at Air Liquide's new Cryogenic Studies Center in Sassenage, France, are contributing to world knowledge on the phenomenon of superconductivity in which resistance ceases around 4°K. Here engineer prepares device for super-cool experiment.

World Radio History



◀ **SPACE POWER**

Electric power system simulator for space power developed by Westinghouse Aerospace Electrical Division, built to fill need for system compatibility testing of space electric power system design concepts/components.

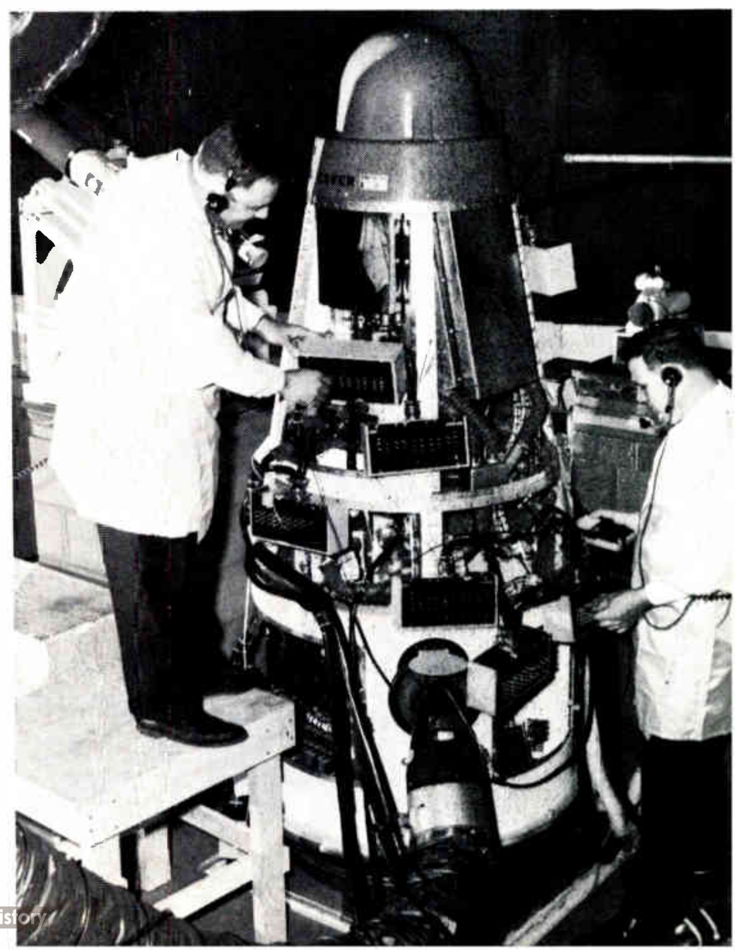


◀ **TESTING SPACE ELECTRONIC GEAR**

Equipment for orbiting observatory that will help determine origin of stars being tested in thermal-vacuum chamber from –70° to +160°F. at Sylvania Electric Products Inc. Equipment in test are EDP and programming devices, guidance systems and power supply.

▼ **INERTIAL GUIDANCE SYSTEM**

Technicians adjust stellar inertial guidance equipment developed by General Precision Aerospace Systems Division and tested from Cape Kennedy. Vehicle also includes power attitude control, telemetry, instrumentation and signal conditioners as support systems.



▼ **DESERT TV**

Closed-circuit TV for desert operations, by Cohu Electronics Inc., includes 2000 series miniaturized camera with sun hood, automatic shutter to protect vidicon, sun filter, and 10:1 zoom lens. Girl demonstrates three of series available in 10 or 20mc bandwidths.

World Radio History

Midgets and specials for electronic assemblies

A cutter that cuts clean and holds the crimped end . . .

One that cuts and crimps wiring on a printed circuit for efficient dip soldering . . .

A trimming plier, flush cutting . . .

A needle nose plier that reaches deep into miniature assemblies . . .

These and dozens of other pliers are available from stock in the complete Klein line. In fact, here you will find pliers exactly designed for any electronic system where clean cutting accuracy, crimping and bending are necessary in extremely confined space.

The Klein line of specially designed electronic pliers offers a plier exactly designed for each specific job—saving time, speeding assemblies, assuring a better product. For complete information write for the Klein catalog on electronic pliers.

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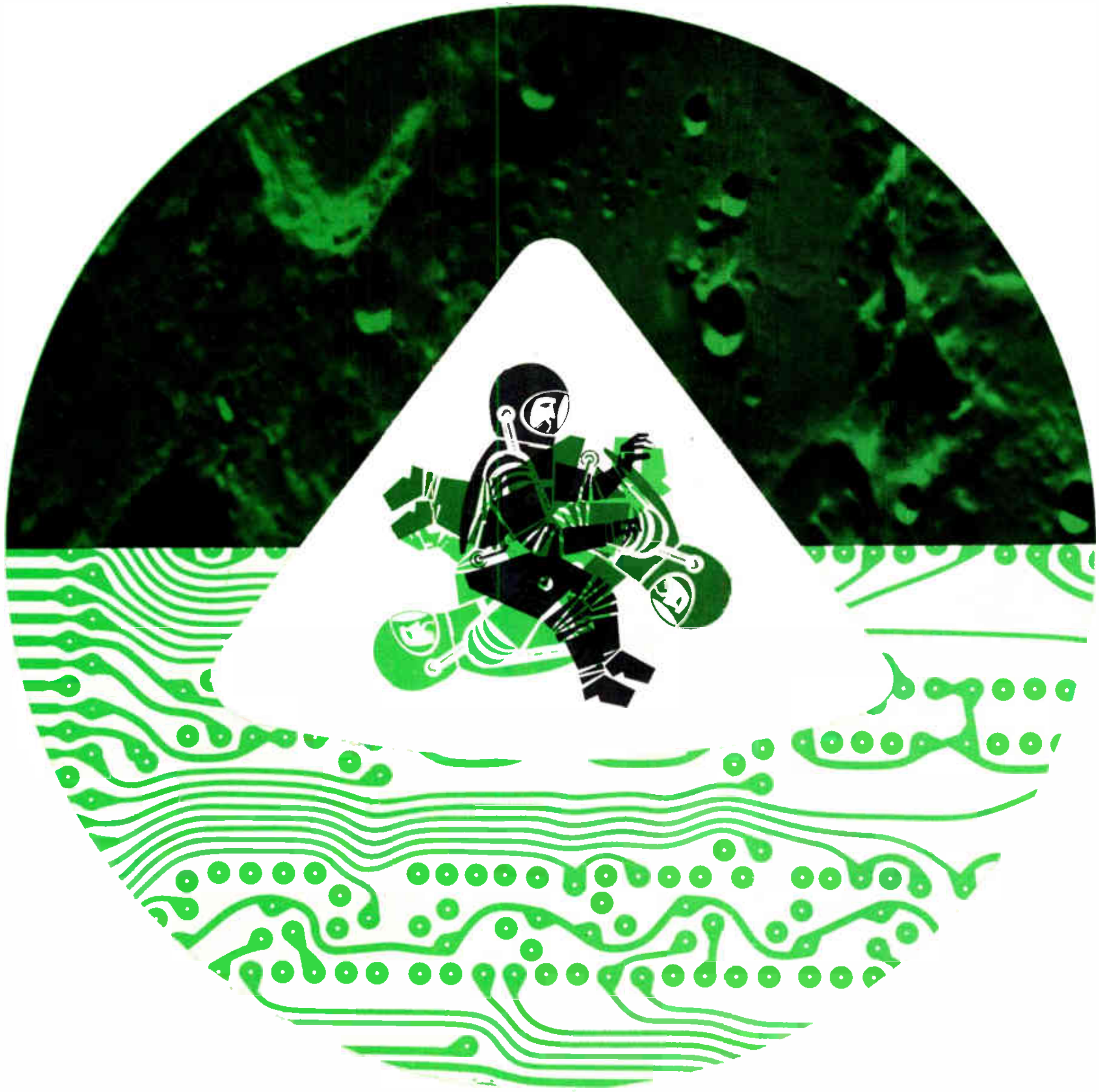

Apollo crews fly make-believe by hybrid computer

Training Apollo astronauts for their first trip to the moon is a complex study in simulation. Astrodata married a digital computer and an analog computer to produce a hybrid system qualified to help with this teaching job. The Astrodata system will simulate the Apollo launch, midcourse maneuvering, moon landing and earth's atmosphere re-entry. Astronauts inside an Apollo capsule will be trained in these simulated phases of the trip and their ability to react to over 2000 possible failures and malfunctions will be tested.

This is the largest hybrid computer yet built. The analog computer, provided by Astrodata's subsidiary, Comcor, Inc., has over 400 operational amplifiers, 30 function generators, 40 multipliers and 60 summing amplifiers.

A solid-state switch increases, by over a thousandfold, the speed of switching from one part of the problem to another. In the computer linkage system there are 104 DAC's, 48 channels of analog information multiplexed into the ADC and 180 channels of multiplexed digital information.

Perhaps you don't have to make a fledgling astronaut into a moon man, but you do have other problems in the data acquisition and processing, telemetry, or range timing instrumentation fields where Astrodata's vast experience in dynamic information handling and hybrid computer techniques can help you. *Write for your free copy of our 20-page brochure, "Astrodata's Systems Experience."*

ASTRODATA

P.O. Box 3003 ▪ 240 E. Palais Road, Anaheim, California ▪ 92803

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World Radio History

DOC REPORTS 147% RISE IN SEMICONDUCTOR INDUSTRY

Value-added-by-manufacture for the semiconductor industry in 1963 amounted to $461 million, an increase of 147% over 1958, according to a preliminary report of the 1963 Census of Manufactures issued by the Department of Commerce, Bureau of the Census.

"Value-added . . ." approximates the value of products shipped less the cost of materials used to manufacture the products.

Manufacturers shipments of semiconductors in 1963 were valued at $680 million, an increase of 172% over 1958, year of the previous Census of Manufactures.

There were 103 plants in the industry in 1963 employing 55,995 persons. In 1958, 48 plants employed 23,370. The payroll increased from $113 million to $318 million during the same period.

EQUIPMENT BECOMES PRIZES IN INDUSTRIAL PROMOTIONS

To help marketing efforts, manufacturers often offer electronic appliances as prizes in consumer contests. In recent months the same idea seems to have bridged over into the industrial market where electronic equipment and instruments are offered as prizes and premiums in industrial promotions. One distributor even gave away money prizes to stimulate component sales.

Fairchild Semiconductor recently tied in with the finished prize. Design engineers were asked to suggest a unique and economical use for an integrate circuit component. Two winners received a hi-fi rig using Fairchild's silicon Planar transistors.

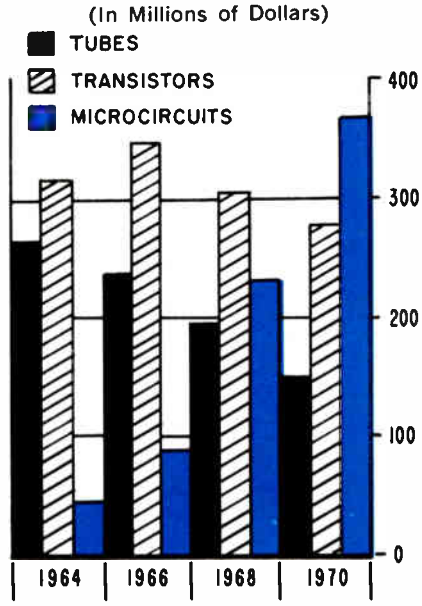
ATMOSPHERE SCIENCE GROWS AS RESEARCH MARKET

The U.S. atmospheric sciences program, including weather modification, has grown from a budget of $2.9 million in Fiscal Year 1959 to $20.2 million in 1964—a growing research market. Of this, the National Science Foundation support for weather modification research in Fiscal Year 1964 was about $1.57 million for 20 projects.

About $6 million was used to support the National Center for Atmospheric Research and $5 million went for basic atmospheric research. The rest was used for projects adjunct to special expeditions and for university studies.

PROJECTED SALES TRENDS OF COMPONENTS

(In Millions of Dollars)



(Electronic Industries estimates based on data from EIA, Dept. of Commerce, and other sources)

INSTRUMENTS WILL KEEP SALES PACE, SURVEY FINDS

Manufacturers of scientific precision equipment have prospered from soaring national expenditures for research and development in the past decade. A new report just issued by The Value Line Investment Survey states that although spending in these areas by defense-oriented industries may not expand as rapidly in the years ahead, vast new markets for precision instruments are emerging in other fields.

The report points to three areas which may serve as springboards for increased sales: (1) the projected upsurge of college and university enrollments will require increased expenditures for scientific apparatus and equipment, (2) rising medical and health spending will soon be accelerated by government outlays under Medicare, (3) new photographic equipment for consumers and industry.

The Value Line report estimates that 1965 sales of companies in the precision instrument industry will rise 11% over last year's level and that this will be translated into a 23% boost in earnings.

BIOMED. ELECTRONIC SALES MAY TRIPLE BY 1975

According to a study released by PREDICASTS, sales of biomedical electronic equipment and systems have grown from $102 million in 1954 to some $267 million in 1964.

Between 1964 and 1975 sales of biomedical equipment are expected to more than triple. Such equipment, at present, includes ultrasonic diagnostic systems, lasers, prosthetic devices, automatic biomedical laboratory equipment, medical scientific data processing systems and patient-monitoring systems.

According to the report, diagnostic equipment sold for around $81 million in 1964 and may bring $150 million in 1975. Biggest growth potential is in data processing equipment at $40 million in 1964, projected to $325 million in 1975.

Other types of equipment include therapeutic, $69 million in 1964 and $135 million in 1975; laboratory equipment and instruments, from $32 million to $90 million, and patient monitoring systems, from $45 million to $195 million. Projected growth is from a total of $267 million in 1964 to some $895 million in 1975.

DOD MARKS SOME PROGRESS IN DEFENSE BUDGET CUTS

Since the fall of 1962 the Defense Cost Reduction Program has managed to trim $1.4 billion from defense costs in FY 1963, reports Paul H. Riley, Deputy Assistant Secretary for Installations and Logistics. The Program has cut $2.8 billion in FY 1964, and $2.9 billion to date in FY 1965. About $4.1 billion already has been removed from the FY 1966 budget.

Earlier this year Defense Secretary McNamara had reminded the nation that in FY 1962 about 10% of the U. S. gross national product (GNP) was marked for defense. He predicted that this 10% will be reduced by one-fourth (that is down to 7.5%) by FY 1967. There will be a 25% cut in the defense budget in relative terms.

BRITISH TV EQUIPMENT CRACKING U. S. MARKET

Marconi television cameras and transmitters will be exported to the U. S. early in September for a new UHF TV station to be built by Television Chicago, a joint venture controlled by Field Communications Corp., subsidiary of Field Enterprises Inc.

This is reportedly the first time that British TV transmitters have ever been sold in the U. S., and the contract also included the first export sale for the new Mark V camera, recently introduced.

World Radio History

Who's first with integrated circuits in a counter/timer?

You're wrong...it's Monsanto!

Don't feel bad.

We have to admit, there are two or three names that come to mind before Monsanto when you think of electronic test instruments.

Til now. But the picture is changing.

And this Model 1000 Counter/Timer is the first reason why. (There will be others coming along right behind.) It originated from advanced state-of-the-art techniques developed in Monsanto's own research laboratories. The Model 1000 utilizes microelectronics in more than 90% of its circuitry. This makes it smaller (3½-inch high front panel), and lighter (only 16 pounds) than the counter/timers you're used to. Even more important, it gives you speed and accuracy that make the Model 1000 the best buy in the industry on a price/performance basis.

The Model 1000 will operate trouble-free for years because of the use of integrated circuits and functional simplicity in design. But if you ever *do* run into trouble, a printed board exchange will quickly take care of it. A two-year warranty backs it up.

We could go on, but here, take a look at the specs and see for yourself why Monsanto is now setting the pace in test instruments.

SPECIFICATIONS

Frequency Range	*0-20 MHz—AC or DC coupled*
Time Interval	*5 x 10^{-8} to 10^{7} seconds*
Resolution	*50 nanoseconds*
Input Sensitivity	*100 millivolt*
Input Impedance	*1 megohm, 20 pf.*
Display	*Seven in-line digits*
Coded Output	*1-2-4-8 BCD and write-command*
Accuracy	*± 1 count + osc. stab.*
Stability (1 hour warm up)	*3 parts in 10^{8}*
Size	*3½" h x 17⅝" w x 16¾" d*
Weight	*16 pounds*
Primary Power	*117 VAC ± 10%, 40-500 cycles (230 V Tap available)*

(Patents applied for. Specifications subject to change without notice.)

Monsanto
Electronics Department
800 N. Lindbergh Blvd.
St. Louis, Missouri 63166

Yes, I see there's a new leader in test instruments. Please send me details about the Model 1000 Counter/Timer.

Monsanto ®

Name/Title ______________________

Company ______________________

Address ______________________

City/State ______________________

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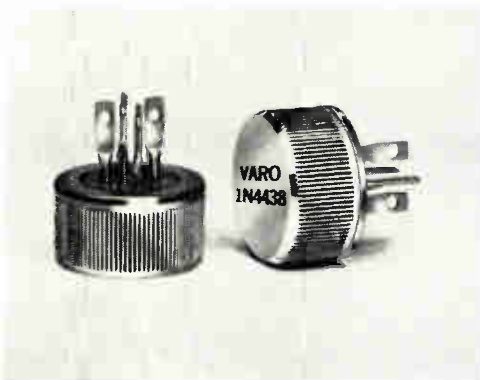
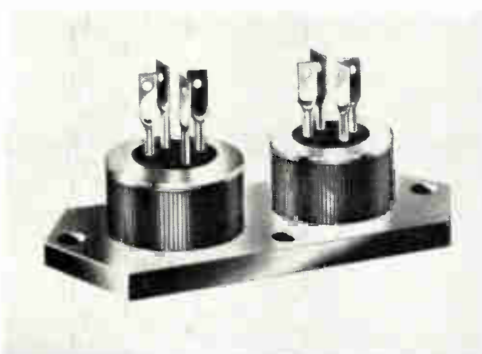
IBR®

SILICON AVALANCHE
INTEGRATED BRIDGE RECTIFIERS

Advanced design solutions for full-wave bridge and three-phase rectification





FULL-WAVE RECTIFICATION FROM ONE SMALL PACKAGE

The Varo IBR® Series offers engineers in the military, commercial and industrial market three reliable, low-cost solutions to problems requiring full-wave rectification: The 1N4436 (250 V BV_R min.), 1N4437 (450 V BV_R min.) and the 1N4438 (650 V BV_R min.).

All three devices feature a single integrated package with 2000 V min. circuit-to-case insulation, and all have SAR® (silicon avalanche rectifier) characteristics to control avalanche voltages and permit lower PRV design considerations. This series has 10 amps DC output current at $T_C = 100°$ C and a 100 amp one-cycle surge current rating.

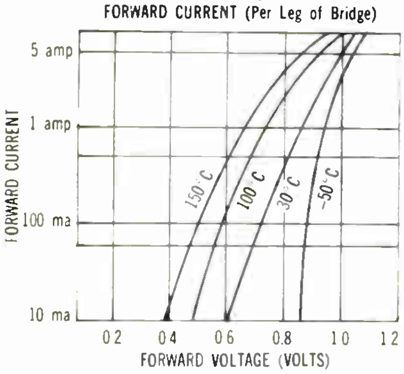
THREE PHASE, HALF OR FULL WAVE

The new IBR® 3-phase half-wave series, 45520 (common cathode) and 45521 (common anode), and the 3-phase full-wave series, 45524, solve a broad range of problems where space and cost requirements have previously prevented the use of semiconductors.

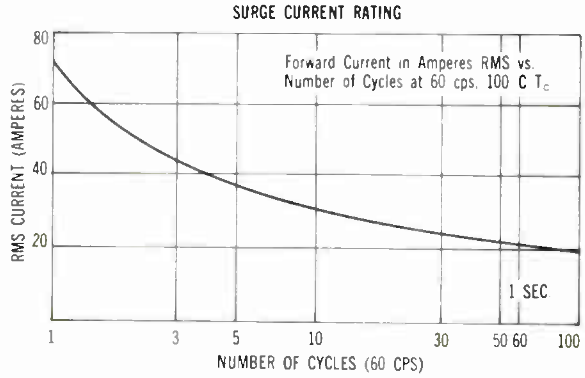
These new IBR®'s have 5 amps/leg DC I_O at 100° C (T_C), 100 amp one-cycle surge current and 2000 V min. circuit-to-case insulation, with 4°C/watt junction to case (θ_{J-C}) thermal resistance. Utilizing SAR® (silicon avalanche rectifier) characteristics, they are available with 250 V and 450 V min. avalanche voltages (BV_R).

Three versatile mounting configurations — press-fit, TO-3 and single stud — are available for all full-wave bridge and 3 ϕ half-wave IBR®'s. This feature further reduces installation time and cost of these advanced design devices.

FORWARD VOLTAGE DROP VS FORWARD CURRENT (Per Leg of Bridge)



SURGE CURRENT RATING



Also available from Varo: Series 7715X, high voltage, fast recovery time diffused silicon rectifiers at prices competitive with selenium rectifiers. Available with PRV ratings from 3 KV to 50 KV and 300 nanosec reverse recovery time.

BE SURE TO SEE VARO • BOOTH 1213-1214, WESCON

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World Radio History

Designed with space in mind

Fresh from our drawing boards and as new as the lunar probe is this A-MP* subminiature circular pin and socket connector. It gives you over *twice the number of contacts* available in conventional connectors of the same size. Compare the contact density of our subminiature connector with any MIL-C-26482 or 26500 type miniature connector and you'll see how "space conscious" our designers really were:

Shell Size	Contacts A-MP Subminiature Connector	Contacts Conventional Min. Connectors
18	85	32
16	58	26
14	37	19
12	26	10
10	14	6

All A-MP contacts have a .030" pin diameter and accommodate wire ranges 22-24 and 26-30 AWG. The contacts are gold over nickel plated and are terminated with a new four indent crimping tool.

Within the design parameters established for the A-MP subminiature circular connector was the elimination of the failure modes encountered in conventional miniature circular connectors. This was accomplished by providing a hard face insert to promote accurate contact alignment and stability; stainless steel shells with positive shell keying and bayonet coupling; the elimination of contact retention clips; a rear guide plate to protect the rear grommet from contact insertion damage; probe proof closed entry sockets; positive contact bottoming in a hard dielectric insert and a choice of front or rear contact extraction without a retention release tool.

In addition, this uniquely engineered connector is designed for all environmental conditions encountered by ground support, aircraft, missile and space applications.

Take a count down of these other space age features:

- Temperature range:—55°C to +150°C
- Altitude—110,000 feet
- Stainless steel shell provides shielding and continuous grounding.
- Retention value: 15 pounds per contact.

AMP's subminiature circular pin and socket connector is tomorrow's answer to your connector problems and it's available today! Write for complete information.

*Trademark of AMP INCORPORATED

AMP INCORPORATED
Harrisburg, Pennsylvania

INDUSTRIAL SALES DIVISION

A-MP* products and engineering assistance are available through subsidiary companies in: Australia • Canada • England • France • Holland • Italy • Japan • Mexico • West Germany

Meet us at the Wescon Show Booths 2609-11 and 2519

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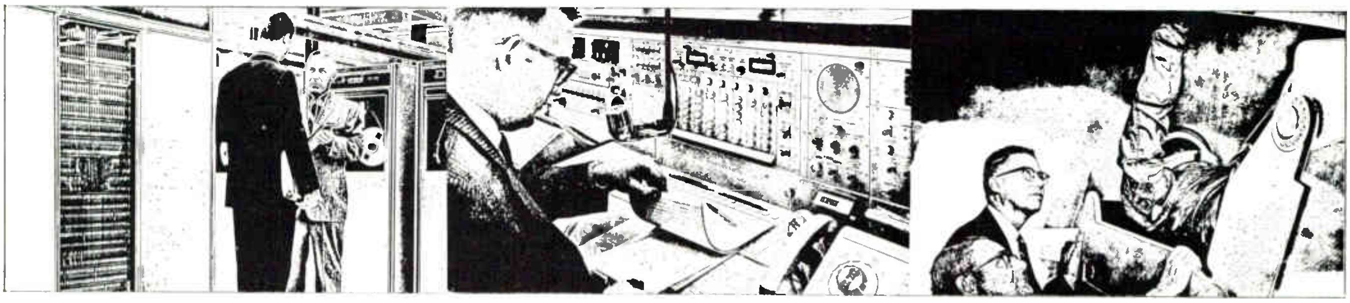
HERE'S AN OPPORTUNITY



TO IMPROVE YOUR FUTURE

. . . Both professionally and personally. Every project at Collins is the most demanding in its area of industry, and we need professionals to continue the growth this level of quality has created. Living and working conditions — and compensation — are commensurate with these standards. These listings are current.

SEND RESUME FOR PROMPT INFORMATION

CIRCUIT DESIGN ENGINEERS — For design of general communications equipment. Prefer solid state and/or digital experience. Project assignments will involve HF through M/W frequency ranges in military, commercial or space programs. B.S.E.E. or M.S.E.E. required. (Cedar Rapids, Dallas and Newport Beach)

RELIABILITY ENGINEERS—(M.E. and E.E.) — M.E.'s to perform stress and dimensional analysis on antenna structures, hydraulic drive systems and electronic packaging. E.E.'s with experience in design and component application to handle qualification and acceptance test analysis and component engineering on high reliability space programs. B.S.E.E. or B.S.M.E. required. (Cedar Rapids, Dallas and Newport Beach)

INDUSTRIAL ENGINEERS — B.S.I.E. or B.S.M.E. with industrial option. Should have experience in manufacturing methods and procedures, work station analysis, facilities planning or material handling. MTM application and training highly desirable. (Cedar Rapids, Dallas and Newport Beach)

MECHANICAL ENGINEERS — B.S.M.E. or higher level degree for various positions including machine design with emphasis on large or small mechanisms, stress analysis, dynamics analysis, design of hydraulic circuits, selection of hydraulic components, and electro mechanical packaging. (Dallas)

RF SYSTEMS ENGINEERS — B.S.E.E. with experience in RF Systems including receivers, transmitters, and antennas in the VHF-UHF frequency range. Of specific interest is experience in phase locked loop receivers, high power transmitters, tracking (monopulse) antenna systems, and tracking system analysis. (Dallas)

POWER SYSTEMS DESIGN ENGINEERS — Power Systems Design Engineers to design large power systems including high voltage DC power supplies for 10 KW and above transmitters. Familiarity with high power outdoor components desired. We desire B.S.E.E. or M.S.E.E. with four years or more power systems or power component experience plus the ability to use an analytical approach to the design of the above systems. (Dallas)

TRANSMITTER DESIGN ENGINEERS — Position involving design of high power transmitters and high voltage DC power supplies. Must be capable of applying filter theory to optimize design of high power transmitters. MF and HF frequency range. B.S.E.E. required; post graduate work desirable. Understanding of computer control of transmitter systems helpful. (Dallas)

ANTENNA DESIGN ENGINEERS — B.S.E.E. with experience with tracking antennas, aircraft, and space antennas, including antenna pattern and impedance measurements. Some openings for individuals with experience in HF and VHF measurement techniques. Background in network and electromagnetic theory is desirable. (Dallas)

COMMUNICATIONS SYSTEMS ENGINEERS (E.E. and M.E.) — Mechanical Engineers should have experience with design of mechanical components used in transportable and fixed station communication systems. Electrical Engineers should be experienced in digital data transmission, airborne transportable or fixed station H/FSSB, or microwave communication systems. Degree required. (Dallas)

MICROWAVE DESIGN ENGINEERS — Microwave Design Engineers with active development background in solid state RF sources; knowledge of wave guide techniques desirable. B.S.E.E. required. (Dallas)

FIELD SUPPORT ENGINEERS — Openings for field engineers with installation and check-out experience in one or more of the following: high density microwave systems, toll terminal equipment, cable and open wire multiplex, monopulse tracking techniques, phase locked loop receivers, parametric amplifiers, Cassegrain feeds, tropospheric scatter systems. Considerable travel involved; some outside continental U.S. and some without family. (Dallas)

MECHANICAL DESIGN ENGINEERS — Must have minimum of four years experience in electronic packaging, preferably in subminiature solid state components, close tolerancing, and high environmental and reliability standards. B.S.M.E. required. (Cedar Rapids and Newport Beach)

COST ESTIMATE ADMINISTRATION — Opening for management-minded man capable of association with all levels of management. Must be able to provide strong administrative support in schedule and quality control of commercial product estimating and government bidding. Degree in Business Administration, Industrial Management, Industrial Engineering or Accounting is preferred. A minimum of two years experience in a similar position is required. (Cedar Rapids)

COMMUNICATION/COMPUTATION/CONTROL

COLLINS

COLLINS RADIO COMPANY

An equal opportunity employer

World Radio History

LETTERS

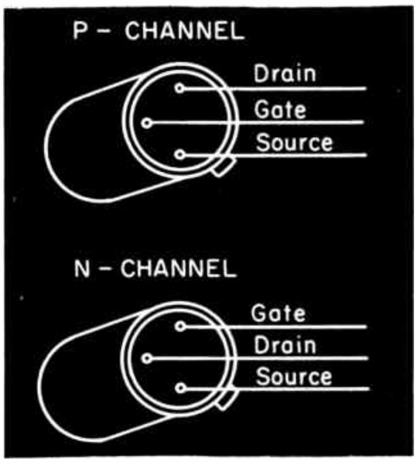
to the Editor

Wanted: Standardization

Editor, ELECTRONIC INDUSTRIES:

There is a lead configuration problem with the new FIELD EFFECT TRANSISTOR (FET) devices. It appears that FET manufacturers have standardized on one configuration for P-channel types and a different one for N-channel types as shown.

Since the FET technology is still very new, I feel that this would be the best time for manufacturers to correct the problem before further difficulties develop. The main objection to different configurations is in maintenance and part testing. Parts have already been burned out by improper breadboard connections, wiring, etc., and also improper insertion in the Tektronix 575 Curve Tracer. The training of personnel handling FET's is complicated with these different configurations.



Manufacturers should adopt a standard for N-channel and P-channel configurations which are identical. I would, from a practical standpoint, like to see a center-lead location of the GATE in order to be analogous to the more common bipolar transistor types. However, I have heard arguments that "collector-to-case" headers are easier to obtain, which would then put the gate in the "collector" position. Whichever method decided upon is fine provided it will be standard for N-channel and P- channels.

Burt Libkits,
Reliability Engineer
General Precision, Inc.
Link Group
1451 California Ave.
Palo Alto, Calif.

Well Done . . .

Editor, ELECTRONIC INDUSTRIES:

Briefly, may I say the June issue of your publication was excellent in every respect. If this is any indication of what we can expect in the future 'Electronics Industries' could become a household word.

Ralph W. Miller
Manager Tape Recorder Eng'g.
Arvin Industries, Inc.
Columbus, Indiana

Automatic Typesetting

Editor, ELECTRONIC INDUSTRIES:

In reference to your June Editorial on the Graphic Arts, we would like to add our equipment line to your list. NCR has had a computer-justified torn tape system in operation for over a year in Orlando, Florida.

Last month we delivered a 26 channel controller which is now controlling 16 tape readers and 16 linotype machines.

Typists punch tape from editor's copy which is then read into one of 26 channels. After the NCR 315 computer program justifies the tape, it selects the proper linotype for font size and automatically outputs tape to be read by the linotype.

I have enjoyed your magazine for many years.

L. W. Gay
Design Development Eng.
The National Cash Register Co.
2815 W. El Segundo Blvd.
Hawthorne, Calif. 90250

Relay Articles

Editor, ELECTRONIC INDUSTRIES:

Your "State-of-the-Art" articles on relays, which you started with your March, 1965 issue of ELECTRONIC INDUSTRIES, is of great interest to us and we would like you to know that we think you did an outstanding job with this presentation.

Somehow, our May copy has become mislaid and we would appreciate receiving another copy if they are still available.

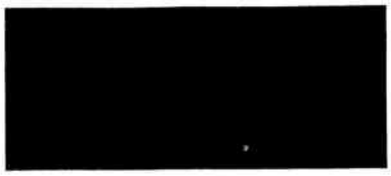
Are reprints of the March and May articles on relays available? If so, we would like to obtain twenty-five copies of each, to be sent to my attention.

P. R. Gustlin
General Manager
Electronics Division
Electronic Specialty Co.
P. O. Box 7455
Portland, Oregon 97220

Ed. Note: We did manage to send the requested copies. However, our supply is very low and we will have to limit requests to two copies while our supply lasts.

"Get Acquainted" Offer

If you'll tell us more about yourself through the confidential resume below, we'll know where to send you this booklet telling more about ourselves.



Send resume to Manager,
Professional Employment,
Collins Radio Company

Cedar Rapids, Iowa
Dallas, Texas
Newport Beach, California

CHECK LISTINGS

Name____ Home Address____
City & State____ Phone____
Present Position, Company____
Primary Experience Area____ No. of years____
Education: EE____ ME____ Math____ Physics____ Chemistry____
Bus. Adm.____ Other____
Degree: BS____ school, date____ MS____ school, date____ PhD____ school, date
Please attach any pertinent information
4

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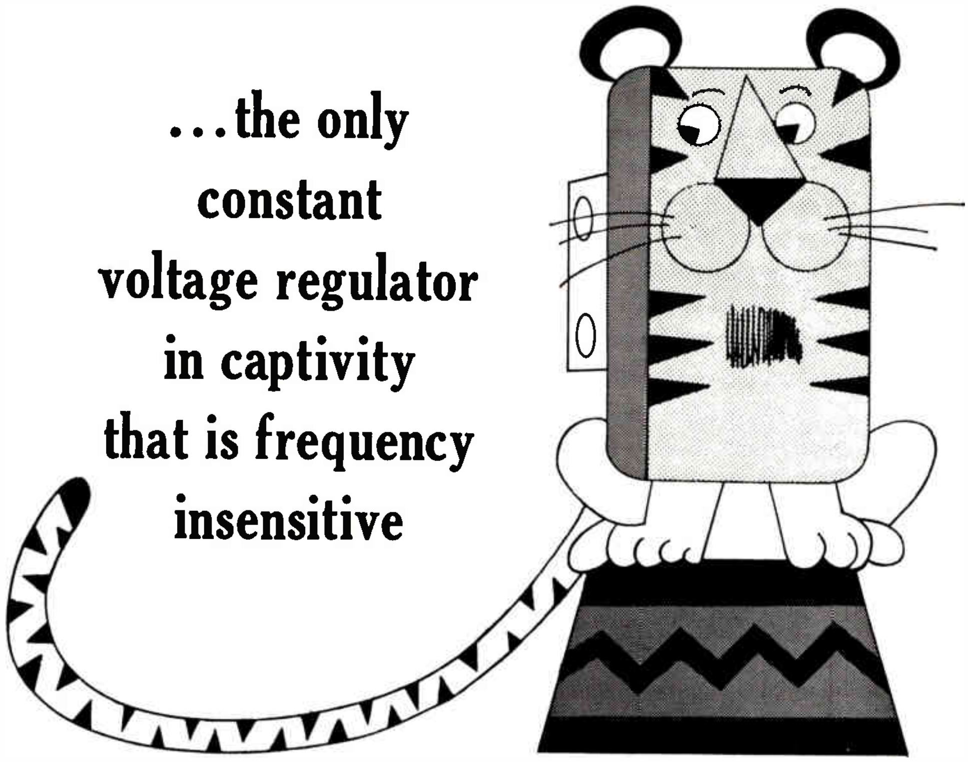
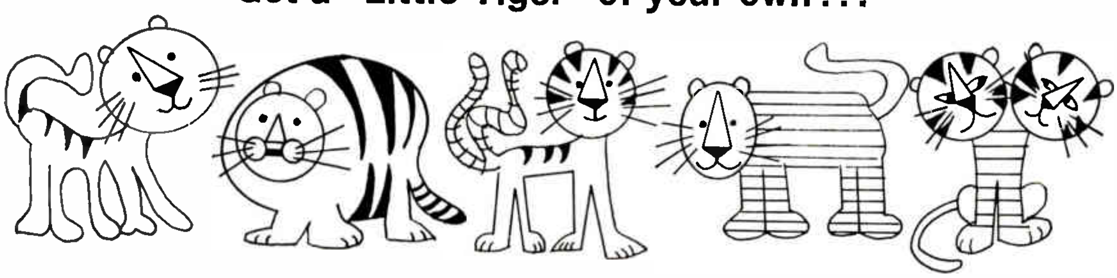
From Sola, the CV leader...

...now, the "Little Tiger"

...the only constant voltage regulator in captivity that is frequency insensitive



Get a "Little Tiger" of your own...



custom designed any way you want it.

It will put an end to one of your most sensitive problems . . . a problem no other constant voltage regulator has been able to master.

Our new frequency insensitive "Little Tiger" is available for 50/60 cycles (47 to 63 cycles). Also adaptable to military applications including 400 cycles. And it regulates to within $\pm$ 1% rms, from an input voltage range of 108 to 132 volts for total line, load, and frequency changes. Present ratings range from 40 to 250 VA. Typical sizes: 60 VA — 4" x 4" x 3"; 120 VA — 4" x 4" x 4"; 240 VA — 4" x 4" x 6".

We can tailor the "Little Tiger" in every way to your specific application. Such features as power factor loading, overload characteristics, harmonic content, and speed of response will be determined after carefully analyzing your requirements. Write for complete information or contact your local Sola representative . . . listed in the Yellow Pages of most major markets. (Or have a talk with Jim Kimball at Sola. Telephone: 312-439-2800.)

SEE THE "LITTLE TIGER" AT WESCON — BOOTH #2819-20

SOLA

BP C

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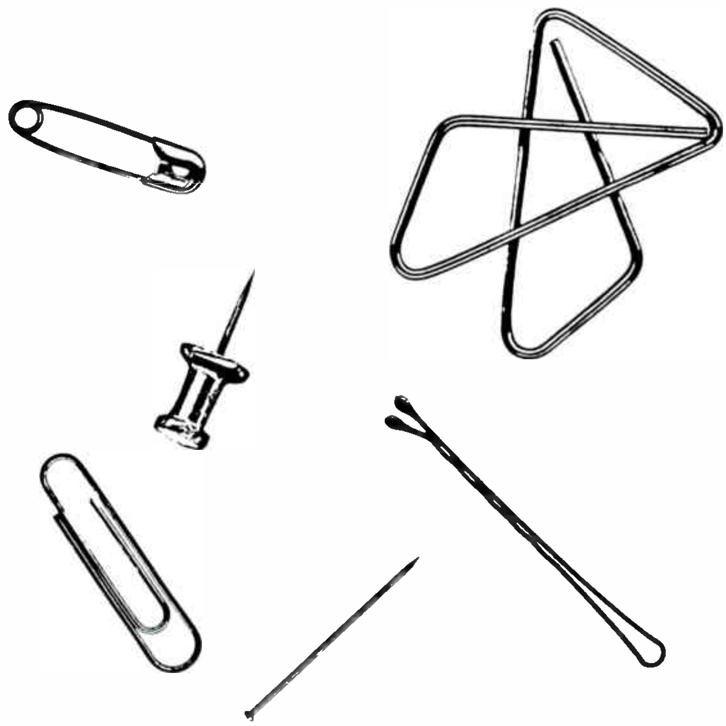
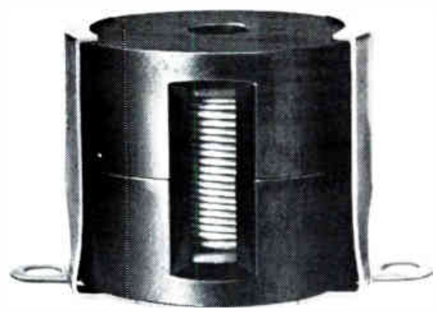




TIMESAVERS, PURE AND SIMPLE

Ferrite Pot Core Hardware Cuts Assembly Time 50%

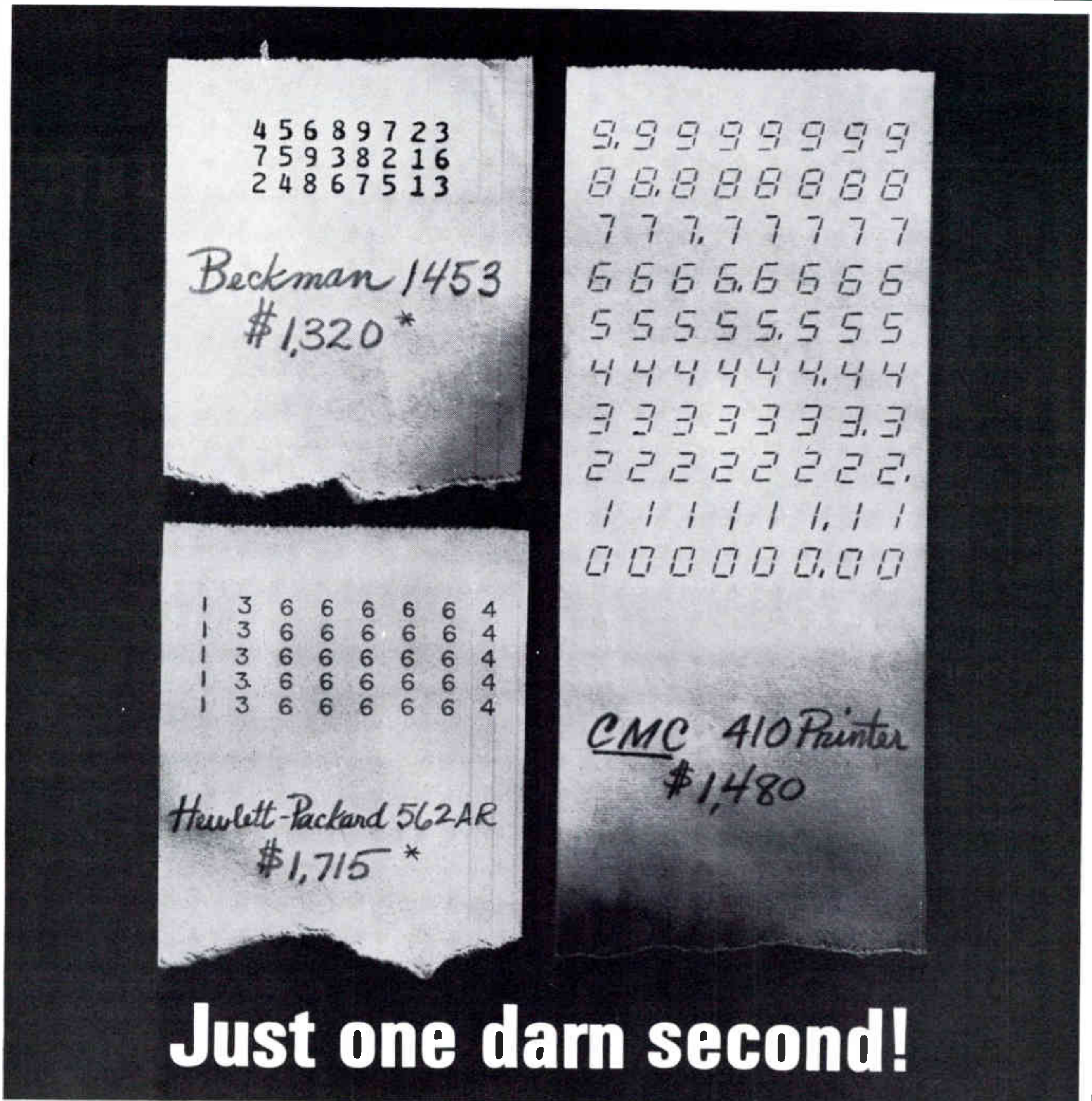
A one-piece spring steel housing snaps the core assembly into place, secures it to the chassis or printed circuit board, whittles minutes out of each production hour. In applications involving high quality inductors for filters, the trimming device has been simplified for hairline adjustment.

In addition to saving time, our ferrites give you extra design advantages with their high Q values and low disaccommodation factors. We guarantee permeability over a wide temperature range (—55°C to +70°C), and precision-ground air gaps assure uniformity of inductance throughout each production lot.

Manganese zinc ferrite cores are furnished in permeabilities of 650, 900, 1300 and 2000 for frequencies up to 2 MC. A 100 perm nickel zinc core covers frequencies up to 10 MC. There are 13 different sizes, including the International Electrotechnical Commission sizes—over 200 cores in all! For more information, write *Magnetics, Inc.* Dept. 31, Butler, Pa.

MAGNETICS inc. ®

World Radio History



*Plus extra cost for decimal column.

Actual size facsimile tapes show results of 1-second printing time.

Tear a piece of tape off all three big-name digital instrumentation printers. Compare speed and readability. One obviously prints at least twice as fast. Obviously one can be read without getting ink on your nose. One reason is, our new CMC 410 Printer is not just another rebuilt adding machine. Another reason: our logic conversion is all electronic. 35-millisec. data-gathering won't stall your source. Only the CMC 410 prints a floating decimal without the cost of an extra column. Our printer is quiet, compact (only half-rack size) solid-state, versatile, and all that. It spews out 8-digit columns at 10 lines per sec. 4 to 12 columns are available. This new CMC 410 Printer is another step in our demoniacal plan to unseat some of the other big names in this business. Wait 'til you see what's next! Incidentally, we still have some of our glorious Crusading Engineer medals lying about. We'd sure be happy to send you this status symbol along with the specs for the new CMC 410 Printer. Just write and ask. If you already have a medal, pin this one on your secretary... or are you man enough?

CMC

12976 Bradley • San Fernando, California • Phone (213) 367-2161 • TWX 213-764-5993

COMPUTER MEASUREMENTS COMPANY IS A LEADING DESIGNER AND MANUFACTURER OF ELECTRONIC INSTRUMENTATION TO COUNT, MEASURE, AND CONTROL.

World Radio History

Products At WESCON
In Color

Cow Palace (top), scene of 1965 Western Electronic Show and Convention. General program will include 25 technical sessions (center), a series of technical films, plus industrial design awards, future engineer awards, Distributor-Manufacturer-Representative Conference, and various social activities. Products will be displayed in 1,050 exhibits.

THE 1965 WESTERN ELECTRONIC SHOW and Convention (WESCON) set for August 24 through 27 at the Cow Palace near San Francisco will include 1,050 exhibits and thousands of new electronic products.

On the following pages Electronic Industries presents—for the first time in full color—a preview of some of the outstanding new products that will be on display at 1965 WESCON. This marks a departure for Electronic Industries in the treatment of new products, selected examples of which will appear in full color in subsequent issues.

Fields of interest covered in the exhibits and new products at WESCON cover production equipment, data processing and automatic control, communications and detection, components, instruments, air and space control systems, and audio and TV. There are also publisher and international product sections.

Technical program will include five special invited-paper sessions and 20 new-style in-depth "team" sessions selected from proposals from companies, universities, and military or private research centers. Papers will be authored by members of each project task force.

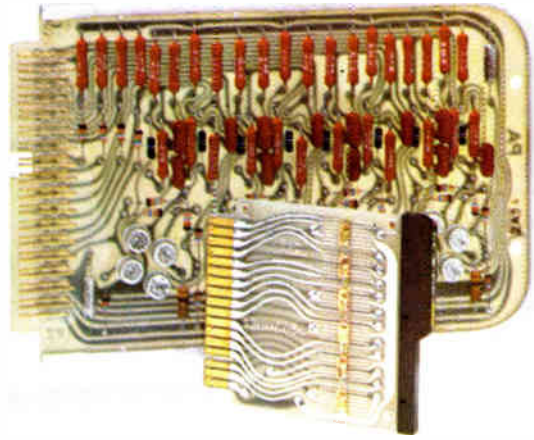
Another innovation will be a continuing series of films on novel electronic devices, new solutions to old problems and general information. A major field trip will be made to Stanford Linear Accelerator Center (SLAC), world's largest linear accelerator.

World Radio History

ELECTRONIC INDUSTRIES

NEW PRODUCTS

AT WESCON

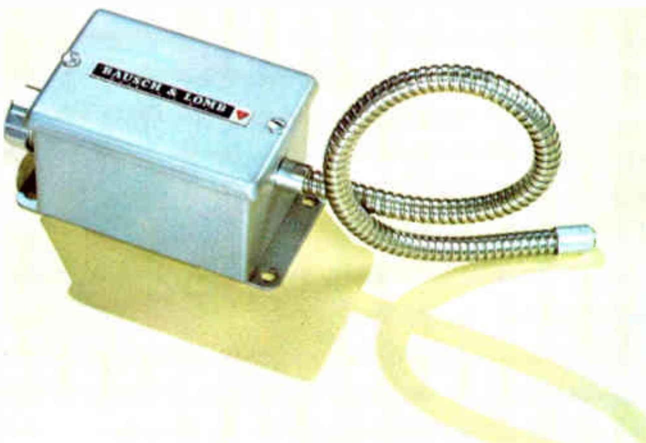


IC DIGITAL MODULES

Use diode transistor logic for noise rejection and speed.

The μPACS are a static asynchronous digital-logic series. The silicon monolithic integrated circuits have input gate expansion, high fan-out, high noise thresholds, and low propagation delays. They come in 14-lead flat packs which are resistance soldered on copper-etched, glass-impregnated epoxy cards. Computer Control Co., Old Connecticut Path, Framingham, Mass. BOOTHS 1501-03.

Circle 229 on Inquiry Card

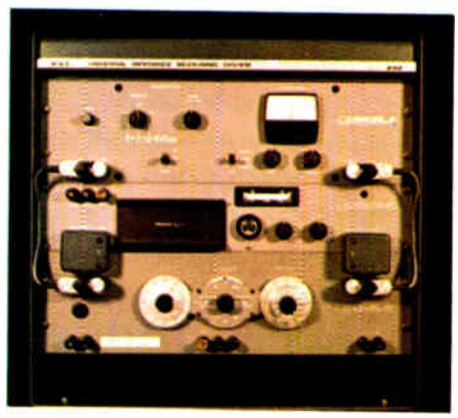


FIBER OPTICS LIGHT SWITCH

Highly sensitive to changes in reflected or direct light.

This electro-optical light switch offers far greater sensitivity than a standard photo-electric cell. Used in conjunction with a readout or warning system, it can serve as a counter, a tachometer, a detector, or a safety device. Basically, the function of the light switch is to detect variations in reflected or direct light. When variations occur, electrical impulses are sent from the light switch to trigger the readout or warning device to which it is attached. To insure max. sensitivity under all working conditions, a sensitivity control is provided. Bausch & Lomb, Rochester, N. Y. BOOTH 3918.

Circle 230 on Inquiry Card

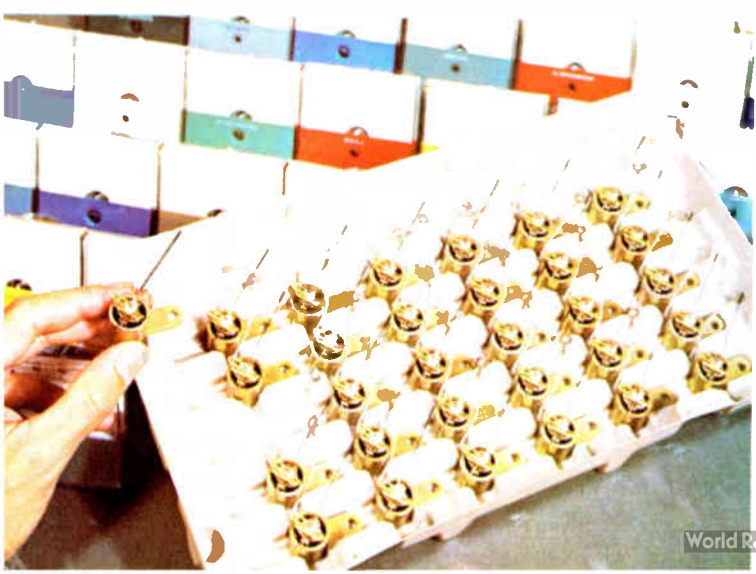


IMPEDANCE BRIDGE

Accuracy: ±0.05% for R and C, ±0.01% for I and C.

The Model 292 universal impedance measuring system provides precise measurements of resistance, conductance, capacitance and inductance. For capacitors and inductors, it also measures the dissipation factor and storage factor. Comparative 5-figure measurements can be made using the 120,005 divisions of dial resolution provided by decade dials. Terminals allow ranges to be extended and special circuit connections can be made. Electro Scientific Industries, Inc., 13900 N. W. Science Park Dr., Portland, Ore. ROOM D-16.

Circle 231 on Inquiry Card



AUTO-TORQUE METERS

Provide band-type meter performance at pivot and jewel price.

The auto-torque meter mechanism consists basically of a moving system suspended on metal bands under tension. The bands conduct current to energize the moving coil and to supply restoring torque. Input current is applied through 1 threaded stud-type terminal to a pole piece, bracket, zero regulator, spring, tension band, balance cross, and to a coil winding. From the coil, current moves through the anchor plate, tension band, tension spring and lead wire and completes the circuit to a second terminal. The magnet is made of high coercive force magnetic material shaped to produce a uniform field in the air gap through which the coil moves. The magnet is surrounded by a soft-iron pole piece that acts as a shield to minimize external magnetic effects. Accuracy of dc meters is ±2% of full scale @ 25°C; for ac rectifier-type meters it is ±3% of full scale @ 25°C. Honeywell Inc., Precision Meter Div., Grenier Field, Manchester, N. H. BOOTH 2727.

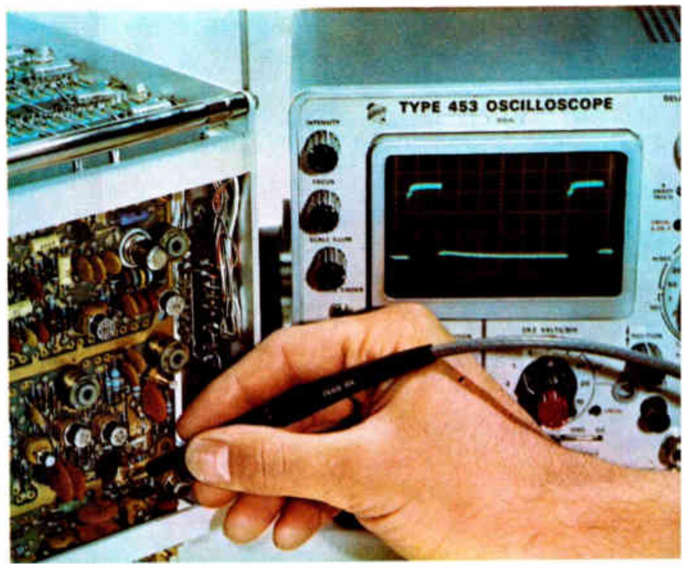
Circle 232 on Inquiry Card

World Radio History

METAL FILM RESISTORS

This line of metal oxide film resistors is rated at ¼w., ½w. and 1w. Major use is in digital circuitry. The new tin-oxide resistors have a temp. coefficient of resistance of ±100 ppm/°C, purchase tolerance of 1, 2 or 5% and load life drift/1000 hrs. of 1%. Corning Glass Works, Electronic Products Div., Corning, N.Y. BOOTHS 3005-06

Circle 233 on Inquiry Card



DUAL-TRACE PORTABLE SCOPE

Combines the performance and features of a laboratory scope.

Type 453 is a portable, 50mc dual-trace oscilloscope. Developed primarily for field service of high-speed, solid-state computers, it is 6¾ x 10¾ x 19 in., and weighs 28 lbs. The scope uses a new 4 in. CRT which provides the high writing rate and brightness required for use under high amb. light conditions. Dual-trace sensitivity is to 20mv/ div. at 50mc, to 5mv/div. at 40mc; channels can be cascaded to obtain 1mv/cm sensitivity at 25mc, single-trace. Signal delay allows viewing the leading edge of the triggering waveform. Calibrated sweeps extend from 5 sec./div. to 0.1μsec./div., with a 10X magnifier extending the fastest sweep to 10nsec./div. Tektronix, Inc., P. O. Box 500, Beaverton; Ore. BOOTHS 3818-22.

Circle 234 on Inquiry Card

PORTABLE IC TESTER

For making accurate measurements on a small number of units.

The Series 400 integrated-circuit test set is a portable, manually operated unit for measuring with high accuracy dc parameters of integrated microcircuits. Programming is flexible enough to provide for critical tests on the most complex elements in production, and for those in development at this time. The tester consists of 5 precision programmable voltage supplies; a variable-range current measuring circuit; a 10 x 15 pin board programming matrix and additional front panel controls that provide extremely versatile programming; test jacks for optional connection of external devices to various points in the test circuit; and a test socket with adapters for axial lead, flatpack and PC card-mounted devices. Fairchild Instrumentation, 844 Charleston Rd., Palo Alto, Calif. BOOTHS 2912-19.

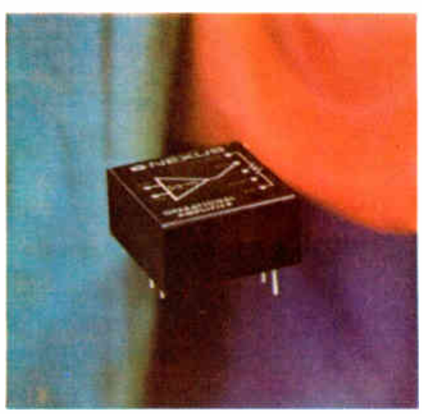
Circle 235 on Inquiry Card

OPERATIONAL AMPLIFIER

Supply voltage is ±15v.; supply current at full output is ±8ma.

Model SQ-10 operational amplifier is for OEM equipment. It is priced less than $25.00. The open gain loop @ dc is 20k, and input Z is 0.1meg. diff. Output voltage range is ±10v. @ 2ma max. Operating temp. range, −25° to +85°C. Nexus Research Laboratory, Inc., Canton, Mass. BOOTH 1005.

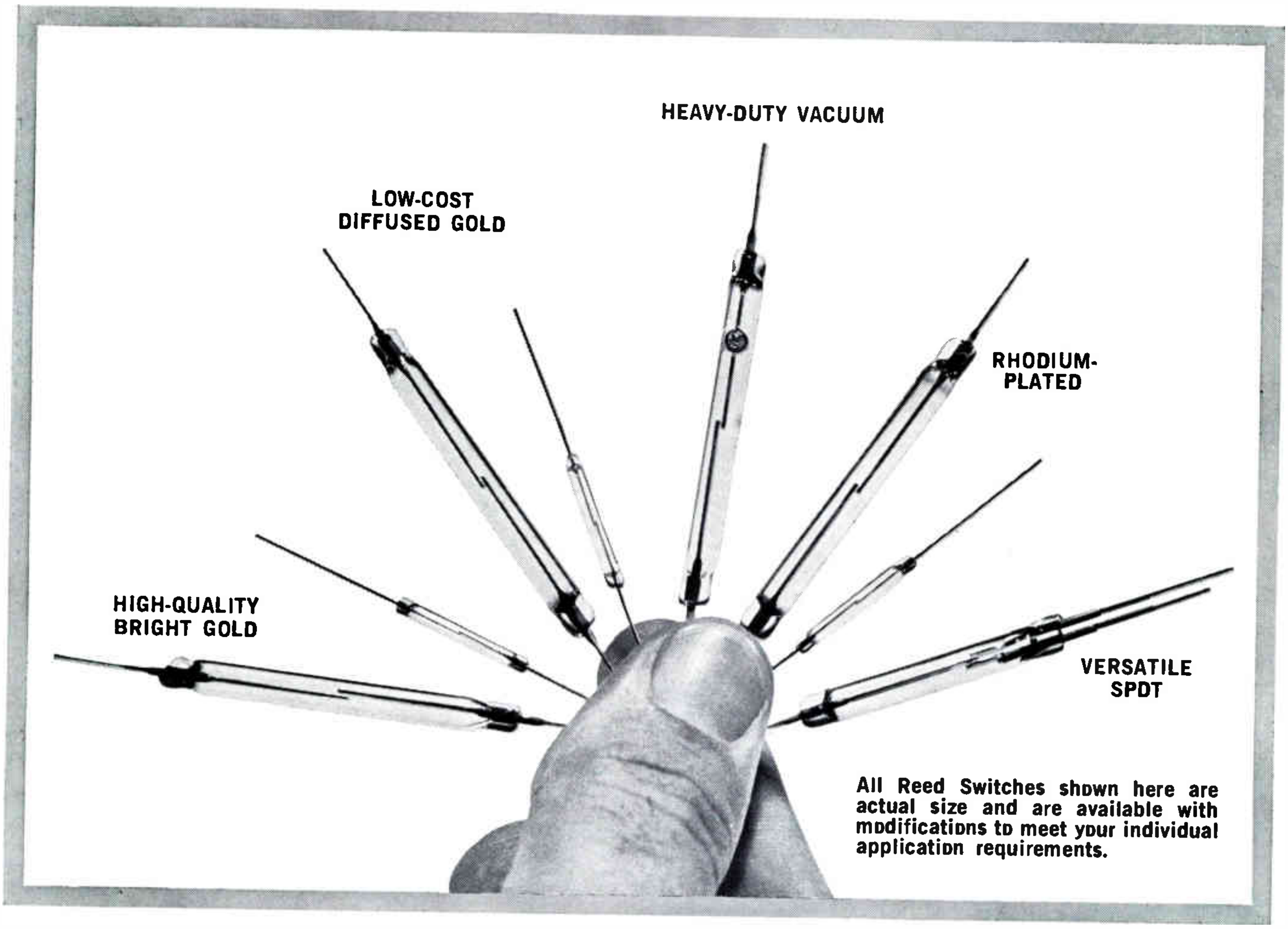
Circle 236 on Inquiry Card



More Color New Products on Page 40.

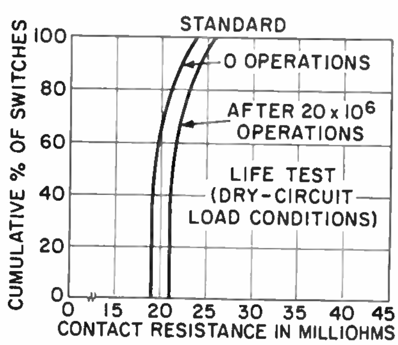
World Radio History

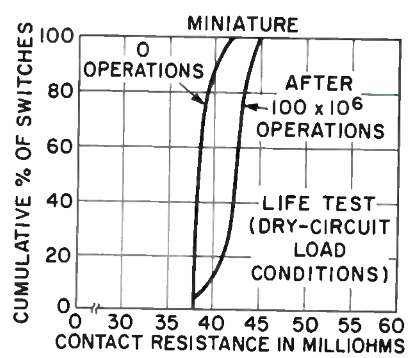
Easy pickin's! Now you can choose the exact Reed Switch you need from GE's extensive line



Anytime you need a simple, high-speed, long-life device for electrical switching, ask General Electric first. Our extensive line of reed switches is made up of the newest and best devices—a switch for just about any type of electro-mechanical equipment. Save time—get the exact switch you need from General Electric.

HIGH-QUALITY BRIGHT GOLO



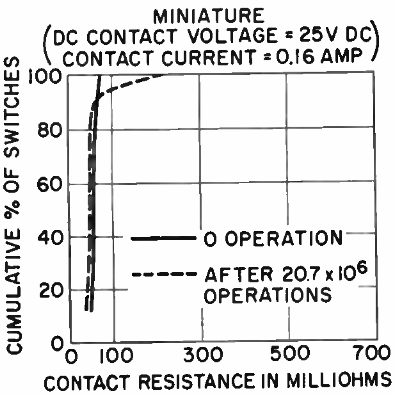


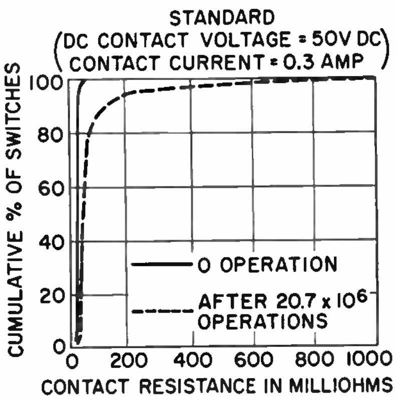
For maintaining extremely low contact resistance during prolonged life under "low level," or "dry circuit" conditions. Typical applications include low-level audio switching and electronic relays. Form A (single-pole, single-throw) bright gold reed switches are available in miniature 1-inch and standard 2-inch versions.

World Radio History

ELECTRONIC
INNOVATIONS
IN ACTION

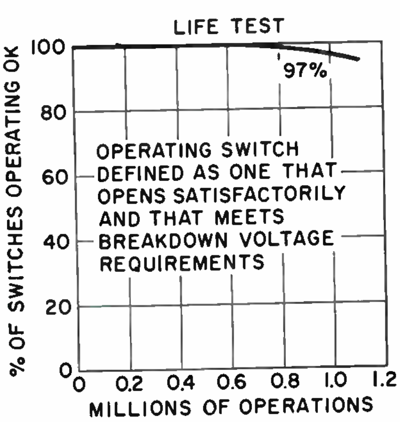
LOW-COST DIFFUSED GOLD





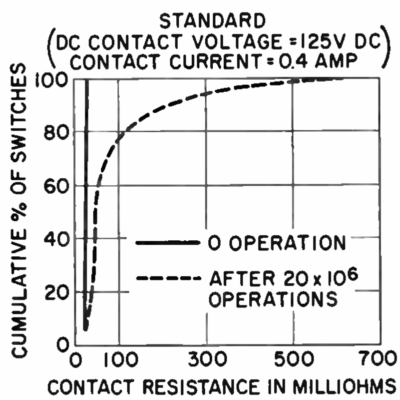
For 15-watt resistive-load switching. Typical applications include telephone switching, computers, industrial controls, and sophisticated toys. Diffused gold Form A reed switches are available in 1-inch and 2-inch versions.

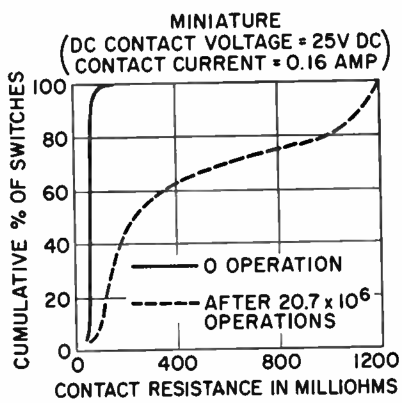
HEAVY-DUTY VACUUM



A special switch for unusual conditions . . . such as high-voltage/-low-current applications, and circuits with large inductances where high-voltage transients are generated. Available in the standard 2-inch, Form A version.

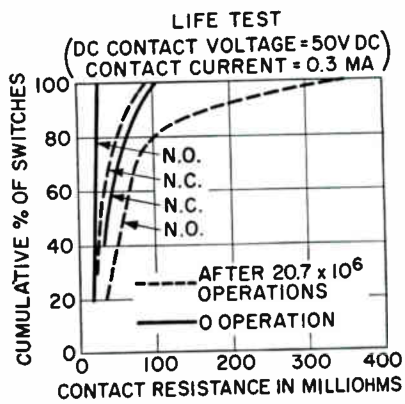
RHODIUM-PLATED





This switch is the established leader for 50-watt resistive-load switching applications such as in medium-size relay and solenoid load applications. Form A rhodium switches are available in both 1-inch and 2-inch versions.

VERSATILE SPDT



This Form C switch is available in the standard 2-inch size . . . for applications of up to 15-watts that require single-pole, double-throw switching.

What are <u>your</u> requirements? For details, specifications, and samples, contact your local G-E salesman, or write to General Electric Company, Section 270-08, Schenectady, New York 12305.

ELECTRONIC COMPONENTS DIVISION

GENERAL ELECTRIC

Circle 20 on Inquiry Card

World Radio History

NEW PRODUCTS

AT WESCON

RELAY TESTER

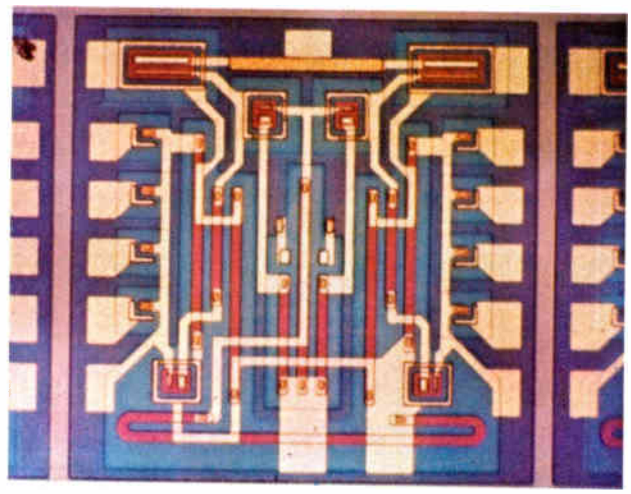
This relay tester automatically checks dry and wet circuit SPDT and DPDT relays for 23 different parameters. Complete electrical inspection of a DPDT relay can be completed in less than 25 sec. Bourns, Inc., 1200 Columbia Ave., Riverside, Calif. BOOTHS 2520-22.

Circle 237 on Inquiry Card

VARIABLE THRESHOLD LOGIC

Variable threshold logic is a new Motorola design concept to overcome the noise problems in industrial logic systems. The VTL logic circuits can be designed for operation over a wide range of logic swings. This permits the designer to provide his system with the best combination of noise immunity and power dissipation. Motorola Semiconductor Products Inc., 5005 E. McDowell Rd., Phoenix, Ariz. BOOTHS 3122-25.

Circle 238 on Inquiry Card



COMMUNICATIONS RECEIVER

Covers the entire l-f through h-f spectrums, from 5KC to 30MC.

The HRO-500 is totally solid-state communications receiver. It covers the h-f spectrums continuously in sixty 500kc bands, with identical dial calibration and tuning rate throughout the entire range. Dial calibration is accurate to 1kc, with 10kc/turn tuning rate. The effective dial scale length is 24 ft./mc. It operates from 12vdc (current drain 200ma) or 115/230vac 50-60 cycle sources. National Radio Co., Inc., Melrose, Mass. BOOTHS 1701-1801.

Circle 239 on Inquiry Card

GAS ANALYZER

Measures minute quantities of gas in evacuated systems.

Type 21-614 residual gas analyzer is a cycloidal-focusing mass spectrometer for identifying and measuring gas. Gases present with mass weights ranging from m/e 1 to 200 are analyzed. The instrument can detect a partial pressure of nitrogen as low as 5×10^{-12} Torr. Cycloidal focusing measures the true mass-to-charge ratio and provides perfect focusing independent of factors which cause ion beam spread. Cycloidal focusing in the 21-614 makes possible wide mass range, high resolution, and high accuracy. Consolidated Electrodynamics, 360 Sierra Madre Villa, Pasadena, Calif. BOOTHS 3218-20.

Circle 240 on Inquiry Card

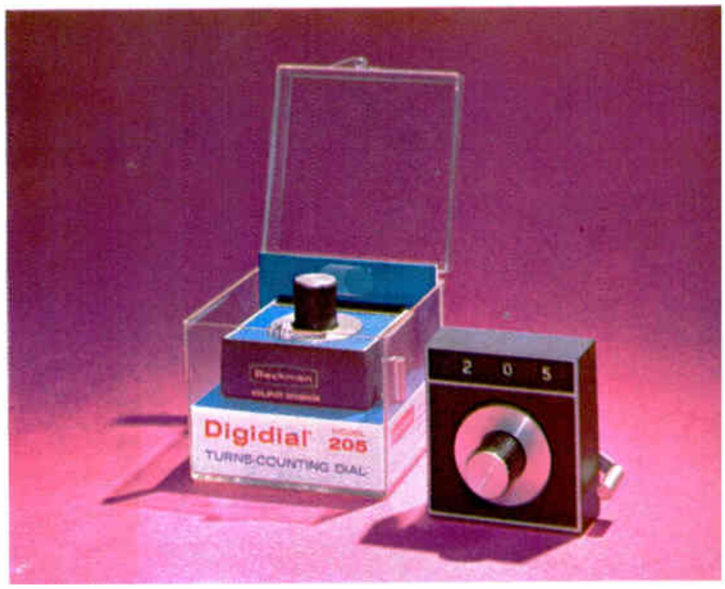
World Radio History

TURNS-COUNTING DIAL

Provides readings in units, tenths and hundredths.

With the Model 205, 4 different appliques are supplied with each dial. Numerals are recessed for glare protection, yet retain a 90° viewing angle and may be read at a distance of 10 ft. Unit measures approx. 2 in. wide x 2 3/32 in. high. A lever located on the right side permits locking of dial settings. The small dia. nylon knob permits rapid settings, with an unobstructed view of the numerals. Helipot Div., Beckman Instruments, Inc., 2500 Harbor Blvd., Fullerton, Calif. BOOTH 2528-29, 4219-22.

Circle 241 on Inquiry Card



PHASE ANGLE STANDARD

Continuous freq. coverage 30 CPS to 10KC. Resolution, 12μ°.

Model 311/RT-1/717 primary phase angle standard is capable of either shifting phase angle, or measuring phase angle with an accuracy of ±0.015° at most freqs. within the operating range of the equipment. It uses a self-calibrating principle that is independent from component errors or imperfections. This system of generating and measuring phase angle offers a high degree of accuracy. Dytronics Co., Inc., 5566 N. High St., Columbus, Ohio. BOOTH 4511.

Circle 242 on Inquiry Card

TIME BASE COUNTER

Freq. range of 1CPS to 120KC; input sensitivity, 10mv RMS.

Model CF-202R is a solid-state, variable time-base counter with an integral 6-channel time base programmer. It features solid-state construction and wide-angle, long-life readout display. Designed for use with turbine flowmeters, tachometers, and other freq. generating transducers, it provides direct digital readout in engineering units, such as gallons/min., lbs./hr., revolutions/min., etc. An integral 6-channel selector switch permits readout of any one of 6 input channels. Each channel has an independently adjustable time base and can be set from 0.0001 to 99.99 sec. by means of 4 thumb wheel switches and a 3-position range multiplier switch. Anadex Instruments Inc., 7833 Haskell Ave., Van Nuys, Calif. BOOTH 3517.

Circle 243 on Inquiry Card

TOOLS AND FITTINGS

For quickly and easily separating the conductor from braid.

A hand tool for stripping the braid from shielded or coaxial conductors, and fittings that terminate and ground the braid on large dia. or multiple conductors will be featured by Thomas & Betts. These tools and fittings are part of a complete system developed for making highly reliable connections on shielded and coaxial conductors of all sizes. They provide secure connections of high electrical integrity with a minimum of operator training. Thomas & Betts Co., Elizabeth, N. J. BOOTHS 236-37.

Circle 244 on Inquiry Card

More Color New Products on Page 44.

World Radio History

Now . . . a complete line of precision

FREQUENCY SYSTEMS

FOR NAVIGATION • COMMUNICATIONS • TRACKING • CALIBRATION

- **Stability of PARTS IN 10^9**
  - S1076AR Frequency Standard 1
  - Digital Counter 6
- **Measurement of PARTS IN 10^9**
  - *S1055A VLF Frequency Standard 2
  - S1061BR Frequency Error Expander 5
  - Digital Counter 6
- **Measurement of PARTS IN 10^{10}**
  - S1055C VLF Phase Comparator 2
  - S1069AR Frequency Standard 3
  - S1061BR Frequency Error Expander 5
  - Digital Counter 6
  - Strip Chart Recorder 7
- **Measurement of PARTS IN 10^{11}**
  - S1055C VLF Phase Comparator 2
  - S1065AR Frequency Standard 4
  - S1061BR Frequency Error Expander 5
  - Digital Counter 6
  - Strip Chart Recorder 7

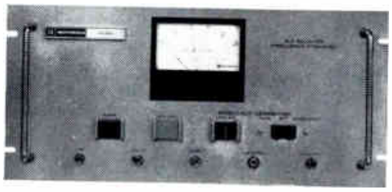
*Automatically Calibrated Frequency Standard

Here is the industry's most complete line of all solid state precision frequency standards. Their advanced performance with **guaranteed specifications,** meets the most exacting time and frequency requirements of electronic systems such as: • Navigation and Guidance Systems • Communications and Computer Equipment • Tracking Systems • Calibration and Standards Labs. Typical Frequency Standard Systems for these applications requiring measurements to parts in 10^9, 10^{10} or 10^{11} with direct digital readout, are shown in the block diagrams (left). Call, or write for a demonstration. Dept. AEI-533.

1 *New . . . low cost standard!*

Motorola S1076AR Frequency Standard—Parts in 10^{10} Setability • Less than 2×10^{-9} Aging Per Day • 10 Second short term stability $\pm 5 \times 10^{-10}$ • 100 kc and 1 mc outputs • Proportional controlled oven • Motorola precision 3 mc crystal • Zener regulation • All silicon circuitry • Coarse and fine frequency adjust • Small size—3½" high • Model S1076AR $585.

2 *Industry's only automatic standard!*

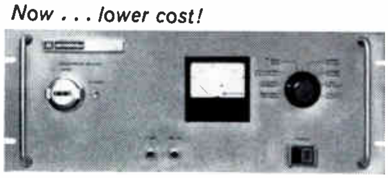


Motorola VLF Receiver Frequency Standard—This unique frequency standard automatically corrects its 1×10^{-9}/day or 5×10^{-10}/day internal oscillator to VLF signals. Also available as a servo driven Phase Comparator to phase plot S1069AR or S1065AR Standard • VLF Frequency Standard Model S1055A $5,850 • VLF Phase Comparator Model S1055C $4,250.

3 *New . . . spectral purity option!*

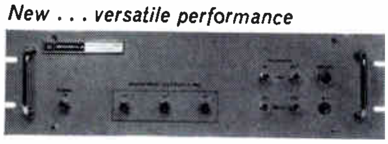
Motorola S1069AR Frequency Standard—1×10^{-10} Setability • Less than 5×10^{-10} Aging Per Day • 1 Second short term stability $\pm 1 \times 10^{-10}$ • Proportional controlled double oven • Motorola precision 3 mc crystal • Zener regulation • All silicon circuitry • Digital reading linear fine frequency adjust • New smaller size—3½" high • Model S1069AR $1,950 • Model S1069BR (single oven) $1,795 • 10/24 hr. internal battery $285.00 • Spectrally Pure 5 mc Output $250.00.

4 *Now . . . lower cost!*



Motorola S1065AR Frequency Standard—1×10^{-11} Setability • Less than 5×10^{-11} Aging Per Day and 1 Second Short Term Stability • Proportional double oven construction • Pre-aged 2.5 mc 5th overtone crystals • Digital reading linear fine frequency adjust • Solid State silicon design • Model S1065AR $3,450 including power supply, rack mounting and 15 hour battery • Spectrally pure 5 mc output $250.00.

5 *New . . . versatile performance*



Motorola S1061BR Frequency Error Expander—This frequency comparator allows high resolution, accurate frequency comparisons to be made quickly on a digital counter directly in parts in 10^9 in 1 second, parts in 10^{10} in 10 seconds, parts in 10^{11} in 100 seconds. Accepts 100, 250, 500 kc and 1, 2, 3, 4, 5 mc Test Inputs. Model S1061BR $1,495.

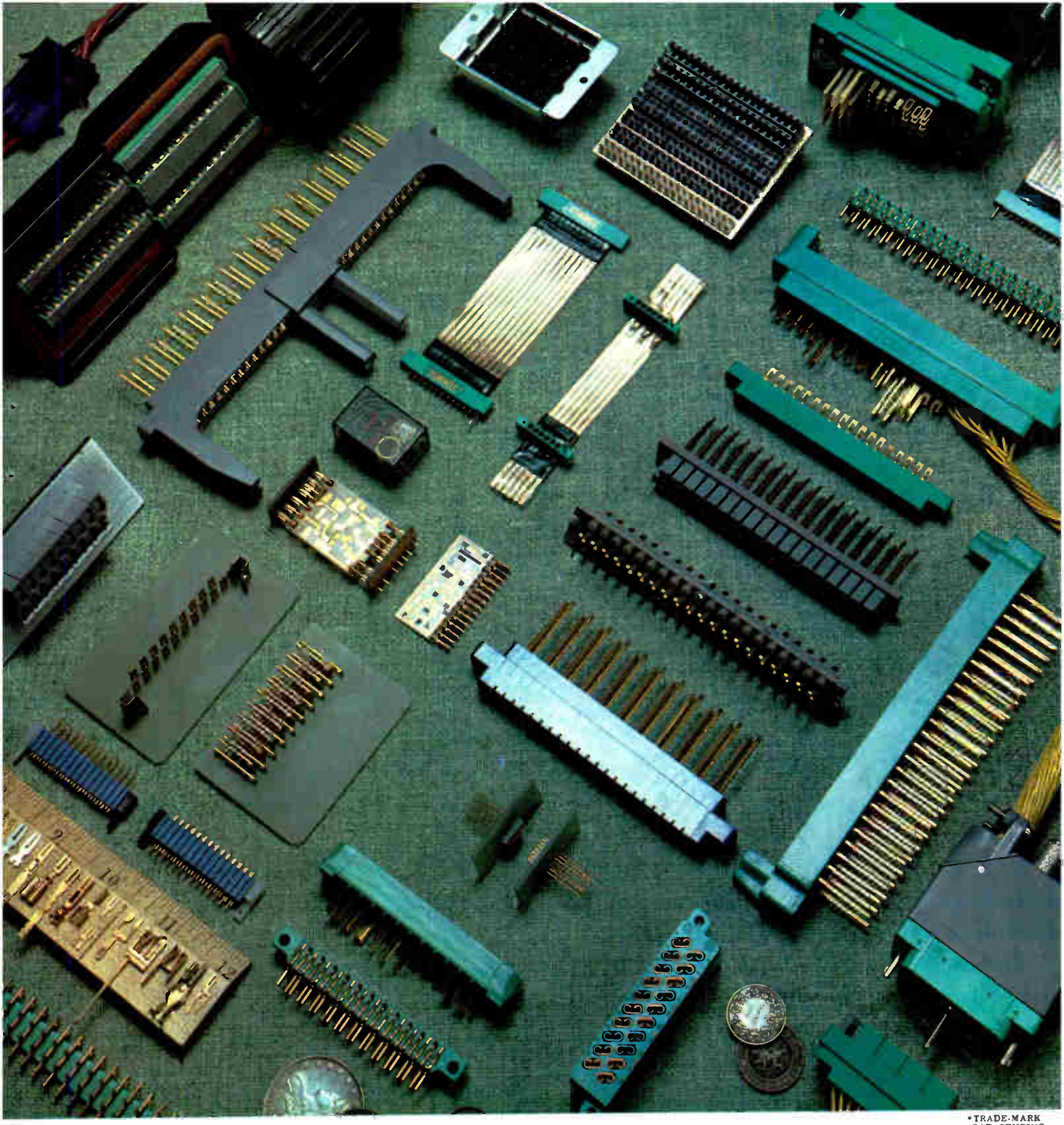
6 Standard 1 mc Electronic Digital Counter

7 Standard 1 ma Strip Chart Recorder.

MOTOROLA PRECISION INSTRUMENT PRODUCTS

Motorola Communications & Electronics • 4501 Augusta Blvd., Chicago, Ill. 60651, Phone 312-772-6500 • A Subsidiary of Motorola Inc.

World Radio History



*TRADE-MARK
†PAT. PENDING

Connector Collector.

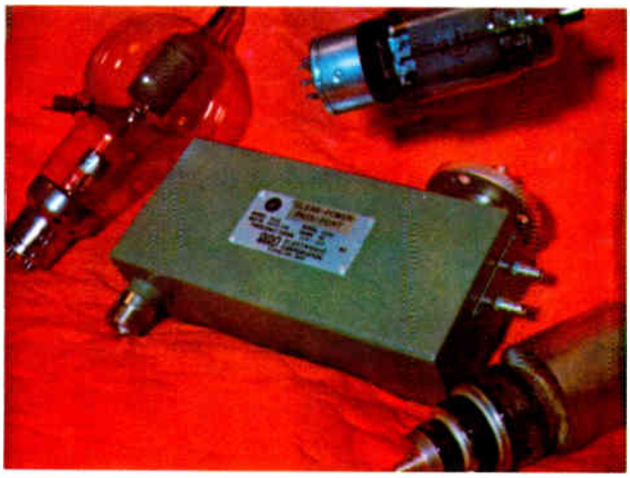
Some men collect ELCO VARICON* Connectors. One sample of each model they've specified and used over the years. To keep for their own personal standard of comparison. For reliability. Versatility. Adaptability. Production economy. One sample of each size. Standard. Miniature. Sub-miniature. Micro-miniature. For rack-and-panel applications. Printed circuitry. Modules. Plates. Packaging. Substrates. Interconnections for integrated circuitry. With contact tails for every conceivable terminating technique. Including our VARILOK* crimp-and-insert, and TERMIWELD*† for flat flexible cables. Each with the world's most reliability-proven fork-design ELCO VARICON* contact. Or other equally hi-rel ELCO VARICON* nose designs.

Send us $29,650 for a hand-made sample of each of our models. Or a 4¢ postal requesting our Product Digest. Or Technical Bulletins covering the exact models you have in mind. That's the thrifty way of starting your own personal ELCO VARICON* Connector collection. At a saving of $29,649.96. Write today while this offer is still in effect.

if it's new...if it's news...it's from ELCO TM

CIRCLE 55 ON READER SERVICE CARD

ELCO CORPORATION: Main Plant and Offices, Willow Grove, Pa. 19090; 215-659-7000; TWX 510 665-5573. ELCO Pacific: W. Los Angeles, Cal. 90064. ELCO Midwest, Chicago, Ill. 60645. Representatives, Subsidiaries and Licensees Throughout the World.

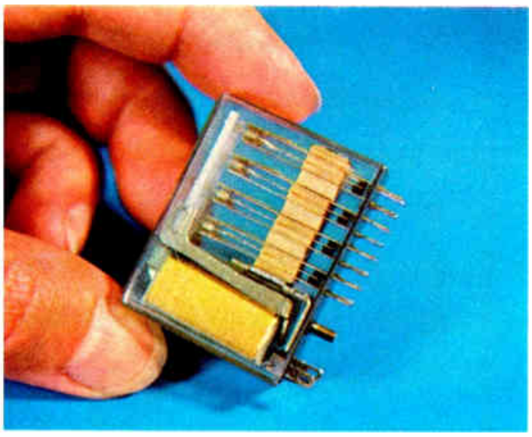


POWER INDICATOR

Removes unwanted signals; measures output and reflected power.

This 50 Ω coaxial r-f product line drastically reduces design, procurement and space problems. It rejects all nonconforming harmonics and spurious signals, and gages the desired power delivered from the transmitter or other r-f power source to the line. It also indicates mismatch conditions in load or line by measuring reflected power. Bird Electronic Corp., 30303 Aurora Rd., Cleveland, Ohio. BOOTHS 3901-02.

Circle 245 on Inquiry Card



INDUSTRIAL RELAY

For industrial applications requiring 1 to 8 Form C's.

The VersaPac 67 relay features welded cross-bar contacts rated at 3 and 5a., and 1-piece frame and core construction to provide a sensitivity of 50mw/pole. The card actuator allows a mechanical life expectancy in excess of 1 million operations. Size is 1 3/16 x 1 3/16 x ¾ in. and weight is 0.95 oz. for the 4-pole unit. Sockets for plug-in mountings are available. Phillips-Advance Control Co., 59 W. Washington, Joliet, Ill. BOOTHS 2702-03.

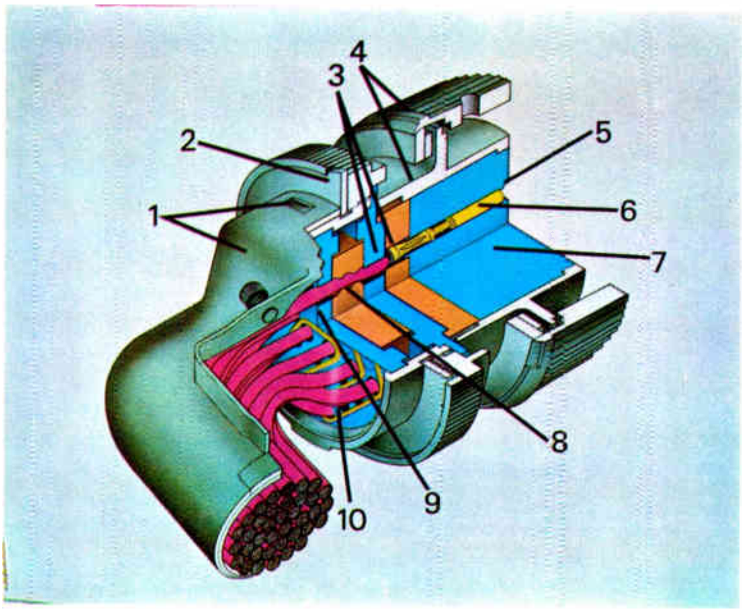
Circle 246 on Inquiry Card

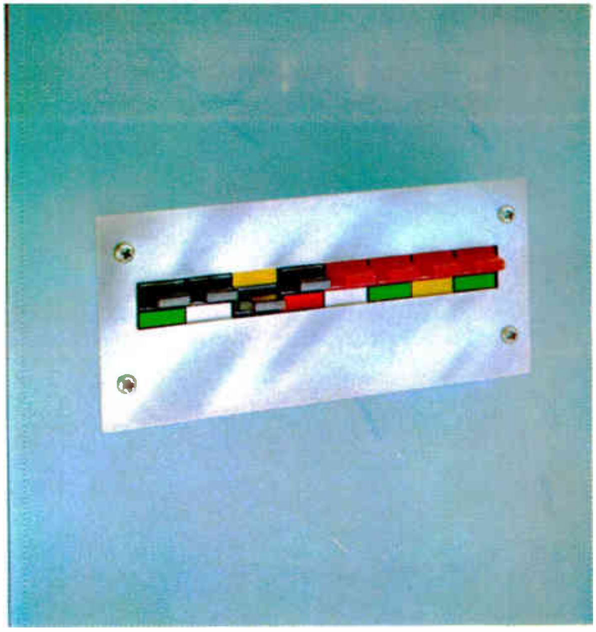
PIN AND SOCKET CONNECTOR

Provides twice the number of contacts as conventional units.

This circular pin and socket connector has twice the usual contact density of units using the same shell sizes. The bayonet-coupled connector has a keyed stainless steel shell for radiation shielding. A 4-indent circular crimp attaches the contacts, the socket member of which is a closed entry design. A unique shift-to-lock design eliminates retention clips, and no tools are required for contact extraction. The subminiature connector is available in 5 shell sizes with 16, 28, 37, 58 and 85 pin and socket positions. Major parts of the socket connector, as shown in the photo, are: (1) Cable clamp applied after connector is wired and assembled, and it can feed out in any of 4 rotated 90° positions. (2) Latching ring which cannot accidentally be moved and release contacts when cable clamp is fastened. (3) Cavity obstructed—contacts retained. Accomplished by a 180° rotation of latching ring after contacts are inserted. (4) Stainless steel shell and bayonet coupling ring for radiation shielding. (5) Hard-face funnel entry. (6) Closed-entry socket contacts. (7) Hard plastic cavity for contacts. (8) Rear grommet seal—2 risers. (9) Hard plastic—to guide straight insertion and prevent rear probe damage. (10) Color coding for wire range or rear face, mating face, and ring on each contact. AMP INC., Harrisburg, Pa. BOOTHS 2519, 2609, 10, 11.

Circle 247 on Inquiry Card





MULTI-SLIDE SWITCHES

Multiple switching action, plus interaction between stations.

Series 39000 multi-slide switch is designed to solve the human engineering problems created by the almost total dependance upon pushbutton switches in design of complex control consoles. It eliminates much of the operating confusion inherent in the constant manipulation of arrays of only pushbuttons. Operator fatigue and error can be lessened by designing slide-switching effort into a console without sacrificing versatility or function. Except for providing illuminated indication, the multi-slide switch provides any switching function common to conventional pushbutton switches. Switchcraft, 5555 N. Elston Ave., Chicago, Ill. BOOTH 2923.

Circle 248 on Inquiry Card

AC-DC DIGITAL VOLTMETER

AC may be any freq. from 30 CPS to 250KC. Accuracy, ¼% f.s.

Model 355 is an ac-dc digital voltmeter in a single compact package. It measures ac voltages from 0 to 1000 in 6 decade ranges with 10mv full scale sensitivity on lowest range, and dc voltages from 0 to 1000 in 5 decade ranges with 100mv full scale sensitivity on lowest range. The ¼% f.s. accuracy is for ac and dc voltages with up to 500 and for mid-band freqs. on ac. Voltages are indicated on a servo-driven 3-digit counter with over-ranging. The last digit may be interpolated to the nearest tenth, thus avoiding the typical ±1 digit restriction of a fully digitized display. Ballantine Laboratories, Inc., Boonton, N. J. BOOTH 4011.

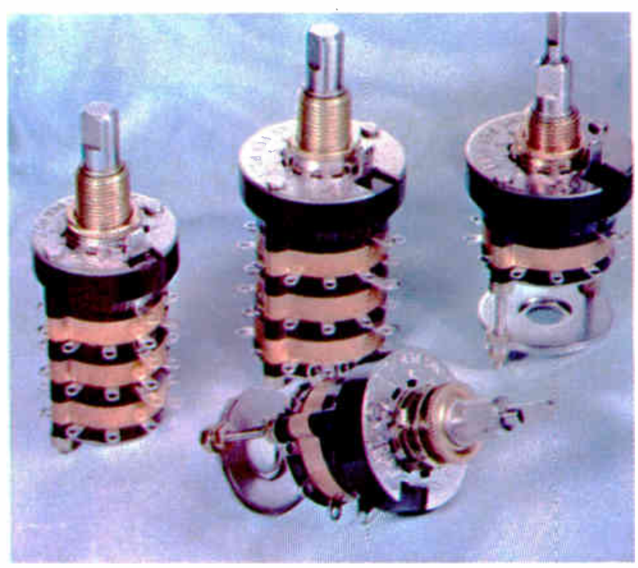
Circle 249 on Inquiry Card

KELVIN BRIDGE COMPARATOR

Deviations read directly without making a null adjustment.

Model B-40 is completely self-contained and requires no external batteries or external null detectors. Ranges are ±1%, ±0.1% and ±0.01% full scale. This new concept allows production personnel to set up and make resistance readings to 10 ppm accuracy. Recovery time is such that 600 resistors can be checked/hr. The self-contained power supply provides either 1, 3 or 10v. excitation voltage. Medistor Instrument Co., 1443 N. Northlake Way, Seattle, Wash. BOOTH 4516.

Circle 250 on Inquiry Card



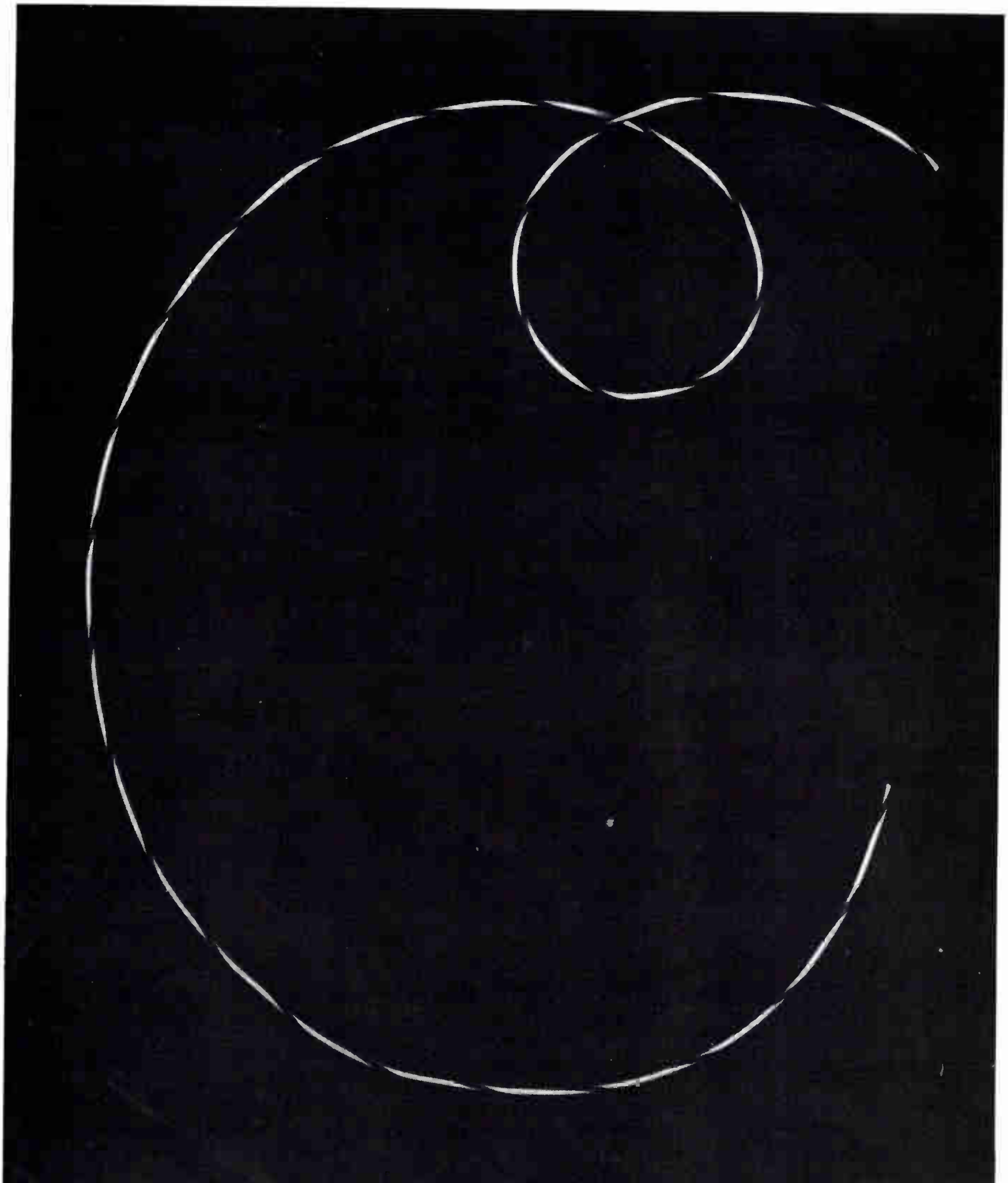
ROTARY SWITCHES

Adjustable stop, 2 to 12 positions; single or multi-deck.

Grayhill will show four new adjustable stop, totally enclosed, rotary switches. They have adjustable stops, 2 to 12 positions; single or multi-deck—1 to 4 poles/deck, 30° or 36° angle of throw. Potentiometer addition is optional. Units are rated to make and break 1a., 115vac resistive and to carry 10a. continuous. Grayhill, Inc., 505 Hillgrove Ave., LaGrange, Ill. BOOTH 3121.

Circle 251 on Inquiry Card

World Radio History



If you ask us for our 3¢ hookup wire, expect a little static.

Before we accept your order, we ask: "What are you using it for? Where? How? When?"

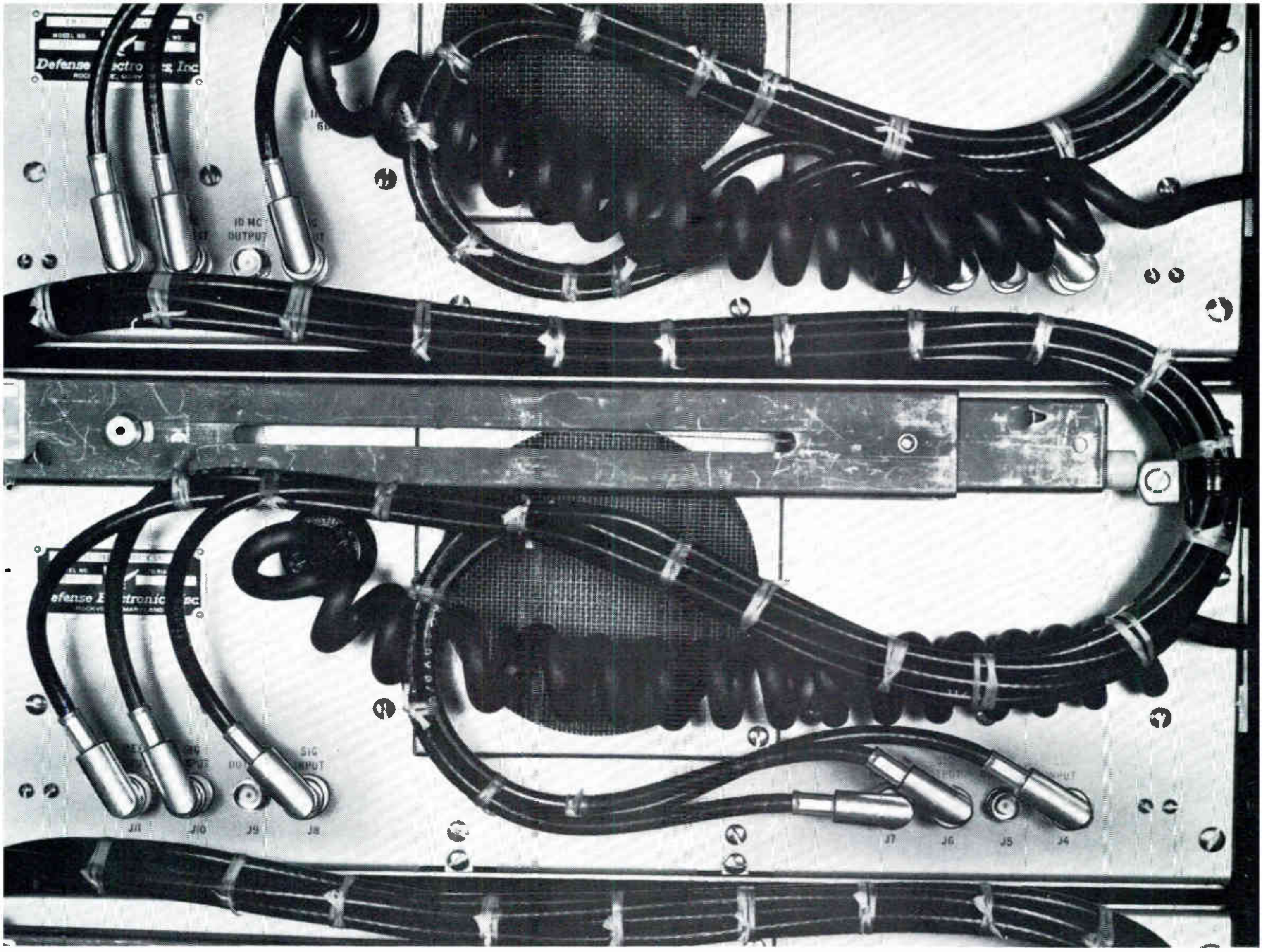
Static? Sure, but we think we know more about wire than any other manufacturer. And we like to pass it on where it'll help.

Based on your answers, maybe we can suggest an equivalent wire that costs less. Or introduce you to a new wire just marketed last week that will work better.

So next time you call Alpha, expect a little static. It'll keep you from getting burned.

Alpha Wire Headquarters: Elizabeth, New Jersey 07207. Write for our new 108-page catalog.
A Division of Loral Corporation

World Radio History



Amphenol helps aerospace electronics firm cut connector costs by 35%

By switching to Amphenol Quick-Crimp BNC connectors, Defense Electronics, Inc. figures it has saved at least 35% of the installed cost of the coaxial connectors used on telemetry equipment produced at its Rockville, Md. plant. These savings very nearly paid for the connectors.

How can *anybody* slash hardware costs this much?

30-SECOND TERMINATION. Instead of using clamp and solder type UG connectors, Defense Electronics now crimps each Amphenol BNC in 30 seconds. No hypercritical tolerances. No tiny washers. Even a stubby-fingered greenhorn can assemble an Amphenol quick-crimp connector's three pieces in almost the time it takes you to dial a telephone number.

LOW VSWR TO 10 GHz*. Constantly striving for improved equipment performance, Defense Electronics, Inc. also uses these connectors in circuits tested up through 3 GHz. Other companies have found that this connector exceeds the performance of the UG version all the way to 10 GHz.

See for yourself. Compare Amphenol performance on any other count: 90 lbs. cable retention (or the breaking point of the braid); SWR of 1.1 from 2.0 to 4.5 GHz . . . and only 1.2 at 10 GHz. Amphenol gives you more.

NEW, LOW PRICES. If you haven't checked our prices since Feb. 1, you'll be surprised: most commonly used Amphenol coaxial connectors—including quick-crimps—have been dramatically reduced.

You can save money right now by specifying Amphenol quick-crimp coaxial connectors.

Ask any Amphenol Sales Engineer. Or your Amphenol distributor. Or write: Amphenol RF Division, 33 East Franklin Street, Danbury, Connecticut 06813.

Amphenol® RF DIVISION

amphenol corporation

*1 GHz = 1 Gc

Specify Amphenol . . . the leading name in cable, connectors, assemblies, RF switches, potentiometers, microelectronics

Circle 23 on Inquiry Card

World Radio History

TELEVISIONE

télévision

テレビ

Fernseher

Television

телевизия

The Universal Telonic SV-13 Sweep Generator "Speaks Television" in any Language

A truly International Test Instrument, Telonic's SV-13 Sweep/Signal Generator is used for alignment and adjustment of TV receivers and tuners world over. Its unique capacity of 13 plug-in channels permits comprehensive coverage of the entire 20-225 MHz frequency range in a single instrument.

Simply by changing these channel plug-in "strips" the user can adapt the SV-13 to check out RF and IF channels and other VHF circuits from Bangor to Bangkok. The instrument may be specified originally with American, European, Italian, Australian, or Japanese channels plus any number of plug-in strips. Channels may even be varied to suit a particular test set-up, e.g. 8 TV channels plus 4 RF bands plus one IF. The instrument's selection dial is engraved according to the standards furnished.

To simplify production application of the SV-13, pulse-type, crystal-calibrated, built-in markers supply frequency indication above and below center frequency at standard 4.5 MHz and 5.5 MHz separation between video and sound carriers.

Other Specifications: RF channels adjustable from 5 to 20 MHz, IF channels from 10 to 40% of center frequency; output is 1 VRMS into 75 ohms; Flatness between markers, ± 1%, over each channel, ± 2.5%, overall, ± 5%; Attenuation is 99 db in steps from 3 db.

And look at these options available with the SV-13

- Additional RF Output System
- Additional IF Markers
- Local Oscillator Adjustment
- Remote Control Channel

Telonic also produces the SD-3, SD-3M and SN-3 sweep generators for Testing UHF circuits, as well as the SV-14 for FM work. Other Telonic sweep generators cover audio to 3000 Mc in a variety of convenient models. A full product line catalog is yours on request.

Telonic® INDUSTRIES, INC.
60 NORTH FIRST AVENUE
BEECH GROVE, INDIANA 46107
TEL: (317) 787-3231 TWX: 810-341-3202

Representatives in all major cities in the U.S., Canada, South America, Europe, Great Britain, Scandinavia, and the Far East.

SWEEP GENERATORS • RF ATTENUATORS • DETECTORS • COAXIAL SWITCHES

See Telonic Products at Wescon, booths 4114-4118

World Radio History

Here are two resistors that are ideally suited for your miniaturized circuits—the Allen-Bradley Type BB ⅛-watt and the Type CB ¼-watt units. While extremely small, both have integrally molded insulated bodies and are full-fledged members of the Allen-Bradley hot molded resistor family.

This is made possible by employing the same exclusive hot molding process as used for the higher ratings of A-B resistors. The use of special automatic machines removes the element of human error, assuring complete uniformity of physical and electrical properties from one resistor to the next—from one billion to the next. And catastrophic failures are absolutely unheard of with Allen-Bradley hot molded resistors.

Be sure you have full specifications on both of these A-B hot molded resistors on hand. Please send for Technical Bulletin 5050 on the Type CB and Technical Bulletin B5005 on the Type BB: Allen-Bradley Co., 222 W. Greenfield Ave., Milwaukee, Wis. 53204. In Canada: Allen-Bradley Canada Ltd., Galt, Ont. Export Office: 630 Third Ave., New York, N.Y., U.S.A. 10017.

HOT MOLDED FIXED RESISTORS are available in all standard EIA and MIL-R-11 resistance values and tolerances, plus values above and below standard limits. Shown actual size.

A-B

ALLEN-BRADLEY

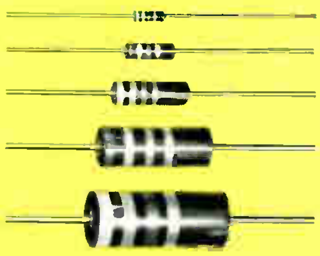
QUALITY ELECTRONIC COMPONENTS

49-07-5E

World Radio History

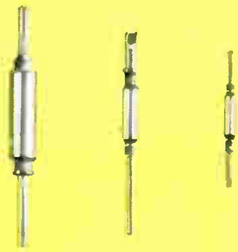
This label of "quality" covers everything made by Allen-Bradley

EXCLUSIVE HOT MOLDED RESISTORS



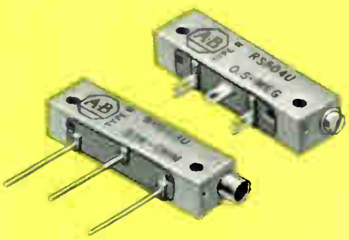
World renowned for their conservative ratings and stable characteristics. Due to uniformity of production, long term performance can be accurately predicted. With billions of these resistors in service, there is no known instance of catastrophic failure. Rated ⅛, ¼, ½, 1, and 2 watts at 70°C. Available in all standard EIA and MIL-R-11 resistance values and tolerances, plus values above and below standard limits.

SUBMINIATURE LOW PASS FILTERS



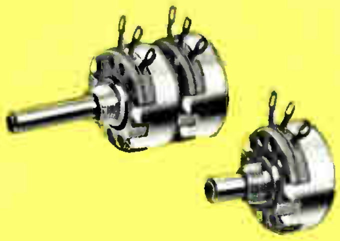
Especially designed for use in cable connectors, FO type filters provide a maximum reduction of RFI in a minimum of space—attenuation is greater than 50 DB over the frequency range from 100 MHz to 10 GHz. With these filters mounted through a ground plane in the connector, there's complete shielding to prevent rf coupling between input and output. Individual filter replacement is possible.

ADJUSTABLE FIXED RESISTORS
Type R



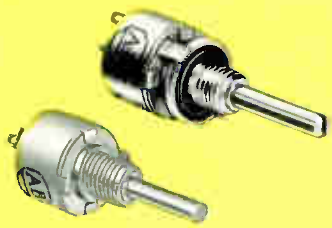
Type R built to withstand environmental extremes. Resistance element and terminals hot molded into integral unit with insulated mounting base. Has stepless adjustment and is noninductive. Watertight, can be encapsulated. Rated ¼ watt at 70°C. Values from 100 ohms to 2.5 megohms. Tol. ±10 and 20%. Type N similar in construction but for less critical environments. Rated ⅓ watt at 50°C.

HOT MOLDED POTENTIOMETERS
Type J and Type K



Type J potentiometers have solid, hot molded resistance element. Smooth, quiet control. Available in single, dual, and triple units, also with vernier adjustment. Rated 2.25 watts at 70°C. Values to 5 megohms. Type K have similar construction rated 1 watt at 125°C, 2 watts at 100°C, and 3 watts at 70°C.

HOT MOLDED POTENTIOMETERS
Type G and Type L



Type G potentiometers are miniature controls with solid molded resistance element. Only ½" in diameter. Quiet, stepless operation. Rated ½ watt at 70°C. Values to 5 megohms. Type L are similar to Type G but rated ½ watt at 100°C. Can be used at 150°C with "no load."

HOT MOLDED POTENTIOMETERS
Type H 5 Watt

Provides higher voltage and wattage ratings for industrial and commercial electronic equipment. Quiet, stepless control. Life exceeds 100,000 complete cycles of operation on accelerated tests with less than 10% resistance change. Rated 5 watts at 40°C and 3 watts at 70°C, with a maximum of 750 volts.

FEED-THRU AND STAND-OFF CAPACITORS

Discoidal design eliminates all parallel resonance effects at 1000 Mcps and less. Insulation resistance exceeds 100,000 megohms. Standard values: 470 mmf ±20% and 1000 mmf GMV. Special values from 6.8 mmf to 1500 mmf. Rated to 500 v DC maximum.

FERRITES AND CERAMIC MAGNETS

Ferrite cores are available in a wide range of sizes and shapes, such as flared yokes; U, E, and cup cores, and torroids.

Ceramic permanent magnets are available in nonoriented and oriented materials. Also types especially suited for use in the design of high efficiency d.c. motors.

Please send for Publication 6024: Allen-Bradley Co., 222 West Greenfield Ave., Milwaukee, Wisconsin 53204. In Canada: Allen-Bradley Canada Ltd., Galt, Ontario. Export Office: 630 Third Ave., New York, N.Y., U.S.A. 10017.

52-07-5E

ALLEN-BRADLEY
QUALITY ELECTRONIC COMPONENTS

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Next time Arco tells you they're a manufacturer, ask why they sell these:

Sure Arco is a manufacturer. But we're also a distributor. And we believe in offering you the best line for each product category we distribute.

When it comes to relays, Allied Control makes the best. So as long as there's an Allied Control, there'll never be an Arco relay.

How do we know they're best? We measure them with the same yardsticks for performance and reliability our manufacturing people use—to test the missile guidance and communications systems capacitors we make.

At Arco, you also get the largest distributor inventory of Allied Control relays. Including their telephone-type cradle relays—the broadest and deepest line in the industry.

As a manufacturer, we have an engineering staff to help you on relay application problems. And as a distributor, we ship your order within 24 hours. Three pieces or three hundred pieces.

See why it pays to do business with a distributor who's also a manufacturer?

Arco Electronics
A DIVISION OF LORAL CORPORATION
COMMUNITY DRIVE, GREAT NECK, N.Y./DALLAS, TEXAS/PASADENA, CALIFORNIA/WRITE FOR OUR FREE CATALOG

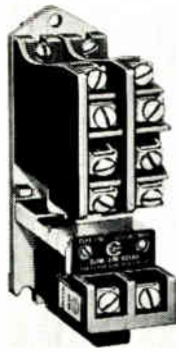
Circle 26 on Inquiry Card

World Radio History

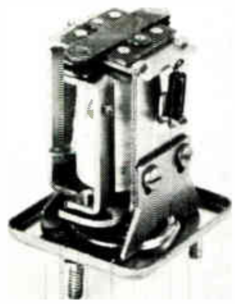
1965 Survey Of Relay Specifications

Part 3—Power Relays

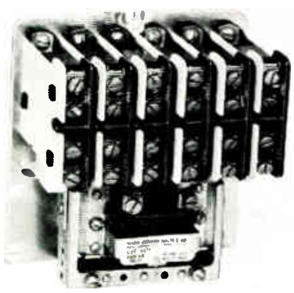
Third in the series of special reports describing key commercial and military type relay specifications as compiled by EI editors from information supplied by the manufacturers.
This section covers relays for heavy duty high voltage or multi-ampere circuits.



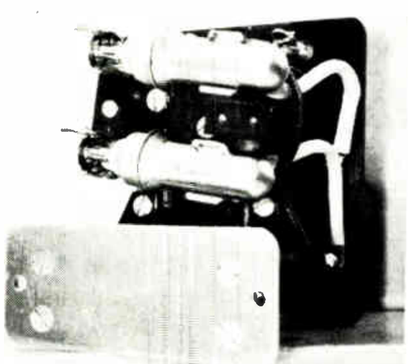
Interchangeable-pole 600-volt relay (Clark)



20-ampere miniature relay (Cornell-Dubilier)

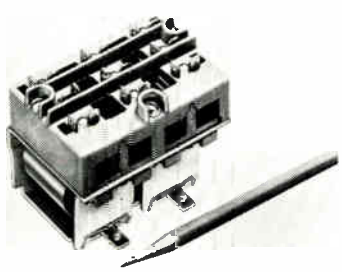


Multi-circuit bi-pole relay (Ward Leonard)



Motor reversing contactor (Struthers-Dunn)

Rotary tube mercury contact relay (Corona)



RELAYS COVERED IN THIS SURVEY are AC and DC contactors used in power distribution, switching, control and fault protection systems. They include heavy duty mill type and industrial multiple relays, contactors and magnetic circuit breakers for control of hydraulic valves, refrigeration and air-conditioning systems, elevators, motors and heaters. Included are high current military types for use in aircraft control and communication circuits.

Our Definition Of Power Relays

No one would hesitate to describe a relay that controls an elevator or a milling lathe as a "power" relay, but there is a vast number among the lesser relays that might be better known as "general purpose" types. Wishing to avoid confusion and for convenience in handling the voluminous data, the editors in this compilation have made every effort to restrict listings to relays with a power capability of 500 volts at 10 amperes, and upwards, simply an arbitrary definition. A few of the types listed may be considered by some as general purpose relays, or vice versa, some "power relays" may have been inadvertently omitted. We hope not. General Purpose relays will be covered in Part 4 of this survey.

Overload Relays

Increased costs often lead design engineers into utilizing electrical equipment at or near its ultimate capacity. This averts having to pay

FINAL REPORT ON RELAYS WILL APPEAR IN **ELECTRONIC INDUSTRIES**, OCTOBER, 1965:

Part 4: SPECIAL & G. P. RELAYS
(incl. Telephone and Subminiature Types)

Previous reports on Relays—

Part 1: REED RELAYS AND SENSITIVE RELAYS
(EI, March, 1965)

Part 2: STEPPING RELAYS AND HIGH-VOLTAGE RELAYS
(EI, May, 1965)

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the higher price for a larger unit and reduces space requirements as well. But it places added emphasis on the role of the overload protection device whatever it may be.

Overload relays are of many types depending upon the equipment they are to protect. Thermal overload relays are widely used to provide overload protection of motors because their inverse time characteristics (operating time decreases with increase in operating current) closely follow the heating curves of the motors. Overload protection is accomplished by shutting off power to the motor.

In one thermal type, a bi-metal element consisting of two dissimilar metals laminated together and pressed into a concave disc suddenly snaps into a convex position when heated by the current drawn by the motor, opening the contacts and stopping the motor. When the disc cools, it snaps back into its original position. The unique disc features precise action and calibration, plus immunity to damage by attempted reset during cooling (Westinghouse).

Another thermally operated device provides conventional, adjustable three-pole overload protection, but also includes a special protective design against "single-phasing" conditions (Schrack). Overload relay panels employing two-coil and three-coil thermal relays capable of handling up to 150 amperes are offered for multi-speed or multi-motor applications (Cutler-Hammer). Also available for limited space applications where up to 12 independent circuits are required are bi-pole solenoid load relays rated at 10 amps 600 volts (Ward-Leonard).

Another type of directly heated over-current relay providing full three-phase protection combines three bi-metal operators in one molded unit to reduce space and provide greater sensitivity. Temperature-compensated types are available for use where motor and control are located in different ambients. Complete adjustability is over a selected current range with a constant trip rating at any setting (Rowan).

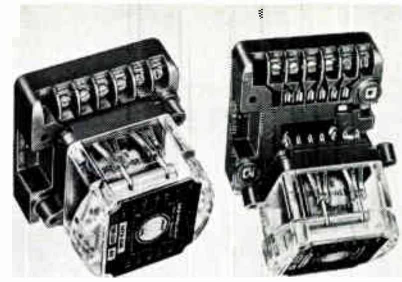
A "dashpot" overload relay, a type which utilizes the time delay provided by oil or some other liquid to slow the movement of a magnetic plunger, features a hermetically sealed element excluding dirt and corrosive atmospheres, and preventing oil from evaporating or splashing out of the enclosure (Clark).

Another hydraulic type overload relay has a hermetically sealed, non-magnetic metal tube which extends through and beyond the solenoid coil. The tube is completely filled with silicone liquid and holds a movable iron core. Small overload currents draw the core through the liquid toward the pole piece, which when reached by the core actuates the relay armature. High magnitude overloads actuate the armature directly before the core reaches the pole piece, and thus produce instantaneous tripping. "Must hold" ratings are from .02 to 60 amps. "Must trip" current values and response times, together with the magnitudes and durations of starting in-rush currents are important parameters to be specified when ordering relays of this type (Heinemann).

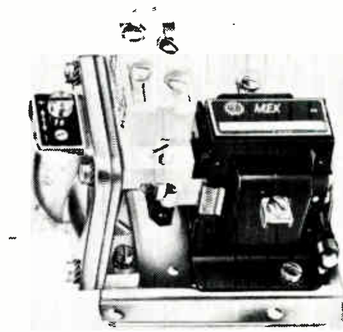
Several types of plunger relays are available for protection of equipment against over-current and under-voltage conditions, and for use as auxiliary devices. Supplied with either instantaneous or time delay action, these plunger relays depend upon a magnetic circuit to attract and release a plunger when predetermined values of current or voltage are reached. The contacts are made quick acting on the upstroke of the plunger, by a snap-toggle mechanism. Types are offered for both AC and DC use at voltages from 12 to 600 with contact ratings of five amperes continuous or 75 amperes for a half-second (General Electric).

Phase Sequence Relays

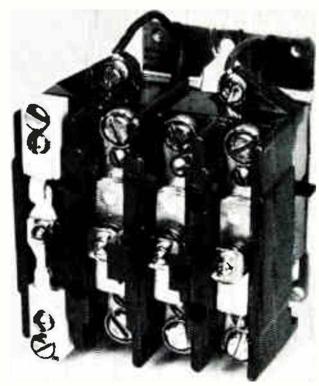
The phase sequence relay is used for automatic monitoring of a three-phase power supply and to prevent incorrect phase sequence from being applied to the load, thus preventing damage to equipment. The relay is also used to prevent a motor from



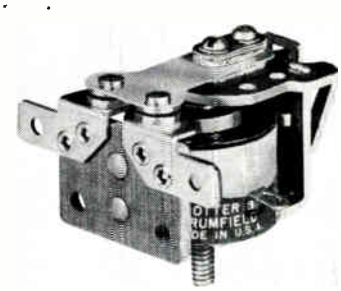
Plug-in industrial control relay (Arrow-Hart)



Pneumatic timer (Machinery Electrification)

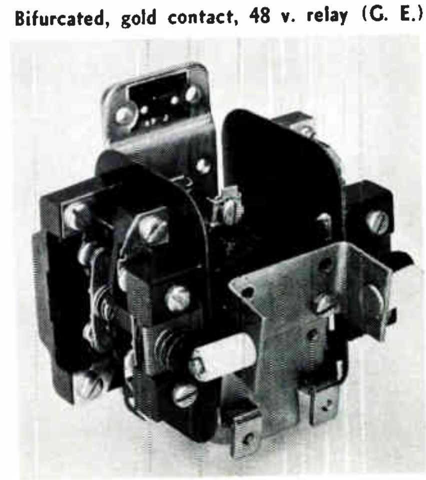


Type B 30-ampere, contactor (Rowan)



Midget 20-amp relay (Potter & Brumfield)

Bifurcated, gold contact, 48 v. relay (G. E.)



World Radio History

running backwards due to incorrect phase sequence.

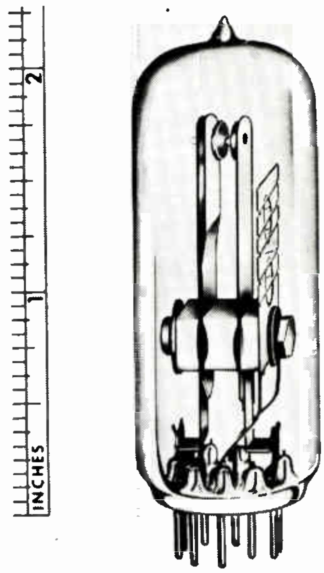
Sensing the applied phase sequence, the relay closes a contact if the sequence is A-B-C. The contact remains open if the phase sequence is C-B-A, or if the power leads are open or grounded. Phase sequence relays can be connected to correct improper phase sequence and then apply power to the load. High environmental units are available designed to military specifications, hermetically sealed and weighing as little as 9 ounces. (Master Specialties.) Types are available for use in 115- and 230-volt systems and frequencies of 60 to 400 cycles. Delta and wye connected versions can be supplied (Filtors).

Motor Field Relays

Several types of magnetic devices such as field loss, field acceleration and field deceleration relays offer protection other than overload for shunt wound and compound wound DC motors.

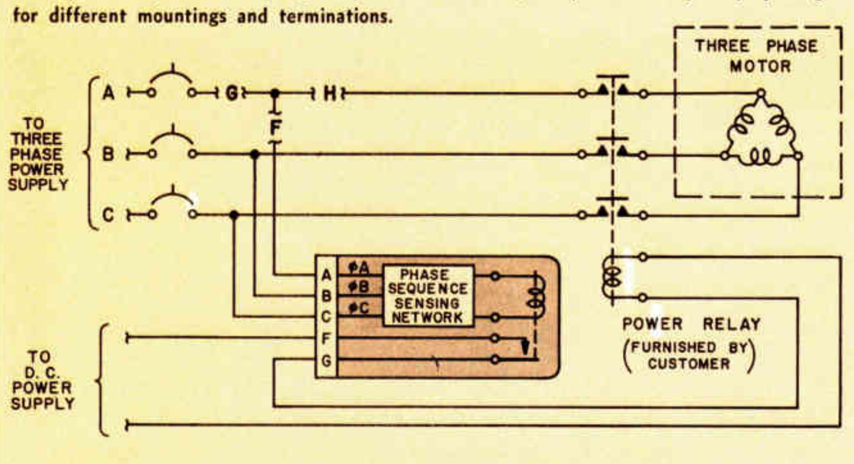
Field loss relays are used to protect lightly loaded motors that might be subject to overspeeding. The relay coil is connected in series with the shunt field and its contacts in the stop circuit. If the field fails, the coil is de-energized and the opening of the contacts shuts down the motor. The field acceleration relay assures a full field during motor starting and speed increase, and in this way limits current in-rushes in the armature circuit. High in-rush current through the relay closes the N. O. contacts, shorting out the field rheostat. Acting in an opposite manner, the field deceleration relay weakens the field during motor slowdown by inserting a field resistor to decrease motor regeneration.

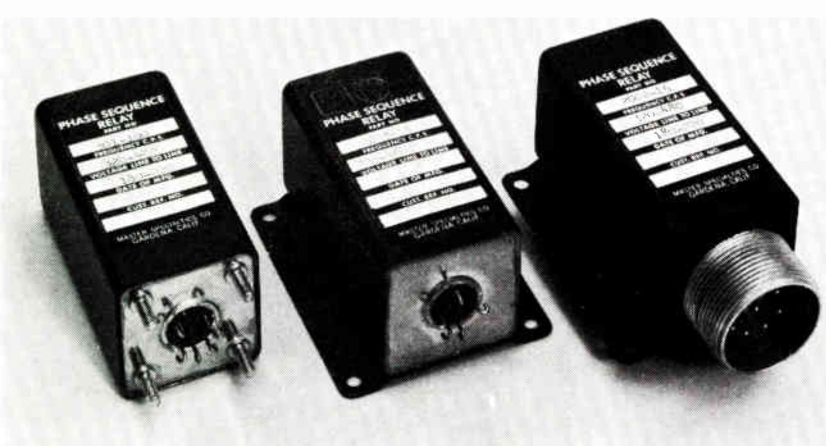
Typical full load motor current ranges for these relays are from 2 to 110 amperes at 230 volts (Ward Leonard), and field current of 5 amp at 230 volt or 2.5 amp at 550 volts (Clark).



Miniature thermal time delay relay (Amperite)

Three-phase sequence monitoring and protection circuit, and phase sensing relays packaged for different mountings and terminations.





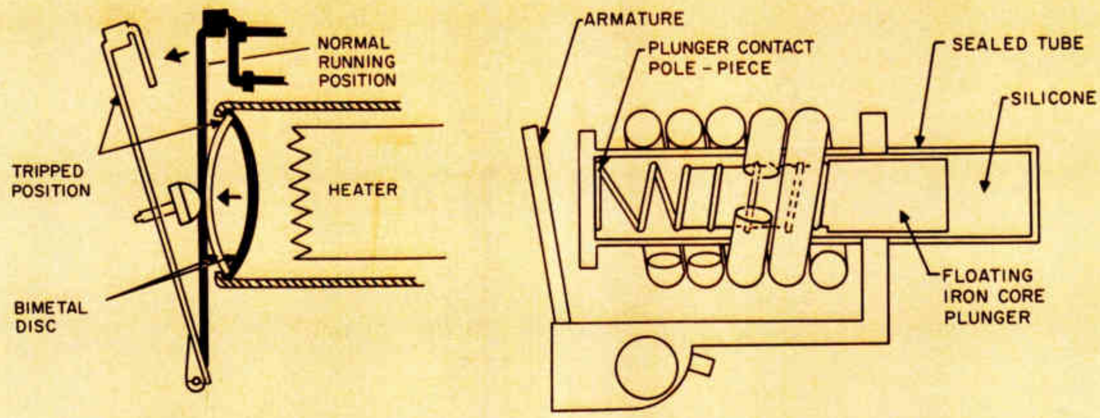
Plugging and Reversing Relays

The plugging relay, usually comprising an operating coil and neutralizing coil, prevents the controller from too quickly removing resistance from the armature circuit after a motor is reversed or plugged. The anti-plugging relay prevents the controller from reversing the motor until the armature has ceased rotation.

One type plugging relay for pilot circuits rated at 600 volts is driven by the plugged motor through a mechanical coupling. It is designed for speeds from 50 to 1800 RPM (Cutler-Hammer).

An economy 3-pole, 1 HP motor reversing contractor with a life expectancy of ten million cycles for

World Radio History



TWO T-D PRINCIPLES USED IN OVERLOAD RELAYS. Above, concave bimetal disc snaps into convex shape actuating contacts (Westinghouse). Right, magnetic core floats through liquid to touch pole piece and actuate armature (Heinemann).

applications requiring frequent jogging service such as overhead doors, hoists and elevators employs a simplified magnetic circuit and coil power of only 12 VA. One set of N. O. double-break contacts is provided per coil (Struthers-Dunn).

Mercury Relays

The mercury contact and mercury plunger relays, as contrasted to mercury wetted relays, are non-armature types that establish contact between fixed electrodes through a pool of mercury within a hermetically sealed tube.

Switching action in most mercury contact relays is caused by electromagnetically tilting the tube, causing mercury to flow into the contact area (for a N.O. relay contact), or out from the contact area (for a N. C. contact form). In mercury plunger relays, the energized coil moves a magnetic plunger causing it to displace enough mercury to flood the contact area thus making electrical contact, or to drain the contact area, breaking contact.

Mercury relays are designed for continuous duty over long periods of time. Moving parts are at a minimum, the most friction being between the liquid and metal. Corrosive or high humidity atmospheres are excluded from the sealed contact area. Relays feature high contact current capability, and contact resistance which can be as low as .003 ohms for a 60 ampere relay (Ebert Electronics). Contacts can handle momentary reactive surges up to eight times the rated current.

However, there are limitations on the angle of tilt for a mercury relay, beyond which contact may be broken. This factor rules out some portable or mobile applications for mercury relays.

Time Delay Relays

A popular timing relay for general purpose machine tool AC timing in industrial control applications is the pneumatically operated time delay relay. One type is a straight DC coil time delay unit rated for 600 volts. The relay incorporates a piston type pneumatic timing head and provides ON delay (time delay after energization) or OFF delay (time delay after de-energization). It also provides either one instantaneous pole and one timed pole or two timed poles. Range is adjustable from 0.2 second to 3 minutes (Clark).

Another pneumatic type featuring ranges from 0.1 second to one minute, employs a turnabout solenoid which changes the operation from ON delay to OFF delay. The time delay element is a spring loaded diaphragm which forces air through a variable orifice. A snap action switch controls two double-break contacts rated at 15 amps for 120 volts AC (Master Specialties).

High Current Relays

Included in the tabulations are a few special relays designed for switching of high current loads of the order of hundreds of amperes.

One type, typically for aircraft inverter service, is a hermetically sealed, high environmental rotary type relay with four poles. In this application, one or two poles would be rated to 150 amps DC motor load (to handle in rush currents up to 1200 amps) and the remaining two or three poles would be supplied with light duty contacts rated at 25 amps to handle the 115 volt 400 cycle inverter output (Price Electric).

Interchangeable Poles & Contacts

Several heavy duty relays are available with new provisions for changing poles and contacts, simplifying contact renewal and making it possible to add poles and even latching mechanisms to existing designs. Some types include kits for easy conversion of the relay from N. O. to N. C. contact arrangements.

• **A REPRINT of ANY ARTICLE in this issue is available from ELECTRONIC INDUSTRIES Reader Service Department.**

List of Manufacturers of Power Relays Begins on the Following Page

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ELECTRONIC INDUSTRIES

SPECIFICATIONS OF POWER RELAYS

POWER RELAYS	TYPE NO. OF SERIES	AC CONTACTOR	DC CONTACTOR	GENERAL PURPOSE	HIGH VOLTAGE CONTACTOR	HIGH CURRENT CONTACTOR	LOW VOLTAGE CONTACTOR	MERCURY CONTACT	MOTOR FIELD	INDUSTRIAL	OVERLOAD	PLUNGER TYPE	REVERSING CONTACTOR	TIME DELAY	UNDER VOLTAGE	PHASE PROTECTION	PLUGGING RELAY	NO. OF POLES	CONTACT FORM	NOM. CONTACT VOLTAGE (V)	NOM. CONTACT CURRENT (A)	NOM. COIL VOLTAGE (V)	NOM. COIL POWER (W)	NOM. COIL VA	MINIATURE	ENCASED	HERMETIC SEAL	MIL SPEC
Adams & Westlake Co.	1040	X				X		X				X						1	ST	115	50	to 440				X		
Elkhart, Ind. 46514	1200		X			X		X				X						1	ST	115	50	to 230				X		
	1140	X				X		X				X						1	ST	115	35	to 440				X		
	1141	X				X		X				X						1	ST	115	50	to 440				X		
	1123/33	X	X			X		X				X						2/3	ST	115	35	to 440				X		
	2101					X		X				X						1	ST	115	100	125				X		
	1101 M	X						X						X				1	ST	115	to 75	to 440				X		
Airborne Accessories Corp.	NC33/MC333	(monitor/								X				X	X			2	DT	115/28	10	to 220	2.5			X		
1414 Chestnut Ave.	Ult Delay	controller)												X				3	DT	115	10	to 220				X		
Hillside 5, N. J.																												
Allen-Bradley Co.	200		X	X			X			X								2-8	NO/NC							X		
136 W. Greenfield Ave.	202		X	X		X	X			X								1,2	NO/NC							X		
Milwaukee 4, Wisc.	205		X	X		X	X			X			X					3	NO/NC							X		
	700	X		X			X			X								2-8	NO/NC							X		
	702	X		X		X	X			X								1-4	NO							X		
	702L	X		X		X	X			X								2-4	NO							X		
	705	X		X		X	X			X			X					3	NO							X		
	808									X							X									X		
	812									X						X										X		
	815									X	X															X		
	1152	X			X	X				X								3	NO							X		
	1620	X	X				X	X		X																	X	
Allied Control Co.	BO	X	X	X														2	DT	115	15	to 230				X	X	
2 East End Ave.	CNA		X	X														1	ST	115	50	to 230				X		
New York 21, N. Y.	PB/PO	X	X	X														2,3,4	DT	115	15	to 230				X	X	
American Instrument, Inc.	4-425			X				X				X						1	SPST	500	30	6	3	3		X		
8023 Georgia Ave.	4-427			X				X				X						1	SPST	500	30	115	9	9		X		
Silver Spring, Md.	4-428			X				X				X						1	SPST	500	30	230	18	18		X		
Arrow-Hart & Hegeman	MR/LR	X	X	X						X								1,2	ST/DT	to 550	5	to 550			X	X		
Electric Co.	MR/LR	X		X						X								3,4	ST/DT	to 550	5	to 550			X	X		
Hartford, Conn. 06106	IMP/FMP	X	X							X								to 10	NO/NC	600	10/15					X		
	CRA/MH	X		X						X (mech. held)								2-5		550	to 300					X		
	RA	X		X						X (with O.L.)								2-4		550								
	RAR	X								X			X (w/wo O.L.)					2-4		550	to 300					X		
	RAS	X	(multi-speed starters)							X								3-5		550						X		
	RAC	X	(combination starters)							X										550						X		
	OR		(thermal O.L.)								X									600	to 300					X		
	MT/L	X		X														4,6	A,B,C	250	10			15		X		
	TEMA	X												X				2	DT	220	5					X		
	FPR/L	X																to 8		300	15					X		
Automatic Electric Co.	AMC		X	X				X										1,2	A,B	80	25	to 250					X	
Northlake, Ill. 60164	FMC	X						X											A,B	80	25	to 230					X	
	S		X			X												1	A	24	25	24				X		
Babcock Relays Corp.	BR5	X	X	X													X	Maximum of four	Form C	26 VDC & 115 VAC	10 Amps. max.	6-12-18-26-115 VDC, up to 115 VAC			X	X	X	X
3501 Harbor Blvd.	BR7	X	X	X													X									X	X	X
Costa Mesa, Calif.	BR8	X	X	X													X								X	X	X	X
	BR9	X	X	X													X									X	X	X
(Continued on next page)	BR10	X	X	X													X								X	X	X	X
	BR11	X	X	X													X								X	X	X	X

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AE is your supermarket for relays and switches. Over 200 types...for off-the-shelf delivery within 7 days!

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Under this growing program, we keep about 205 types of relays, switches and accessories on hand at all times. In quantities large enough to fill your ordinary requirements within one week.

You get this fast delivery on many of the most popular types from AE's broad line: EIN (integral socket) relays with power contacts; mercury-wetted contact relays; PC Correeds*; rotary stepping switches with Gold Levels for dry circuits; ERM (magnetic latching) relays; Class E relays with four different terminal designs, and many more.

Send for your free copy of Circular 1053, "AE Relays and Switches in Stock." It's the latest listing of items available for quick delivery. Just write to the Director, Relay Control Equipment Sales, Automatic Electric, Northlake, Ill. 60164.

*U. S. Patent Pending

AUTOMATIC ELECTRIC

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You Don't Need The Roll Chart

with a HICKOK Model 580

. . . . . even though it has one, because the 580 is a totally **different** tube tester. Its unique design permits direct read-in of a wide range of test parameters—which means it can be set up directly from the tube handbook, for instance. For the first time in **any** tube tester you can measure Gm under conditions of your own choosing. Of course, it has a roll chart, too—for your convenience. In addition, the model 580 makes complete "fringe" tests, including measurement of gas effects down to 0.05 μa and leakage to 50 megohms.

See your HICKOK distributor or write for circular #TT-644.

HICKOK

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Now long waits are a thing of the past. We've got as many Guardian series 1220 relays in factory stock as you need—in quantities up to thousands. You call in your order today; we ship it today.

This means that now you can order series 1220 relays as you require them. You don't need to carry an excessive inventory on hand—because we take care of your stocking problems for you.

So when you need 10 amp. DPDT or 3PDT relays that are compact, trouble-free and long-lived and you need them in a hurry, just pick up your phone and call 312/CH 3-1100. Or write or wire. We'll see that your 1220's are on their way to you that very day. If you'd like to check technical specs and dimensions, ask us for bulletin B2. Guardian Electric Manufacturing Co. Dept. E158 1550 West Carroll Avenue, Chicago, Illinois 60607.

GUARDIAN ELECTRIC

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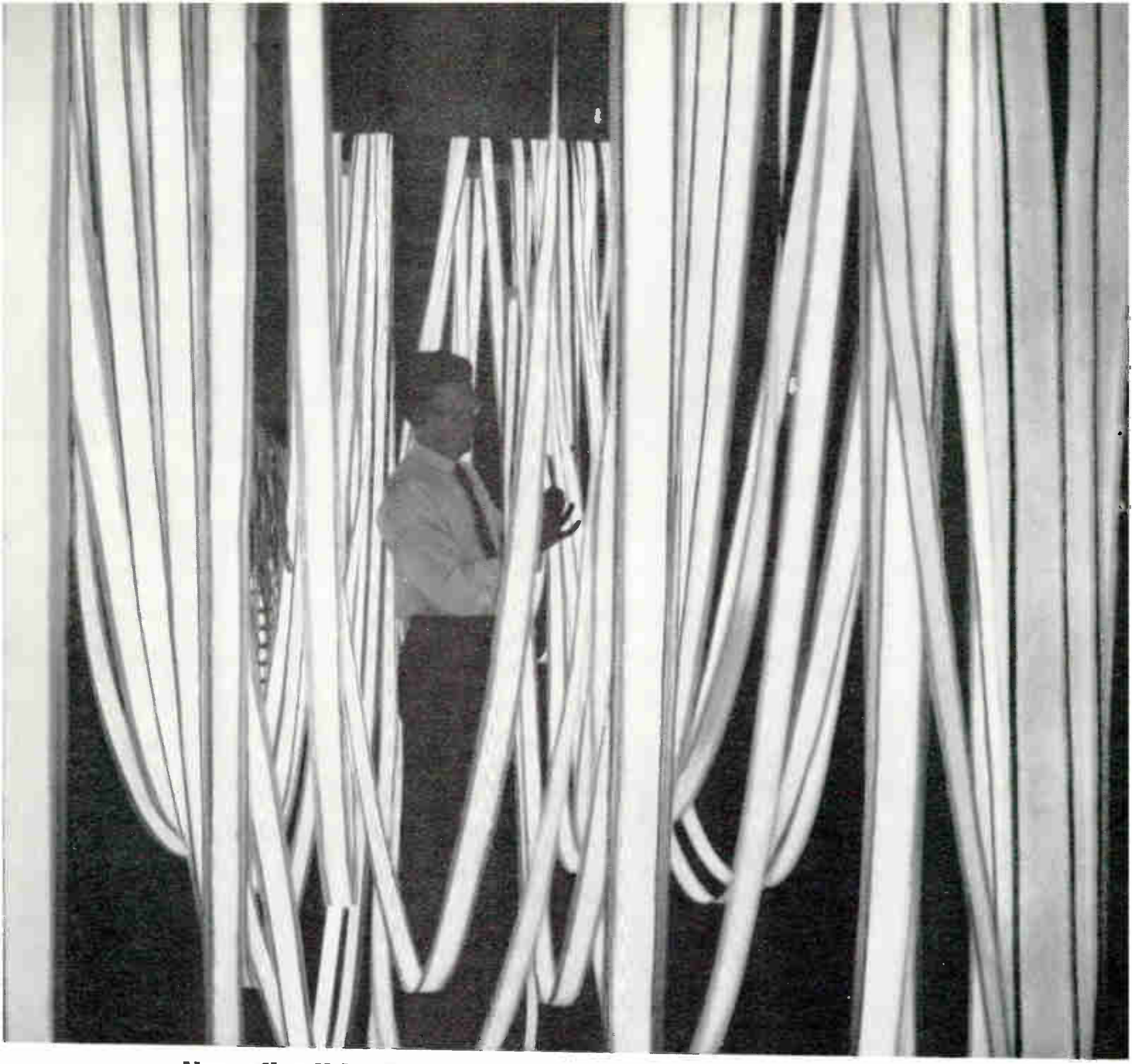

New flexible lighting you can twist, coil, weave...

it's protected by ACLAR®

Panelescent* Tape-Lite—developed by Sylvania—makes lighting available in a continuous flexible ribbon only $\frac{1}{32}$" thick. The electroluminescent light source consists of a thin strip of aluminum foil, a layer of phosphors and a transparent conductive coating—all sealed between protective layers of Allied Chemical Aclar fluorohalocarbon film.

Why did Sylvania choose Aclar? Because it protects better than any other transparent film! Aclar absorbs no water at all and transmits virtually no moisture vapor. It has excellent dielectric strength . . . withstands severe shock and pressure . . . resists tearing and pinholing, and is chemically inert to harshest chemicals. The film is fully transparent—all the brightness of Tape-Lite comes through!

Shielded by Aclar, Tape-Lite flexible lighting has many display and safety applications, as in decorative wall lighting, highway marking, and instrument panel illumination. What clear, strong, moisture-proof Aclar has done for lighting . . . it may be able to do for *your* product. To explore the possibilities, write to:

Allied Chemical

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World Radio History

Electronic Engineering Profile—1965

TABULATED RESULTS

Here are the tabulated results for some twenty-eight questions contained in our Electronic Engineering Profile questionnaires which we published in March and April of this year. This information is of industry-wide interest and will provide useful future guidelines in many fields.

To facilitate identification with your own answers, we have purposely retained the format of the original questionnaire. The printed results here reflect answers "yes," "no" or by a number. The questionnaire also included a number of open-end questions where the response was a written opinion. This part of the questionnaire is still being analyzed by our staff. Additional profile information involving the open-ended questions will be published in our next issue.

Have you ever considered working as a technical civil service employee for a Federal Government agency in an administrative, engineering or other capacity?

	(CHECK ONE)	
Yes, administrative capacity	6 (%)	1
Yes, engineering capacity	45	2
Yes, other capacity What?	2	3
No	46	4

Which of the following sources do you use most often to keep up to date technically?

Read trade magazines?	87 (%)	1
Read professional journals?	60	2
Attend technical meetings?	24	3
Attend conventions and exhibits?	22	4
Read books?	43	5
Other – What? 15		

Place a check in the box which indicates how interested you are in:

	Very Int.		Int.		Mildly Int.		Not Int.	
Business/Industry?	40 (%)	1	44 (%)	2	15 (%)	3	1 (%)	4
Engineer Personnel?	18	1	33	2	35	3	14	4
Book Reviews?	8	1	24	2	37	3	31	4
International News?	25	1	48	2	21	3	6	4
Stock Market?	22	1	30	2	[illegible]	3	12	4
Political News?	28	1	41	2	[illegible]	3	6	4
Technical News?	60	1	36	2	4	3	–	4

To enable magazines to help you as a continuing means of adult education, how would you rank the following typical editorial features in order of preference?

	RANK FROM 1 TO 7	
Feature design articles	Second	1
State of the art reports	First	2
Management articles	Fifth	3
Marketing articles	Sixth	4
How-to-design articles	Fourth	5
Staff studies on specific subjects	Third	6
Others – What?	Seventh	7

How important would you say technical magazines are in your job?

	(CHECK)	
A must	33 %	1
Very important	31 %	2
Useful	30 %	3
Marginal	5 %	4
Little value	1 %	5

Following is a list of statements about different feelings engineers may have about themselves or their jobs. Based on your first impressions, just check the box corresponding to how strongly you agree or disagree with each statement.

	STRONGLY AGREE		MILDLY AGREE		NEITHER AGREE OR DISAGREE		MILDLY DISAGREE		STRONGLY DISAGREE	
Electrical engineers have actually achieved a very small degree of professionalism.	35 (%)	1	36 (%)	2	11 (%)	3	10 (%)	4	8 (%)	5
In my present job, I consider myself to be a professional part of labor.	26	1	31	2	11	3	16	4	15	5
In my present job, I consider myself to be a part of management.	20	1	34	2	13	3	15	4	18	5
Engineers should not belong to unions.	56	1	11	2	11	3	8	4	13	5
In most cases, engineers are being exploited.	14	1	24	2	26	3	21	4	15	5
A lot of the work engineers do can actually be done by technicians.	39	1	40	2	8	3	8	4	5	5
Much of an engineer's work is actually sub-professional work.	35	1	42	2	9	3	9	4	5	5
Working overtime without pay is part of an engineer's job.	17	1	29	2	14	3	15	4	25	5
Most engineers have a non-professional attitude.	17	1	32	2	15	3	23	4	13	5

World Radio History

"PROFILE OF TODAY'S ELECTRONIC ENGINEER—1965"

Which of these is your ultimate goal?

	(CHECK ONE)	
Design Engineering	10 (%)	1
Supervisory Engineering	35	2
Engineering Research	14	3
Sales Engineering	2	4
Corporate Management	31	5
Other (specify)	8	6

If you had to decide your career all over again what would you do? Would you:

	(CHECK ONE)	
Consider study in a different field?	28 (%)	1
Study engineering in a different field?	7	2
Study engineering and management?	27	3
Follow the same field of study?	8	4

How secure do you feel in your present job?

	(CHECK)	
Very secure	30 %	1
Secure	47 %	2
Not secure at all	22 %	3

If a high school student came to you for advice about his career, would you recommend electrical engineering? (Check one)

Yes	67 %	1
No	32 %	2

In which of these areas do you feel that you would have liked to have additional education or training?

(CHECK)	YES		NO
Social Studies	28 (%)	1	2
English	35	1	2
Mathematics	53	1	2
Business Administration	70	1	2
Marketing	41	1	2
Other – What:	24	1	2

Place a check below in the first column opposite the area in which you are now working, and another check in the second column to indicate the area you would like to change to.

(CHECK)	Area In Now		Want To Change To	
Defense Electronics	44 (%)	1	1(%)	1
Aerospace Electronics	32	2	4	2
Consumer Electronics	7	3	16	3
Industrial Electronics	17	4	27	4
Other – What?	10			
No Change			18	

We are interested in your job functions, past and present. Please do the following:

-- In column 1, check off all functions you have ever done since you started your career.

-- In column 2, check off all functions you now do.

-- In column 3, check off the one function you consider to be your primary function.

Job Functions	Col. 1 All Functions		Col. 2 Current Functions		Col. 3 Primary Functions	
Corporate Management	5 (%)	1	2 (%)	1	2 (%)	1
Operating or Production Management	16	2	9	2	2	2
Technical or Engineering Management	50	3	36	3	19	3
Design Engineering: Equipment Design	74	4	39	4	16	4
Design Engineering: Systems Design	69	5	48	5	23	5
Design Engineering: Components Design	35	6	12	6	2	6
Research and Development Engineering	72	7	38	7	18	7
Reliability & Quality Control Engineering	27	8	14	8	3	8
Mechanical & Electromechanical Engineering	36	9	13	9	1	9
Value and Evaluation Engineering	31	0	16	0	4	0
Standard and Test Engineering	44	1	17	1	6	1
Application Engineering	43	2	18	2	9	2
Production Engineering	32	3	14	3	4	3
Sales and Advertising	15	4	5	4	2	4
Purchasing	21	5	5	5	–	5
Other (PLEASE SPECIFY BELOW)	7		5		3	

(Continued on page 67)

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Red 110-2	alpha ferric oxide	cubical	0.3-1.2	5.4	.33	.67	99.1 99.4	.05 .10	.25 .35	.10 .15	.03	.02 .04	.10 .15	002 .005	.002 .004	.08 .15

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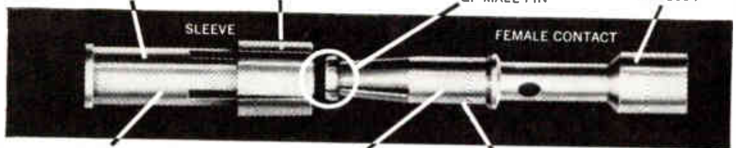
NEW REMOVABLE CRIMP-CONTACT REPC* CONNECTORS THAT MEET TRI-SERVICE SPECS MIL-C-23353/9 AND MIL-C-23353/10—AVAILABLE NOW!

REPC* A NEW ESTABLISHED RELIABILITY CONCEPT FROM U.S.C.

*REmovable RE-entrancy Printed Circuit



(REPC-F32 SHOWN)

The new U. S. C. REPC concept utilizes the unique REMI design that confines mechanical stresses between *metallic* elements only. Five years of use in millions of REMI connectors is *proof* of its established reliability! This outstanding U. S. C. patented ** contact sleeve design, is now specified as MS18135 (per MIL-C-23216) along with U. S. C. Part No. 1242-9 (female crimp-barrel socket contact MS18134 per MIL-C-23216), on both new military specification sheets.

Why settle for less than the best removable crimp-contact connector for *your* equipment? Write for the new REPC brochure or phone today for prompt assistance regarding your standard or special connector needs.

**U. S. Pat. 2,979,689 & FIVE INTERNATIONAL PATENTS.

REPC-F ( ) SERIES MEETS MIL-C-23353/9

CONTACT CENTER-TO-CENTER .156 INCH.

CONTACTS: Part 1242-9 meet MS18134 per latest MIL-C-23216 and are ordered separately. Type is crimp, removable, closed-entry.

NO. OF CONTACTS: 7, 11, 15, 19, 23 (in Military Spec.) and 32 Contact.

TEST VOLTAGE: 1800 V.R.M.S. at Sea Level.
CURRENT RATING: 7.5 Amps.
MATING CONNECTORS: Any numerical counterpart in UPCC-M ( ) A, B, or C Series.

CONNECTORS WITH 7 THRU 23 CONTACTS MEET APPLICABLE PROVISIONS OF NAS713 AND NAS714.
VARIOUS POLARIZATIONS OPTIONAL.

FULL LINE OF CRIMPING TOOLS AVAILABLE — MIL-T-22520A CLASS I, MS3191 (ALL) and CLASS II TOOLS. REMOVAL TOOL RT1256 MEETS MS18137 PER LATEST MIL-C-23216.

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REPC-SGF ( ) SERIES MEETS MIL-C-23353/10

CONTACT CENTER-TO-CENTER .100 INCH.
CONTACTS: Part 1242-9 meets MS18134 per latest MIL-C-23216 and are ordered separately. Type is crimp, removable, closed-entry.

NO. OF CONTACTS: 11, 17, 23, 29, 35.
TEST VOLTAGE: 1800 V.R.M.S. at Sea Level.
CURRENT RATING: 7.5 Amps.
MATING CONNECTORS: Any numerical counterpart in UPCC-SGM ( ) A, B, or C Series.

THESE CONNECTORS MEET ALL APPLICABLE PROVISIONS OF NAS713. VARIOUS POLARIZATIONS OPTIONAL.

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"PROFILE OF TODAY'S ELECTRONIC ENGINEER—1965"

When is your anticipated next promotion?

	(CHECK)	
Within 3 months	13 (%)	1
Within 6 months	10	2
Within 1 year	15	3
Don't Know	62	4

Suppose you were to consider a new job with another company, how would you rank the following aspects of employment?

	RANK FROM 1 TO 6	
Year-round recreational facilities	Sixth	1
Freedom to work with less tape	Second	2
Opportunities for further education	Fourth	3
Added fringe benefits	Fifth	4
Security	Third	5
Geographical location	First	6

As the situation stands now, would you say that:

	(CHECK ONE)	
You are satisfied with your job?	52 (%)	1
You have already looked for a new job?	12	2
You are just now looking for a new job?	10	3
You are just thinking about looking for a new job?	25	4

Now just a few questions about you, your background and interests: First of all . . . .
How old are you?

	(CHECK)	
Under 25	1 (%)	1
25 – 29	23	2
30 – 34	25	3
35 – 39	21	4
40 – 44	18	5
45 – 49	7	6
50 – 54	3	7
55 or over	1	8

How many different companies have you worked for since you started your career in engineering?

One - 29 (%)	Five - 5
Two - 27	Six - 4
Three - 21	Seven - 1
Four - 10	Eight - 1

Which group represents your total annual salary before taxes?

	(CHECK ONE)	
Under $ 6,000	0	
6,000 – 7,449	1 (%)	1
7,500 – 9,999	26	2
10,000 – 12,449	31	3
12,500 – 14,999	19	4
15,000 – 17,999	16	5
18,000 and over	7	6

How many persons are there in your household including yourself?

One - 6 (%)	Four - 10
Two - 13	Five - 27
Three - 12	Six - 9
	Seven - 2

Since your last degree have you pursued studies in any subject to further your education?

	(CHECK)	
Yes	76 %	1
No	24 %	2

Have you ever taught school, contemplated teaching or do you actually plan to teach?

	(CHECK)	
Taught school	31 (%)	1
Contemplated	28	2
Plan to teach	9	3
None of above	38	4

Please check any of the following activities in which you participate?

	CHECK AS MANY AS APPLY	
Civic Organizations	35 (%)	1
Social Welfare	6	2
Veteran's Organizations	4	3
Church groups	50	4
Fraternal and Service Organizations	30	5
Country Clubs	5	6
Other Sports Clubs	25	7
Professional Business Associations	43	8
Other Organizations	20	
What? ______		

Do you hold any outside remunerative jobs after hours?

	(CHECK)	
Yes	17 %	1
No	83 %	2

(If applicable:) Is this job in the electronic field or is it outside of the electronic field?

	(CHECK)	
Electronic Field	58 %	1
Outside of electronic field	42 %	2
Specify ______		

Which of the following are included in your retirement plans from an electronic field?

	CHECK AS MANY AS APPLY	
Pension Plan – Company	76 (%)	1
Pension Plan – Personal	32	2
Profit Sharing	12	3
Own Business	13	4
Own Stocks	60	5
Mutual Funds	25	6
Other – What? ______	11	

Do you own stock?

	(CHECK)	
Yes	68 %	1
No	32 %	2

Do you own stock in your own company?

	(CHECK)	
Yes	37 %	1
No	63 %	2

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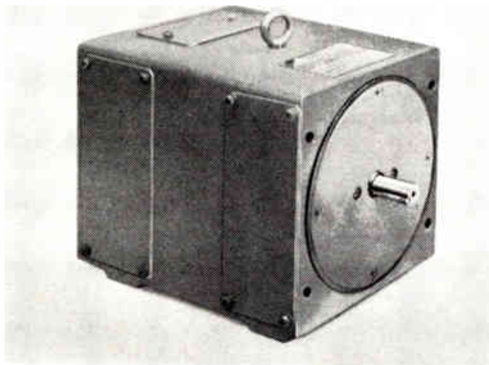

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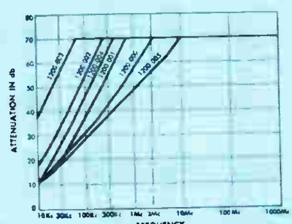

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Ind. (Sea Level)—2.5 amps
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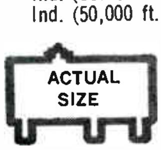

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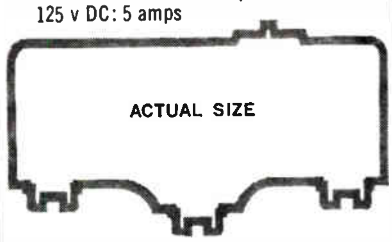
125/250/480 v AC: 15 amps (U. L. listed)
125 v AC: ½ h.p. (U. L. listed)
250 v AC: 1 h.p. (U. L. listed)
30 v DC: Res. —15 amps
Ind. — 5 amps
Motor— 5 amps
125 v DC: 5 amps



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ELECTRICAL RATING

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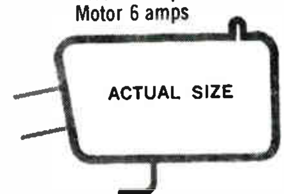
250 v AC: ⅓ h.p. (U. L. listed)
125 v DC: ½ amps
250 v DC: ¼ amps
30 v DC: Res. 10 amps
Ind. 6 amps
Motor 6 amps



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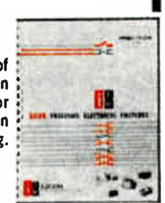

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Varactor tuning has its pitfalls and limitations along with strong appeal. This article points out some of the problem areas and how to handle them. The included graphs provide a quick source of information to designers using varactors. An example is also included as an aid.

Designing Varactor-Tuned Circuits

WITH THE VARACTOR DIODE has come much interest in all electronically tuned circuits. The speed of operation and absence of mechanical parts has contributed to increased use. However, as in all new devices, there are pitfalls and limitations. Neglecting to consider these can only result in failure. The upper limits of performance are limited by the maximum control range available and restrictions on this range imposed by the amplitude of applied signal(s).

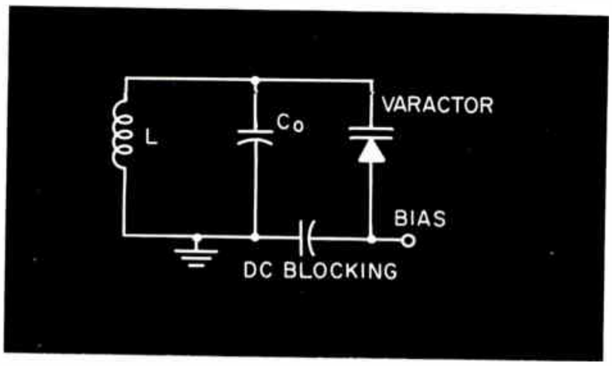

Fig. 1: A typical varactor tuned circuit that is used.

The nature of a back biased semiconductor junction diode has been well discussed[1]. Here we will be concerned with the abrupt junction which is commonly used in high frequency tuned systems. Curves for graded junctions under small signal conditions are included in some cases for comparison.

The varactor is limited in tuning range to the capacitance variation obtainable between the limits of forward conduction, zener breakdown, and the character of the semiconductor junction. These set the maximum tuning range possible. A typical circuit is given in Fig. 1.

Taking each component at a time, the tuning obtainable is a function of the capacity vs. bias voltage. The shape of this curve depends upon the fabrication of the varactor junction, and is given by:

$$C = C_{min}\left[\frac{\phi + V_b}{\phi + V_B}\right]^{-n}$$

where ϕ is the diode contact potential (0.7 v typical for silicon diodes), V_B the varactor zener breakdown voltage, and V_b the bias voltage. The exponent n is a function of the diode junction and is 0.5 for an ideal abrupt junction, 0.48 for a more practical abrupt junction, and ⅓ for a graded junction. A plot of C vs. V_b normalized at $V_b = 1$ is given in Fig. 2 for a practical abrupt junction. Fig. 3 gives the maximum capacity tuning range possible with each junction type for a control voltage range of 0 to V_B in Fig. 1 with $C_O = 0$. This is the small-signal, or no-signal tuning curve and is a plot of

$$C_{max}/C_{min} = \left[\frac{\phi + V_b}{\phi + V_B}\right]^{-n}$$

through the range V_B of 1 to 100 v with $V_b = 0$

The introduction of a signal of peak magnitude V_s reduces the maximum tuning range, which is now given by:

$$C_{max}/C_{min} = \left[\frac{\phi + V_s}{\phi + V_B - V_s}\right]^{-n}$$

Changing this expression to the equivalent operating condition of signal in the contact potential region reduces the expression to:

$$C_{max}/C_{min} = \left[\frac{V_s}{\phi + V_B - V_s}\right]^{-n}$$

This curve is plotted in Fig. 4 for the function $C_{max}/C_{min} = F(V_S/V_B)$. This curve is correct as shown under conditions of no signal, with $V_S/-\phi$ being the minimum and V_B-V_S being the maximum operating bias. Detuning effects due to signal result from modulation of the varactor capacity, producing an integral in the average (over a cycle) value of C_{max} which is higher at signal than at no-signal conditions. This effect is most significant when the peak signal voltage approaches the value of the bias voltage ($V_b + \phi$). The correction factor for this effect is given in Fig. 5, which is a plot of:

$$C_{avg}/C_b = \frac{1}{2\pi}\int_{-\pi}^{+\pi}\left[\frac{\phi + V_b + KV_b \sin\theta}{\phi + V_B}\right]^{-n} d\theta$$

by GEORGE STRICKHOLM

President
New Haven Assoc.
So. Lincoln, Vt. 05467

World Radio History

for the exponent value of $n = 0.48$ and values of K from 0 to 0.999. It is obvious that $KV_b = V_S$. This curve is superimposed on Fig. 2 and 4 as a family of curves which show the rapid change in tuning that occurs as the peak signal amplitude approaches the bias voltage. The circuit design should avoid operating in this region as much as possible.

Power in a Tuned Circuit

In a varactor tuned circuit the maximum amplitude of the applied signal voltage is limited by available varactors and the required tuning range of the system using it. Taking into account the stray circuit capacities (C_O) which serve to reduce the varactor tuning ratio from that obtainable from the varactors alone, we have

$$C'_{max}/C'_{min} = (C_{max} + C_o)/(C_{min} + C_o)$$

This factor shows the need for a larger C_{max}/C_{min} ratio, which in turn limits the value of V_S as obtainable from Fig. 4 The external energy available from a resonant circuit is given by:

$$P = \frac{V_s^2}{2Q_1\omega L} \times \frac{Q_u\omega L}{Q_u\omega L + R_L}$$

Solving this for C_{max}, and keeping in mind that V_S is a peak value we obtain:

$$C'_{max} = \frac{2PQ_L}{\omega_1 V_s^2} \times \frac{R_L + Q_u\omega_1 L}{Q_u\omega_1 L}$$

The equation is solved at the lowest frequency of operation ω_1 since this is where the limit on the magnitude of V_S is set. The value of C'_{max} obtained is the minimum value which will handle the power required.

Example: Find the maximum available signal power output of a varactor tuned transistor oscillator operating over the range of 5-10 MC. Assume stray circuit capacities (C_O) are equal to the varactor minimum capacity $C_{min} = 10$ pf, $Q_u = 100$, $Q_L = 10$, for control circuit limitations $V_B = 50$ v, and transistor loading is neglected.

$$C'_{max}/C'_{min} = \frac{C_{max}\, C_o}{C_{min}\, C_o} = (f_{max}/f_{min})^2 = 4 = 80 \text{ pf}/20 \text{ pf}$$

From above expression,

$$C_{max}/C_{min} = 7$$

Referring to Fig. 4, $V_S = 0.017V_b$

With V_B limited to 50 v, $V_S = 0.85$ v.

The total circulating energy in the tuned circuit is:

$$P = \frac{V_s^2}{2/\omega_1 C'_{max}} = \frac{(0.85)^2}{2/2\pi 5\times 10^6 \times 80 \times 10^{-12}} = 1.81 \text{ mw}$$

From the initial assumptions, the energy available to external circuits is $P/Q_L = 0.181$ mw, of which 0.0181 mw is dissipated in tuned circuit losses (Q_u) and 0.163 mw is available for external circuit loading.

To obtain more output power from the above circuit, the greatest improvement can come from reducing stray circuit capacities. If C_O can be reduced to 2 pf, and using the same varactor, then

$$C'_{min} = 10 \text{ pf} + 2 \text{ pf} = 12 \text{ pf}$$
$$C'_{max} = 4 \times 12 \text{ pf} = 48 \text{ pf}$$
$$C_{max} = C'_{max} - C_o = 46 \text{ pf}$$
$$C_{max}/C_{min} = 46/10 = 4.6$$

Referring to Fig. 4 for this value of C_{max}/C_{min}, $V_S/V_B = 0.040$ and, for a $V_B = 50$ v, $V_S = 2.0$ v. At 5 MC the circulating energy becomes; $P = 6.03$ mw, and for a $Q_L = 10$, the available energy, less losses, becomes 0.603 mw. The external load will decide the

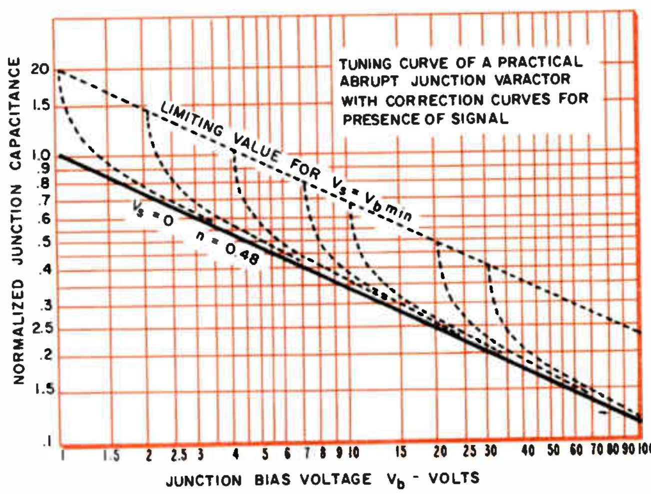

Fig. 2: A plot of C vs. V_b normalized at $V_b = 1$ is shown in graph above.

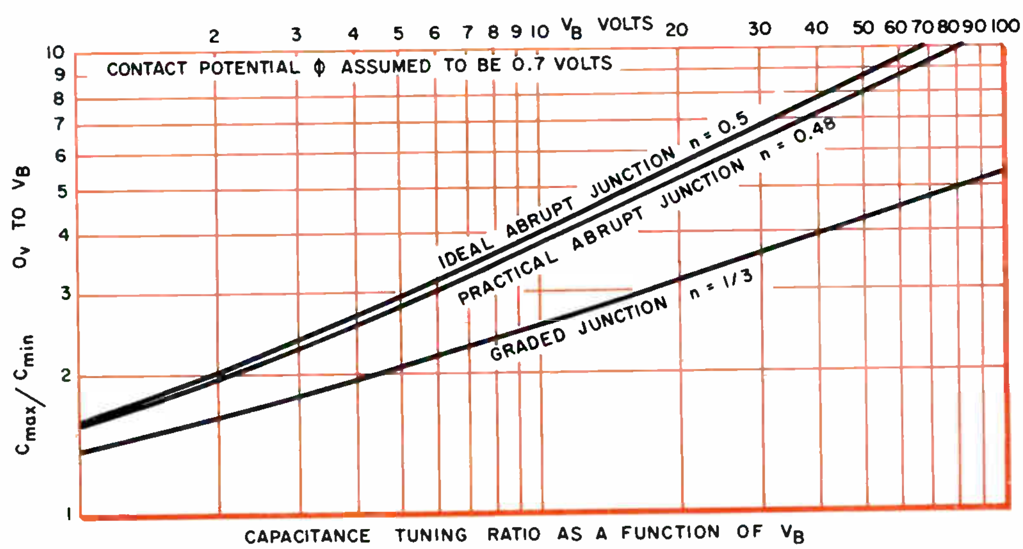

Fig. 3 (left): Capacitance tuning ratio is shown as a function of V_b.

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loaded Q, and the available power into the load can be as high as 0.590 mw.

The importance of reducing circuit stray capacities to an absolute minimum to obtain maximum possible power output and/or frequency control range can be seen. Ideally, the varactor should be the only capacity needed to resonate the circuit. To increase the power further from the values calculated, two varactors in parallel might be used at the same operating bias voltages for a 3db increase in output, or V_B could be raised. For $V_B = 100$ v and C_{min} maintained at 10 pf, P_{out} would be raised by 6 db.

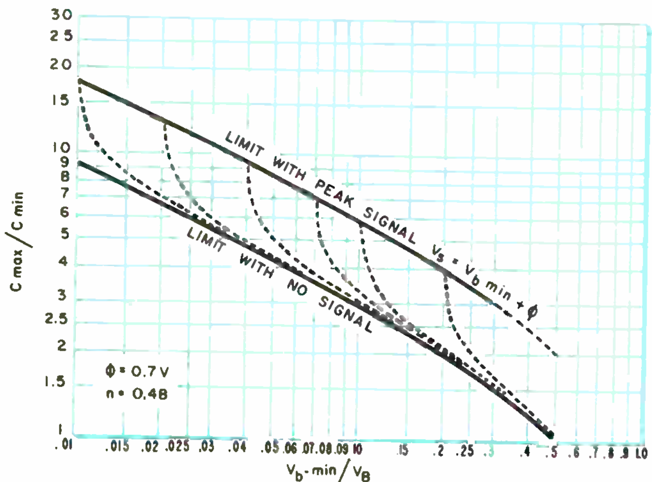


Fig. 4: Tuning range as a function of signal level limitations.

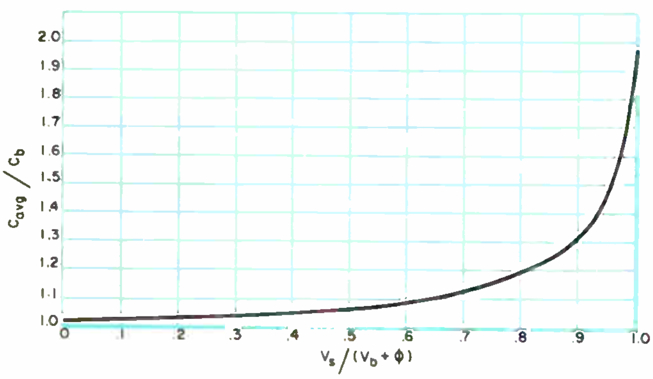


Fig. 5: Curve shows the detuning effects due to signal.

Other Aspects of Circuit Design

Most varactor controlled circuits cannot be simply taken by themselves, but are part of complex systems. For this reason, the control voltage is probably driven from a linear voltage/frequency source operating through a shaper. The design of the shaper and the tuning adjustments in each varactor tuned circuit determine the circuit practicality and reproducibility.

Normal tolerance in run-of-the-mill varactors are much broader than that normally used in resonant circuits. If the normal variations are due to different junction areas, all that would be needed is a variable shunt trimmer capacitor to set the C'_{max}/C'_{min} ratio to the desired value (reducing the tuning range and dynamic range feasible) and then a variable inductance to set the frequency to the desired range. The electronic shaper should then take care of tracking across the band. If variations in junction diffusion produce large variations in tuning characteristics, then adjustments in the shaper may be in order.

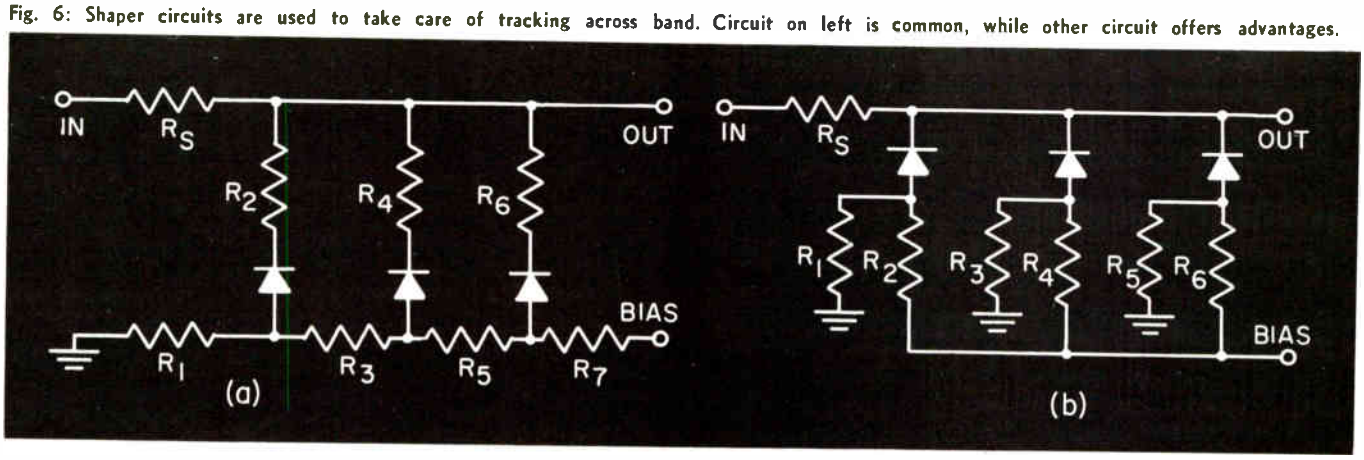
A typical shaper circuit is given in Fig. 6a. This is a common circuit, but interactions between bias cut-in points and circuit loading make the computation of values difficult. Also, a common practice is to make the values of the divider resistances (R_1, R_3, R_5 and R_7) low, with the resultant higher power drain.

The circuit of Fig. 6b presents many advantages in this respect. The bias voltage of each break point can be adjusted without affecting any of the other points, and the equivalent source impedance of each break point is established by setting the equivalent impedance of each divider to the wanted value. If this does not result in practical values, a third resistor in series with each diode can be used to set the source impedance. The circuit of Fig. 6b also employs one less resistor than that of Fig. 6a.

References;

1) Chang, K.K.N. Parametric and Tunnel Diodes, Prentice-Hall 1964

Fig. 6: Shaper circuits are used to take care of tracking across band. Circuit on left is common, while other circuit offers advantages.



World Radio History

CIRCUIT-WISE

Monostable Multivibrator

THE CIRCUIT shown in Fig. 1 (U. S. Patent No. 3,085,165) is satisfactory for certain applications of light loading. If one is required to drive a heavy load from the cathode of Q_1, the biasing resistor R_2 must be of such a low value that circuit efficiency in standby would suffer. The reset capacitor C_2 would have to be so large that circuit cutoff by negative transients on the supply bus could occur.

Improvement of the circuit to provide greater reliability and load-carrying capability was desired.

In Fig. 2, the reset transistor Q_1 and coupling diode D_1 (of Fig. 1) have been eliminated. This circuit is inherently insensitive to both positive and negative transients on the supply bus. It is more efficient when heavily loaded and has essentially zero standby current (the leakage current of Q_1). In this circuit, reset is done by adding the low impedance output from base 1 of Q_2 to the cathode voltage of Q_1. This effectively back biases Q_1 and reduces the current to a value below its holding current. Coupling capacitor C_1 is large enough for the time constant R (effective load) $\times$ C_2 to sufficiently exceed the turn-off time of Q_1. A resistance at R_1 of 470K ohms and a capacitance at C_1 of 100 μ give a time interval of about 50 sec.

The circuit has driven loads up to 150 ma over a temperature range of $-30°$ to $+80°C$.

For further information contact: Technology Utilization Officer, Goddard Space Flight Ctr., Greenbelt, Md. 20771. Ref. B65-10011.

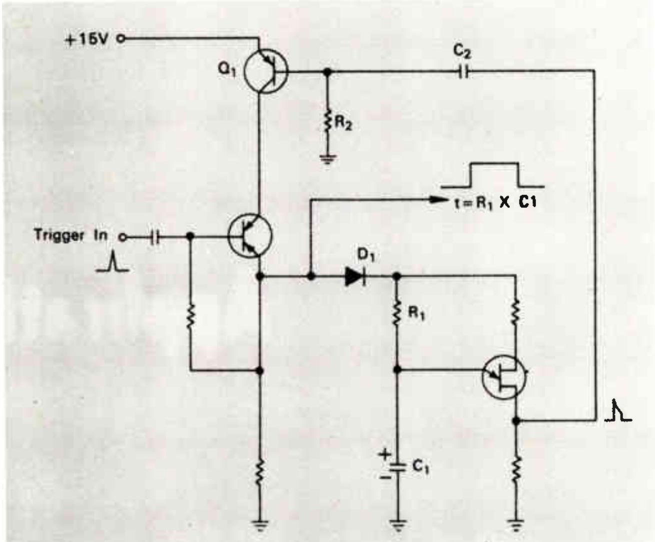


FIGURE 1

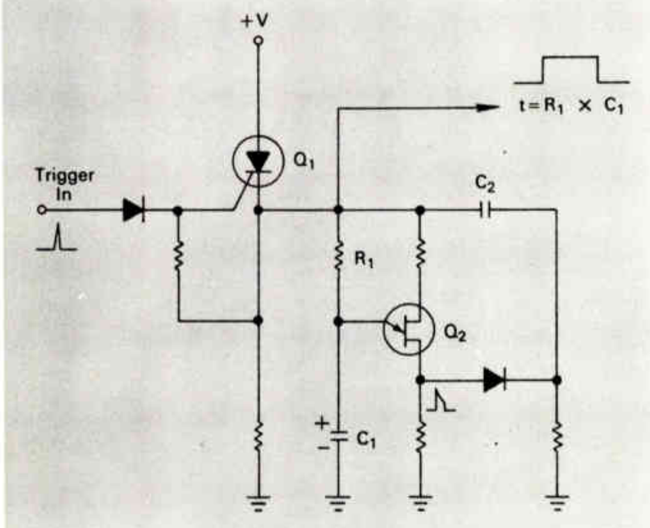
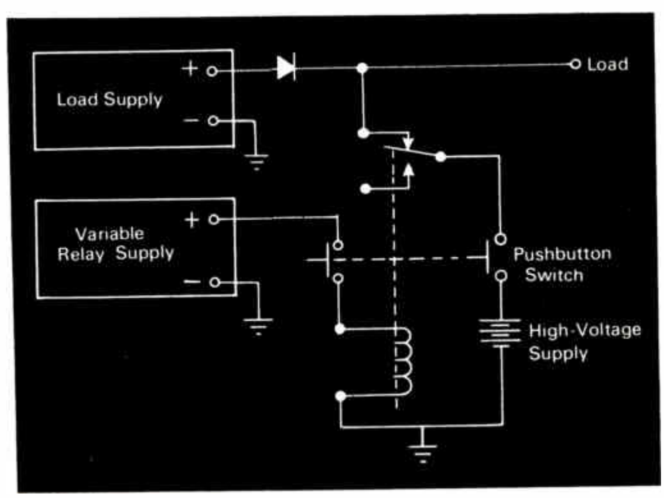


FIGURE 2

Testing of Component Breakdown Voltage

THERE WAS A NEED for a nondestructive test for finding the breakdown voltage of transistors and other electronic components. A simple relay circuit that permits application of low-energy, high-voltage μsec. pulses to the components under test was used.

The high-voltage dc power supply is normally disconnected from the test component, represented as the load in the circuit diagram, by the 2-section pushbutton. When the pushbutton is depressed, the high-voltage supply is connected to the load and power is simultaneously supplied to the relay coil from the variable supply. The voltage applied to the load is of μsec. duration, as it is determined only by the rise time required to energize the relay coil and open its normally closed contact. The diode blocks the high voltage from the load supply.



For further information contact: Technology Utilization Officer, Manned Spacecraft Ctr., P. O. Box 1537, Houston, Tex., 77001. Ref: B65-10054.

(More Circuit-Wise on page 168)

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Application of collector logic often allows a reduction in the number of circuits needed for a specific purpose. It also shortens the delay from input to output. The method described here allows the collector logic to be formed directly from the Veitch diagram.

Applications of Collector Logic

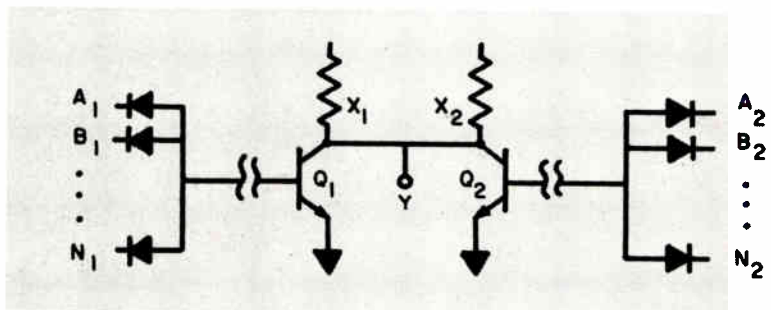


Fig. 1: Common outputs from two NAND circuits.

IN MOST TYPES OF NAND CIRCUITRY, the outputs (or collectors) may be tied together, and the output of the circuits taken from this common connection. The number of circuits needed may often be reduced and the delay from inputs to output as well.

* * *

Consider a NAND gate with inputs A, B, .., N, and output X such that

$$X = \bar{A} + \bar{B} + \cdots + \bar{N} = \overline{A \cdot B \cdot \cdots \cdot N} \qquad (1)$$

If now, two such circuits with inputs A_1, B_1 .. N_1 and A_2, B_2, .. N_2 have their outputs, X_1 and X_2 tied together (Fig. 1), it is seen that when X_1 is logical 0, resulting from Q_1 being on, output X_2 will be pulled down to 0 regardless of the condition of Q_2. The reverse is also true. Overall output Y, then cannot be a logical 1 unless both X_1 and X_2 are logical 1. Thus,

$$Y = X_1 X_2 \qquad (2)$$

From Eqs. 1 and 2,

$$Y = \overline{(A_1 \cdot B_1 \cdots N_1)} \cdot \overline{(A_2 \cdot B_2 \cdots N_2)} \qquad (3)$$

$$Y = (\bar{A}_1 + \bar{B}_1 + \cdots \bar{N}_1)(\bar{A}_2 + \bar{B}_2 + \cdots + \bar{N}_2) \qquad (4)$$

$$Y = \overline{(A_1 \cdot B_1 \cdots N_1) + (A_2 \cdot B_2 \cdots N_2)} \qquad (5)$$

By use of Eqs. 3, 4, and 5, we can mechanize some commonly used functions using collector logic.

(A) Exclusive OR. Using Eq. 4, if

$$A_1 = A,\ B_1 = B,\ A_2 = \bar{A},\ B_2 = \bar{B}$$

$$Y = (\bar{A} + \bar{B})(A + B) = A\bar{B} + \bar{A}B = A \oplus B$$

The logic is shown in Fig. 2.

(B) Many input "AND," using NAND's with limited number of inputs. From Eq. 3, A_1, B_1, ... N_1 are inputs of an N input gate, and A_2, B_2, ... N_2 are inputs of another N input gate, etc., an Nn input AND gate can be formed where $n = 2, 3, 4 \ldots$ as follows:

$$\begin{aligned} Y &= \overline{\overline{(A_1B_1 \cdots N_1)}}\ \overline{\overline{(A_2B_2 \cdots N_2)}} \cdots \overline{\overline{(A_nB_n \cdots N_n)}} \\ &= (A_1B_1 \cdots N \cdot A_2B_2 \cdots N_2 \cdots A_nB_n \cdots N_n) \end{aligned}$$

The logic is shown in Fig. 3.

(C) AND-OR. From Eq 5, directly implemented as shown in Fig. 4, the AND-OR function can be realized.

Deviation of a Direct Method

The method to be described allows forming the collector logic implementation directly from the Veitch diagram.

From the "basic theorem" of Boolean algebra, any function, f, of N variables may be represented as a Boolean product of maxterms of the variables, or as a Boolean sum of their minterms.

A minterm, m, of N variables is defined to be the Boolean product of all variables. The variables within the minterm may appear in uncomplemented or complemented form. For N variables, there are 2^N minterms, number 0 through $2^N - 1$. Thus for $N = 3$,

$$m_0 = \bar{A}\ \bar{B}\ \bar{C},\ m_1 = \bar{A}\ \bar{B}\ C,\ m_2 = \bar{A}\ B\ \bar{C},\ m_3 = \bar{A}\ B\ C,$$

$$m_4 = A\ \bar{B}\ \bar{C},\ m_5 = A\ \bar{B}\ C,\ m_6 = A\ B\ \bar{C},\ m_7 = A\ B\ C$$

A maxterm, M is the Boolean sum of N variables.

World Radio History

By M. J. SLONAKER, Design Engineer, Interstate Electronics Corp., Anaheim, Calif.

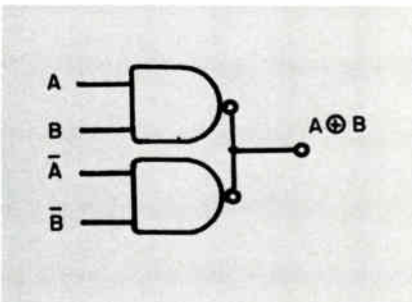
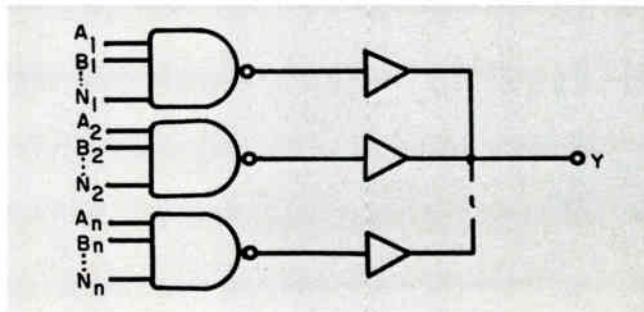


Fig. 2: Exclusive OR logic (left).

Fig. 3: Many input AND logic (right).



$$M_0 = \bar{A} + \bar{B} + \bar{C},\ M_1 = \bar{A} + \bar{B} + C \cdot \cdot \cdot \cdot M_7 = A + B + C$$

By representing some minterms and maxterms on the Veitch diagram, it can be seen that, since minterms occupy only one square, and maxterms occupy all but one square:

$$\bar{m}_i = M_{(2^N - 1) - i} \quad \text{and} \quad \bar{M}_i = m_{(2^N - 1) - i} \qquad (6)$$

The basic theorem may be stated as:

$$f = \sum_{i=0}^{2^N - 1} f_i m_i \qquad (7)$$

where f_i is a series of constants, 1 or 0. Using Eq. 7, the complement of f may be written

$$\bar{f} = \sum_{i=0}^{2^N - 1} \bar{f}_i m_i \qquad (8)$$

Eq. 8 states that to form the complement of f, remove all minterms in the original expression, and include all minterms not in the original expression.

By expanding Eq. 8, then applying DeMorgan's Rule we have

$$\bar{f} = \bar{f}_0 m_0 + \bar{f}_1 m_1 + \cdot \cdot \cdot \cdot + f_{2^N - 1}\, m_{2^N - 1}$$

$$= \overline{\overline{(\bar{f}_0 m_0)}\ \overline{(\bar{f}_1 m_1)} \cdot \cdot \cdot \cdot \overline{(\bar{f}_{2^N - 1}\, m_{2^N - 1})}}$$

$$= \prod_{i=0}^{2^N - 1} \overline{\bar{f}_i m_i} \qquad (9)$$

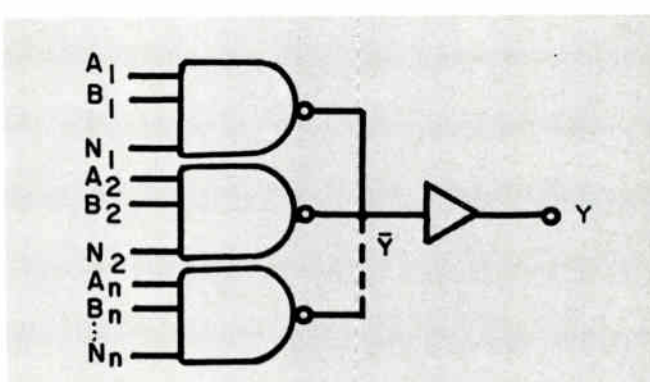
Eq. 9 states that the original function, expressed as a Boolean sum of minterms, may be expressed as a product of negations of the minterms not included in the original expression. Negations of the minterm can be produced by entering the variables of the minterms into the inputs of a NAND gate. The product or AND is formed by tying the outputs together (See Eqs. 1 and 2).

Often simplification of the minterms not included in the original expression (the negation of the original expression) is possible and may be done on the Veitch Diagram. The rules for realizing the function using collector logic may be stated as follows:

(1) Plot the negation, $\bar{f}$, and the function, f, to be mechanized.

(2) Write $\bar{f}$ in its simplified minterm (sum of products) form.

Fig. 4: AND-OR logic is shown below.



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(3) The mechanization contains a NAND gate corresponding to each product group in the sum of products. Each variable present in a product group is entered into an input of its gate.

(4) Connect all gate outputs together. The common output is f.

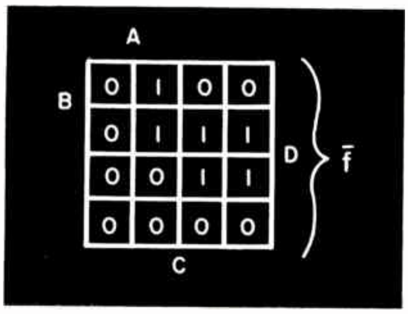


Fig. 5: Veitch diagram function plot for inverse of $A\bar C + A\bar B + \overline{AD}$.

Applications

The function $f = A\,\bar C + A\,\bar B + \bar A\,\bar D$ is to be simplified using these rules. Fig. 5 is a Veitch Diagram plot of f, from which $\bar f = \bar A D + ABC$.

Comparison of the mechanization of Fig. 6 with the usual "and-or" method shows a 50% gate savings,

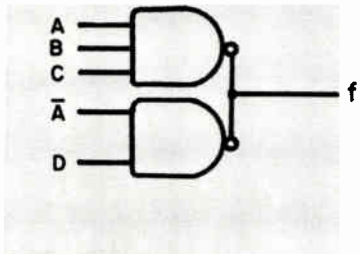


Fig. 6: Mechanization of $f = A\bar C + A\bar B + \overline{AD}$.

plus a reduction in propagation delay.

Let us investigate mechanizing the function $A = B$, where A and B are 4-bit words. That is, $A = A_3, A_2, A_1, A_0$ and $B = B_3, B_2, B_1, B_0$. If the inverse function is plotted and simplified, we obtain

$$\bar f = A_3\bar B_3 + \bar A_3 B_3 + A_2\bar B_2 + \bar A_2 B_2 + A_1\bar B_1 + \bar A_1 B_1 + A_0\bar B_0 + \bar A_0 B_0$$

$$f = \overline{A_3\bar B_3} \cdot \overline{\bar A_3 B_3} \cdot \overline{A_2\bar B_2} \cdot \overline{\bar A_2 B_2} \cdot \overline{A_1\bar B_1} \cdot \overline{\bar A_1 B_1} \cdot \overline{A_0\bar B_0} \cdot \overline{\bar A_0 B_0}$$

The mechanization is shown in Fig. 7. This result could have been arrived at in a different manner. Consider the formation of $A_3 = B_3$ by Eq. 4. If $A_1 = A_3$, $B_1 = B_3$, $A_2 = A_3$, and $B_2 = B_3$, we have

$$Y = (\bar A_3 + B_3)\,(A_3 + \bar B_3) = \bar A_3\bar B_3 + A_3 B_3 \qquad (10)$$

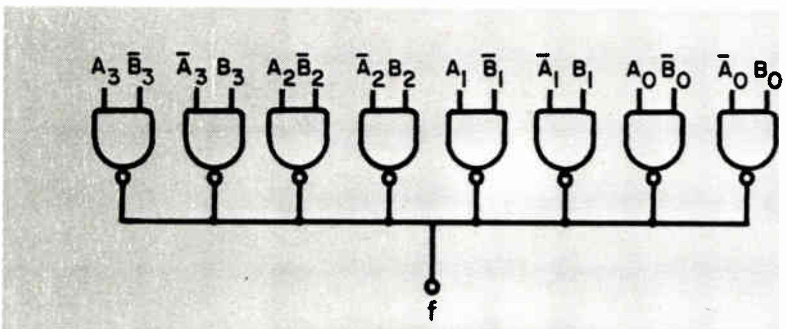


Fig. 7: Mechanization of A = B (above).

Fig. 8: Formation of A ⊕ B and A ⊙ B when assertion inputs only are allowed.

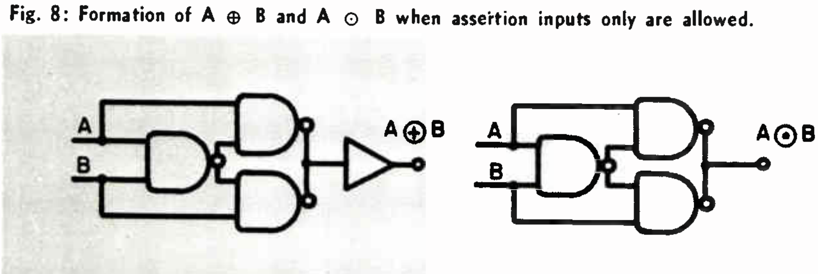
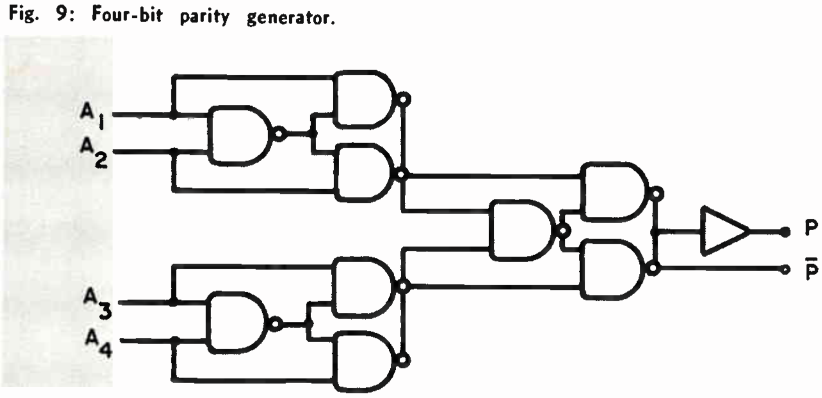


Fig. 9: Four-bit parity generator.



Eq. 10, the coincidence function of A_3 and B_3 ($Y = A_3 \odot B_3$,) is true whenever $A_3 = B_3$. For $A = B$ we want $A_3 = B_3$ and $A_2 = B_2$, etc., so Fig. 7 again results. If only uncomplemented variables are allowed as inputs, the formation of $A \oplus B$ and $A \odot B$ must be altered according to Fig. 8.

From Fig. 8, it is apparent that if possible, $A \odot B$ should be used instead of $A \oplus B$. Often this is possible as is seen by establishing some relations between the two. From Fig. 8, it is seen that

$$A \odot B = \overline{A \oplus B} \qquad (11)$$

If we are now interested in combining three variables in coincidence, we have

$$A \odot B \odot C = (A \odot B)C + \overline{(A \odot B)}\,\bar C$$

Applying Eq. 11

$$A \odot B \odot C = \overline{(A \oplus B)}\,C + (A \oplus B)\,\bar C$$

and $\quad A \odot B \odot C = A \oplus B \oplus C \qquad (12)$

(*Continued on p. 182*)

World Radio History

Electronic correlators are being used more and more in electronic equipment and also in other fields. The correlator and its operation are discussed here. Its growing role in the field of Photogrammetry is also discussed illustrating just one of its many applications.

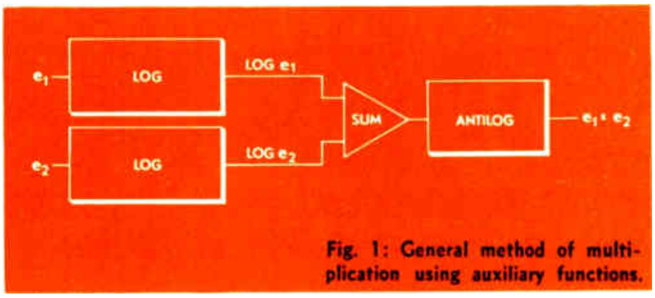


Fig. 1: General method of multiplication using auxiliary functions.

THE ELECTRONIC CORRELATOR

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Electronic Correlators used in radar systems, communications, photogrammetry, Geophysics, seismic systems, etc., measure the similarity between two input signals or waveforms. They are used for signal detecting, pulse-compression, echo detecting, and in general filtering operations.

* * *

Output of the correlator reaches a maximum when the input signals are identical and in phase. As one input is delayed or changes phase with respect to the other input, the correlator output drops toward zero.

The degree of similarity between two waveforms can be measured by multiplying them together, ordinate by ordinate, and then adding the product over the duration of the waveform. A general method of multiplication using auxiliary functions is shown in Fig. 1. This circuit solves the equation—Log $e_1 \times e_2$ — Log e_1 + Log e_2.

A factor to be considered in multiplying circuits is the allowable algebraic sign of each input. If the sign of neither input changes, a single-quadrant multiplier may be used. If the sign of one input changes, a two quadrant multiplier is needed. If the signs of both inputs change, a four quadrant multiplier is needed.

Basic Correlator

The basic correlator (Fig. 2) consists of a four quadrant multiplier and an integrator. The output yields a voltage analogous to the similarity between the incoming signals as a function of the phase shift or time delay between them. Diodes CR-1, CR-2, CR-3 and CR-4, along with resistors R provide an approximation to a square law current-voltage relationship. The push-pull transformers are used to make available both polarities of the incoming signals. Output voltage across the capacitor can be written as:

$$e_{out} = \frac{K}{RC} \int_0^T [(A + B)^2 - (A - B)^2]\, dt \qquad (1)$$

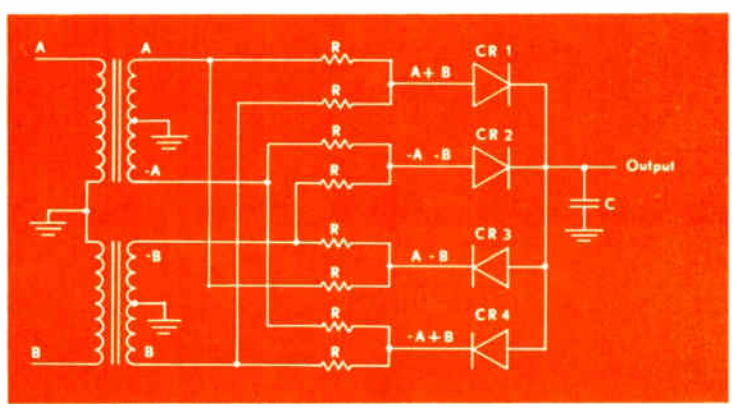
where $A + B$ is supplied through CR-1 if $A + B$ is greater than zero and through CR-2 if $A + B$ is less than zero. Similarly $A - B$ is supplied through CR-3 if $A - B$ is less than zero and through CR-4 if $A - B$ is greater than zero. Diodes CR-3 and CR-4 are reversed to effect the subtraction. Eq. 1 can be simplified to:

$$e_{out} = \frac{4K}{RC} \int_0^T A \bullet B\, dt \qquad (2)$$

which shows output voltage is a measure of the average product of the incoming signals and hence the correlation between them.

In the circuit of Fig. 2, no attempt is made to operate the diodes in their square law region. The outputs may be closer to linear than to square law so that the current-voltage relationship is given by $i = K_1 (A + B)$ instead of $i = K_2 (A + B)^2$. This alters the behavior of the circuit in detail only, and tests show a negligible difference between a true square law type correlator and the one shown in Fig. 2. Capacitor C is loaded by resistance R and by any load supplied by the circuit it drives.

Fig. 2: The basic correlator.



World Radio History

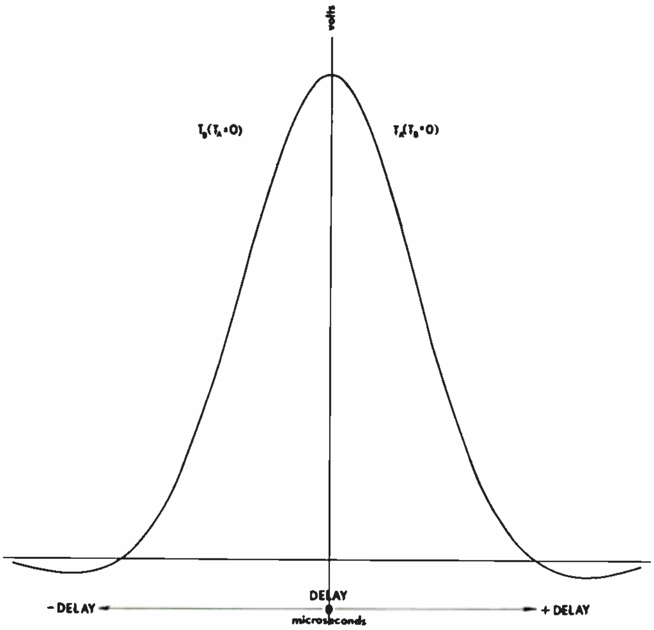


Fig. 3: Correlator output vs delay between incoming signals.

Delay Between Signals

If A and B in Fig. 2 are identical input signals, and the output voltage of the correlator is plotted as a function of phase shift or time delay between the signals, the resulting curve is shown in Fig. 3. The correlator will have maximum output when there is no delay or phase shift between the signals. It will drop to a low output as one signal is delayed with respect to the other.

By delaying one of the input signals with a delay line, Fig. 5, the maximum output from the correlator will shift in time by the amount of the delay. This can be explained by rewriting Eq. 1 as:

$$S(\tau) = \frac{1}{T} \int_{t-T}^{t} g(t)\, h(t - \tau)\, dt \qquad (3)$$

where $g(t)$ and $h(t)$ are the two input signals A and B (Fig. 2) to be compared, τ is a fixed delay between the signals, and S (τ) provides the desired measure of the similarity of the two incoming signals over the range of integration. The delay parameter τ allows the signals to be compared with different time offsets. A set of curves of the correlator output as a function of delay τ is shown in Fig. 4.

To adapt the correlator output to a servo positioning system, two correlators can be connected with delay lines and a difference amplifier, Fig. 5. The amplifier will have zero output when inputs "g" and "h" are in phase and will have a positive or negative output when there is a delay or phase shift between the input signals in phase.

• A REPRINT of ANY ARTICLE in this issue is available from ELECTRONIC INDUSTRIES Reader Service Department.

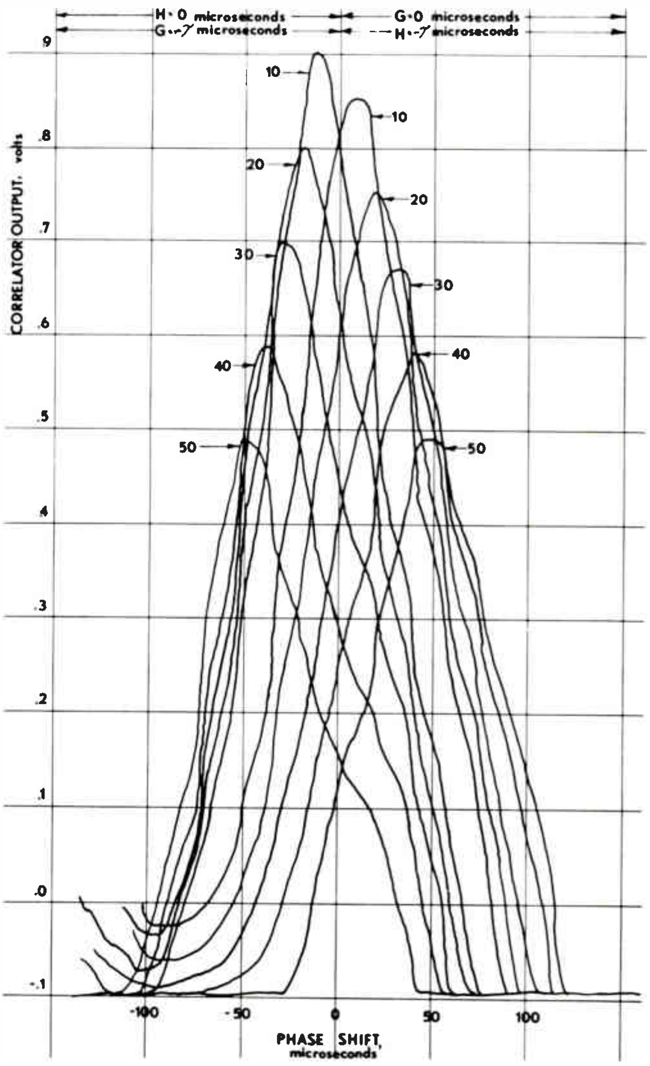
Use in Photogrammetry

The Electronic Correlator is playing an increasingly important role in the field of Photogrammetry, where substantial efforts are being applied to the automation of map making. For example, in the Stereomapping System developed by Bunker-Ramo Corp., a Kelsh-plotter is mechanized to automatically produce contour data and orthophotos from stereo photographs taken with an aerial camera.

The system uses a Nipkow disc to scan the stereo image. And, with the aid of electronic correlation circuitry (Fig. 5), augmented by a servo system, it makes appropriate height changes to keep the scanning surface at the elevation of the terrain surface. The detailed terrain data obtained from the scan is used to re-

(*Continued on page* 180)

Fig. 4: Correlator output with delay τ vs delay between signals in.



World Radio History

COVER STORY

Synthetic crystals have reached a very high level of development, so that they fill all but a few demands of electronic equipment. Natural crystals were formed over entire geological ages; still, only synthetic crystals can be used when natural material is inadequate in purity, size, or availability.

Neodymium in scheelite (calcium tungstate) crystal for an optical maser grown by Czochralski method at Bell Telephone Laboratories.

Growing Crystals for Electronic Devices

GROWING OF SYNTHETIC CRYSTALS is no longer pure art but rather an art based on scientific principles. What was once relegated to a secondary level in the lapidary and gem trade is now a growing technology of formidable proportions that is changing the face of electronic development.

Most crystal-growing methods, though not really new, have been somewhat refined with in the past five years. A pioneer in the development is the Bell Telephone Laboratories, which investigated early forms of synthetic ruby, fluorite and scheelite crystals for laser use. A recent Bell discovery is a large lithium metaniobate crystal, vital element of a coherent-light oscillator with a wavelength variable between 9,700 and 11,500Å. This crystal was produced by the most common crystal-growing technique—the Czochralski method, originated in 1918 though not fully appreciated until the 1950's. Much material for silicon and germanium single crystals for semiconductors is still grown by this method.

Crystals from the Melt

Briefly, the Czochralski method consists of lowering a seed crystal into a molten mass of the same material melted by heat from radio frequency induction. The coil is water-cooled and the frequency is about 450kc. Heat, generated by thousands of amperes, is transferred to the crucible, usually of iridium or rhodium. The crystal is grown over a period of days by slowly raising and lowering the crystal in the melt. Each time the crystal is dipped some of the melt solidifies on the rising crystal. Temperature, lowering and raising rates are precisely controlled to avert either cracking or polycrystallization. The goal is a pure single crystal.

Among Bell developments are varied forms of scheelite, which is calcium tungstate ($CaWO_4$), and fluorite (CaF_2). These crystals, also used in lasers, are all variations of the same thing, merely being doped with chemical "impurities" such as neodymium. Scheelite and fluorite are also grown by the Czochralski method, except that flourite must be grown in helium.

Synthetic garnet crystals, as well as ruby, have been developed and evaluated in laser work by several firms, including Bell. Garnets and some rubies are usually made by the flux growth method. Examples of garnets made by this method are yttrium aluminum, yttrium gallium, and gadolinium gallium.

Growth from the flux requires a mix of flux chemicals and the materials for forming the crystals in a large platinum crucible. In the case of ruby, such chemicals would include oxides of lead and boron as flux and oxides of aluminum and chromium (the color producer) as the ruby maker. The crucible is rotated in one direction and then the other to mix the molten mass. At 1,300°C all oxides of aluminum and chromium dissolve. After six hours the mass is allowed to cool slowly under rigid and steady control for eight days.

Ruby crystals begin to form at 1240°C and they grow in size as the mass cools. Control of temperature must be constant. A sudden drop would cause smaller crystals to form. Either of two crystal forms result. Depending on conditions, the yield is chunky rhombohedral crystals ¾" across, or larger flat plates several inches across. The flux is washed away with nitric acid.

(Continued on following page)

(Abstracted from material supplied by Dr. Kurt Nassau, Bell Telephone Laboratories Inc., Whippany, N.J.)

World Radio History

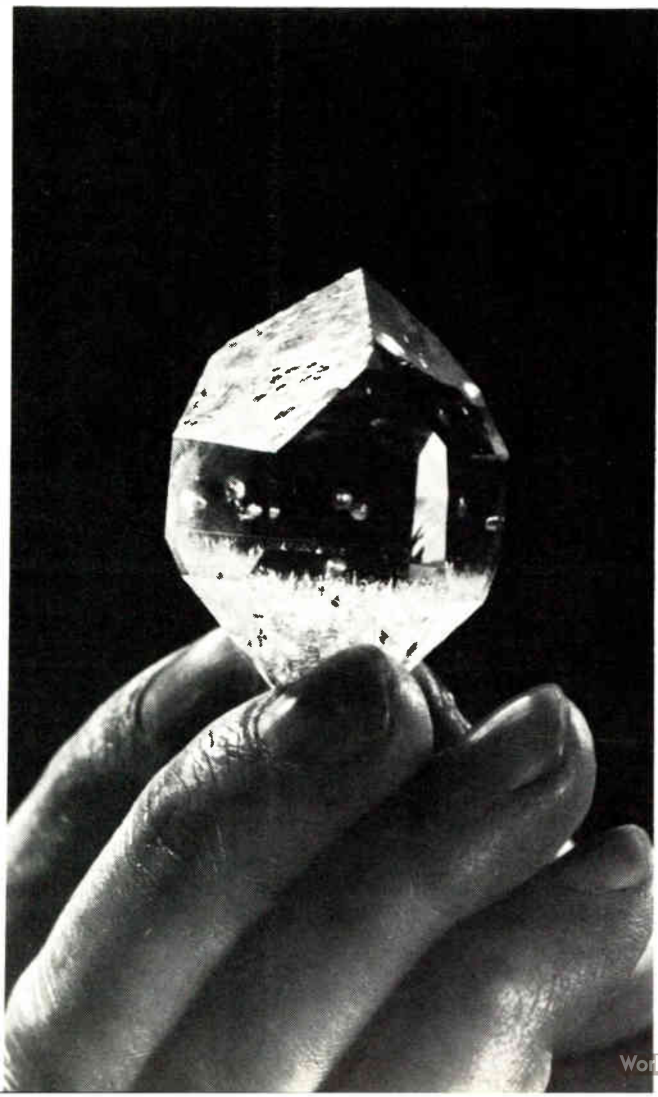
Grouping of Techniques

Crystal-growing methods can be grouped in three basic categories: a) growth from the solution, b) growth from the melt, and c) growth from the gas phase.

Chief among the solution growth methods is the flux method already described. Crystal growth from saturated and super-saturated aqueous solutions is well-known but is seldom used for electronic technology. An interesting and important variation of the water solution method, however, is the hydrothermal and high pressure growth. This is simply the forcing of an otherwise insoluble substance to dissolve in water through high temperature and under extreme pressure, as in the case of synthesizing quartz. A "mineralyzer" is often added to the system to help the material dissolve by forming a compound with the material. Temperatures in this process may reach 700°C and pressures may approach 50,000 lbs./sq. in. Major producers of synthetic quartz are Sawyer Research Products and Western Electric Co.

Growth from the melt includes by far the most important of all crystal-growing techniques for electronic technology. Major advantages of melt growth are absence of solvent impurities, and rapidity of growth in hours per inch rather than in days per inch. Chief among the melt techniques are the Czochralski method as described, and zone melting, sometimes called zone refining. The latter is widely used for producing semiconductor materials.

Synthetic quartz crystal for piezoelectricity grown at Bell Labs.



This technique, perfected by Bell Labs, mostly to purify semiconductor materials, is also used for crystal growing. Material is placed in a graphite boat about a foot long inside a quartz tube. The contents are melted a section at a time as either the boat and the tube, or the narrow r-f induction heating coil is moved horizontally. The molten zone is traversed along the boat, melting new material in front, solidifying crystal in back. For purification, a number of such passes is made. Fluorite a scheelite crystals are sometimes made by this method. A variation is the float zone technique in which the material is placed in a vertical compacted rod and the zone is passed vertically along the rod.

Crystals grown by the zone method may also be melt-grown with the Bridgman-Stockbarger technique. There are many variations of this method all basically the same. The Bridgman-Stockbarger system, used to grow fluorite, scheelite, mica, some metals and semiconductors, includes a furnace in two halves. The upper half is kept at slightly above the melting point of the molten material, the lower half is slightly below the melting point.

A pointed platinum crucible with the melt is slowly lowered from the upper half of the furnace into the lower half over several days. The crucible point enters the cooler lower half first and crystallization begins at that point. If temperature and other factors are precisely controlled, the yield will be a single crystal. Variations include those where the crucible is kept fixed and the furnace is moved, or where both are fixed and the temperature gradient is moved by controlling power level in portions of the h-f furnace coil.

Also important in growing crystals from the melt is the Verneuil method discovered in the 1890's. The Linde Division of Union Carbide has used this method and some variations to grow ruby discs and also ruby rods nearly a foot long.

In the Verneuil furnace the essential part is an oxy-hydrogen torch with the flame pointing downward. A central oxygen tube includes a sort of saltshaker that allows material feed powder to flow down the center of the flame toward a pedestal. The flame impinges on this pedestal where material begins to pile up. As the pile rises it reaches the hotter part of the flame (2050°-C) where it melts. As the molten region rises and increases in size the melt begins to solidify at the lower end. As more powder falls, the solidifying region broadens into a crystal with a molten cap. At that point the pedestal begins to lower and the crystal, or boule, grows in length only.

With some modifications, including auxiliary heaters and the rotating or oscillating of crystals vertically to make growth more uniform, ruby crystal rods more than one inch wide and several feet long can be grown.

(*Continued on page* 170)

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ELECTRONIC INDUSTRIES

This material is being presented in three parts—
Part 1: Photoconductors; Part 2: Photovoltaic Diodes; and
Part 3: Phototransistors & PNPN Light Activated Devices.
Also included in Part 3 will be a complete table of manufacturers,
their general categories of devices and complete mailing addresses.

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1965 Survey of Commercial Semiconductor Photosensitive Devices

Part 2: Photovoltaic Diodes

PHOTOVOLTAIC DIODES are active PN, PIN, or NPN[a] junction devices. PN junction devices are unique because they may be operated in either of two modes[b]; reverse biased mode—N region biased positive with respect to the P region via an external source, or forward mode (without external bias)—as a light-activated current (or voltage) generator. In the reverse biased mode, the photo current, dependent on sensitive area and the spectral energy distribution of the source, varies linearly with light intensity.

Likewise, in the forward mode, the short-circuit current, dependent on sensitive area and the spectral energy distribution of the source, varies linearly with light intensity. The open circuit voltage—dependent on temperature and the spectral energy distribution of the source, but theoretically independent of sensitive area—varies logarithmically with light intensity.

The PIN photodiode, a light-sensitive device with an intrinsic region between P and N regions, is designed for operation in the reverse biased mode with the junction region extending across the intrinsic region.

The photo-duo-diode is an NPN junction device designed for operation with either N region biased positive with respect to the other.

Solar cells are PN junction devices designed for efficient conversion of solar radiant power into electrical power. The performance of a solar cell is usually described in terms of the conversion efficiency. This is defined as the ratio of electrical power output to the radiant power input when operating under optimum load conditions for maximum electrical power transfer. Electrically conducting grids are added to reduce the sheet resistance which increases the conversion efficiency. The N/P (N on P) devices that are resistant to degradation from high-energy particles (protons and electrons), for space and missile applications, are termed "radiation resistant" solar cells.

By operating the photovoltaic diode in the reverse biased mode, thus reducing the junction capacitance, improved transient response is achieved. Response times decrease with load resistance. Presently, silicon devices with nanosecond rise times and gigacycle cut-off frequencies are available.

Unlike photoconductor materials, most materials used in photovoltaic diodes show negligible fatique effects with the exception of selenium. For illumination levels below 100 ft-c[c], the fatigue effects in selenium are temporary. On a time scale, temporary fatigue is generally characterized by a concave curve which flattens out after about 10 min. Under conditions of moderate illumination (100 ft-c) and low load resistance (less than 100 ohms), the initial 10-min fatigue has been observed to be as high as 12%[1].

The unique characteristic of the selenium cell is that its spectral response approximates that of the standard human observer more closely than any other material type.

Typically, when irradiated with 100 mw/cm^2, silicon commercial types exhibit open circuit voltages of 0.55 v and short circuit currents of 75 ma/cm^2 of sensitive area. Because of the wider energy gap, temperature performance of gallium arsenide is superior to that of silicon.

Because of the enhanced infrared response to an incandescent source of 2870°K color temperature, the illumination sensitivity per unit area of germanium is about ten times that of silicon. Typically, the gain in sensitivity is counterbalanced by adverse noise and temperature characteristics.

a. Includes photo-duo-diodes which are symmetrical phototransistors.
b. Those devices designed only for operation in the reverse biased mode are denoted using Note m.
c. Illumination from an incandescent source at 2870°K.

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TABLE 2: CHARACTERISTICS OF PHOTOVOLTAIC DIODES

Manufacturer	Type Number	Material	Spectral Response: Spectral Limits (10% Points)	Spectral Response: Sensitivity Peak	Device Description	Physical Dimensions: Diameter	Physical Dimensions: Depth	Physical Dimensions: Length	Physical Dimensions: Width	Dimensional Coding	Sensitive Area	Package Description	Dark Characteristics: Reverse Voltage	Dark Characteristics: Maximum Dark Current	Ambient Test Temp.	Light Characteristics, Forward: Short Circuit Current	Forward: Open Circuit Voltage	Forward: Power Output	Forward: Load Resistor	Forward: Load Photo Current	Reverse: Reverse Voltage	Reverse: Biased Photo Current	Conversion Efficiency
			micron	micron		in.	in.	in.	in.		sq. in.		v	μa	°C	ma	v	mw	K	ma	v	ma	%
Amark Corp.	710N[ff]	Se		0.55	PV	0.394				D	0.0434	X				0.028	0.32						
	718N[ff]	Se		0.55	PV	0.708				D	0.202	X				0.13	0.32						
	732N[ff]	Se		0.55	PV	1.26				D	0.822	X				0.53	0.32						
	735N[ff]	Se		0.55	PV	1.38				D	1.02	X				0.66	0.32						
	780N[ff]	Se		0.55	PV	0.985				D	0.434	X				0.28	0.32						
	781N[ff]	Se		0.55	PV	1.77				D	1.72	X				1.11	0.32						
	782N[ff]	Se		0.55	PV	2.64				D	4.12	X				2.66	0.32						
	792N[ff]	Se		0.55	PV	4.02				D	10.55	X				6.8	0.32						
	860N[ff]	Se		0.55	PV			0.63	0.394	D	0.186	X				0.12	0.32						
	861N[ff]	Se		0.55	PV			0.945	0.394	D	0.31	X				0.2	0.32						
	870N[ff]	Se		0.55	PV			0.945	0.472	D	0.341	X				0.22	0.32						
	874N[ff]	Se		0.55	PV			1.18	1.18	D	0.978	X				0.63	0.32						
	876N[ff]	Se		0.55	PV			1.65	0.452	D	0.636	X				0.41	0.32						
	877N[ff]	Se		0.55	PV			1.65	0.472	D	0.62	X				0.4	0.32						
	878N[ff]	Se		0.55	PV			1.415	0.552	D	0.65	X				0.42	0.32						
	880N[ff]	Se		0.55	PV			1.575	0.867	D	0.838	X				0.54	0.32						
	883N[ff]	Se		0.55	PV			1.97	1.46	D	2.2	X				1.42	0.32						
	884N[ff]	Se		0.55	PV			1.455	0.65	D	0.682	X				0.44	0.32						
	885N[ff]	Se		0.55	PV			2.01	1.025	D	1.425	X				0.92	0.32						
	886N[ff]	Se		0.55	PV			1.65	1.3	D	1.735	X				1.12	0.32						
	888N[ff]	Se		0.55	PV			2.16	0.71	D	1.21	X				0.78	0.32						
	890N[ff]	Se		0.55	PV			4.33	1.97	D	7.1	X				4.57	0.32						
American Semiconductor Corp.	AC10-8	Si		0.85	SC		0.025	0.8	0.4	D	0.28	B,J			28			>14.4		>36			>8
	AC10-9	Si		0.85	SC		0.025	0.8	0.4	D	0.28	B,J			28			>16.2		>40.5			>9
	AC10-10	Si		0.85	SC		0.025	0.8	0.4	D	0.28	B,J			28			>18		>45			>10
	AC10-11	Si		0.85	SC		0.025	0.8	0.4	D	0.28	B,J			28			>19.8		>49.5			>11
	AC20	Si		0.85	SC		0.025	0.8	0.2	D	0.12	B,J			28	20	0.55	6		15			
	AC30	Si		0.85	SC	1.125	0.025			D	0.79	B,J			28	130	0.55	40		100			
Amperex Electronic Corp.	OAP12	Ge		1.55	PV[m]	0.11	0.315			P	0.00155		10	15	25								
Block Engineering Inc.	KH-33	InAs	0.4-3.9	3.5	PV	0.5	0.18			P	0.00496	A			25								
Clairex Corp.	JC1K1	Si	0.39-1.12	0.84	PV						0.00975	B	0.5	20	25				1	0.47			
	JC1K6	Si	0.39-1.12	0.84	PV						0.00975	L	0.5	20	25				1	0.47			
	JC1K7	Si	0.39-1.12	0.84	PV						0.00975	L	0.5	20	25				1	0.47			
	JC1K8	Si	0.39-1.12	0.84	PV						0.00975	L	0.5	20	25				1	0.47			
	JC1K9	Si	0.39-1.12	0.84	PV						0.00975	L	0.5	20	25				1	0.47			
Datasensors Inc.	1020	Si		0.82	SC			0.1	0.2	D	0.64	B			25					1.5			
	1087	Si		0.84	PV		0.021	0.85	0.2	P	0.0107	L	0.5	20	25	>0.225	>0.315		1	>0.15			
	2020	Si		0.82	SC			0.2	0.2	D	0.03	B			25			1.2		3			
	2040	Si		0.82	SC			0.2	0.4	D	0.07	B			25			2.8		7			
	3141	Si		0.82	SC	1.125				D	0.79	B			25			30		75			
	4020	Si		0.82	SC			0.4	0.2	D	0.06	B			25			2.4		6			
	4040	Si		0.82	SC			0.4	0.4	D	0.14	B			25			5.6		14			
	4100	Si		0.84	PV		0.021	0.38	0.2	P	0.0128	L			25	>0.25	>0.315		1	>0.2			
	5100	Si		0.84	PV		0.021	0.48	0.2	P	0.0128	L			25	>0.25	>0.315		1	>0.2			
	6100	Si		0.84	PV		0.021	0.58	0.2	P	0.0128	L			25	>0.25	>0.315		1	>0.2			
	7100	Si		0.84	PV		0.021	0.68	0.2	P	0.0128	L			25	>0.25	>0.315		1	>0.2			
	8020	Si		0.82	SC			0.8	0.2	D	0.12	B			25			4.8		12			
	8040-6	Si		0.82	SC			0.8	0.4	D	0.28	B			25			11.2		28			
	8100	Si		0.84	PV		0.021	0.78	0.2	P	0.0128	L			25	>0.25	>0.315		1	>0.2			
	9100	Si		0.84	PV		0.021	0.88	0.2	P	0.0128	L			25	>0.25	>0.315		1	>0.2			
Davers Corp.	A-100	InAs		3.5	PV	0.23	0.22			P	0.00283	G			27								
Edgerton, Germeshausen & Grier, Inc.	SD-100	Si	0.35-1.13	0.94	PV[m]	0.35	0.215			P	0.011	D	90	10	25								
Electro-Nuclear Laboratories Inc.	601-5	Si		0.85	PV						0.0388[uu]				27								
	601-5D	Si		0.85	PV						0.0304[vv]				27								
	601-10	Si		0.85	PV						0.155[uu]				27								
	601-10D	Si		0.85	PV						0.122[vv]				27								
	602-5	Si		0.85	PV						0.0388[uu]				27								
	602-5D	Si		0.85	PV						0.0304[vv]				27								
	602-10	Si		0.85	PV						0.155[uu]				27								
	602-10D	Si		0.85	PV						0.122[vv]				27								
	612A	Si	0.75-1.18	1.06	PV						0.0304[vv]		2	0.5	27								
	612B	Si	0.75-1.18	1.06	PV						0.0304[vv]		2	0.5	27								
	626A	Si	0.4-1.09	0.85	PV	0.219	0.19			P		G			27	0.05	0.31						
	626B	Si	0.4-1.09	0.85	PV	0.219	0.19			P		G			27	0.06	0.33						
	632	InAs		3.2	PV	0.219	0.19			P	0.00485	G			27								
Fairchild Semiconductors	IN3734	Si	0.4-1.07	0.84	PV[m]	0.23	0.23			P		G	50	0.05	25						50	>0.005	
Ferranti Electric, Inc.	MS1A	Si		0.85	PV		0.025	0.084	0.184	D	0.012	B	1	50[ww]	25	1	0.5	>0.19	0.45	>0.65			
	MS1AE	Si		0.85	PV		0.25	0.245	0.135	P	0.012	R	1	50[ww]	25	1	0.5	>0.19	0.45	>0.65			
	MS1B	Si		0.85	PV		0.025	0.084	0.184	D	0.012	B	1	30[ww]	25	1	0.5	>0.19	0.45	>0.65			

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Radiation Source							Sensitivity									Maximum Ratings				Response Times			Response Time Test Parameters			
Illumination	Irradiation	Type	Wavelength	Color Temperature	Chopping Frequency	Bandwidth	Illumination Sensitivity	Irradiation Sensitivity	Illumination Sensitivity per Unit Area	Irradiation Sensitivity per Unit Area	Noise Equivalent Power (NEP)	Noise Equivalent Input (NEI)	Detectivity (D*)	Detectivity at Spectral Peak (D_λ*)	Dynamic Resistance	Reverse Voltage	Power Dissipation at 25°C	Steady State Photo Current	Ambient Operating Temp.	Rise Time (10-90%)	Fall Time (90-10%)	Time Constant	Series Resistance	Supply Voltage	3 db Cutoff Frequency	Notes
ft-c	mw/cm2		micron	°K	cps	cps	μa/ft-c	μa/(mw/cm2)	μa/ft-c/in.2	μa/(mw/cm2)/in.2	X10-12 w/cps½	X10-10 w/(cm2 · cps½)	X10^8 (cm · cps½)/w	X10^8 (cm · cps½)/w	ohms	v	mw	ma	°C	μsec	μsec	μsec	K	v	cps	
930							0.0301		0.695																	
930							0.14		0.695																	
930							0.57		0.695																	
930							0.71		0.695																	
930							0.301		0.695																	bb
930							1.195		0.695																	bb
930							2.86		0.695																	bb
930							7.3		0.695																	
930							0.129		0.695																	
930							0.215		0.695																	
930							0.237		0.695																	
930							0.678		0.695																	
930							0.441		0.695																	
930							0.43		0.695																	
930							0.452		0.695																	
930							0.58		0.695																	
930							1.53		0.695																	
930							0.473		0.695																	
930							0.99		0.695																	
930							1.205		0.695																	
930							0.84		0.695																	
930							4.91		0.695																	
	100	ESA		2800																<20						
	100	ESA		2800																<20						
	100	ESA		2800																<20						
	100	ESA		2800																<20						
	100	ESA		2800																<20						
	100	ESA		2800																<20						
10							>0.5		>323							30	30	3					100	10	40Kc	a
		BK		500^n	1000	1					895	279	2	20	10							10				b
1250		T		2854																<20						
1250		T		2854																<20						c
1250		T		2854																<20						c
1250		T		2854																<20						c
1250		T		2854																<20						c
	100	T		2800															175							
500		T		2800			>0.45		>42										125							mm
	100	T		2800															175							
	100	T		2800															175							
	100	T		2800															175							
	100	T		2800															175							
	100	T		2800															175							
500		T		2800			>0.5		>39										125							nn
500		T		2800			>0.5		>39										125							nn
500		T		2800			>0.5		>39										125							nn
500		T		2800			>0.5		>39										125							nn
	100	T		2800															175							
	100	T		2800															175							
500		T		2800			>0.5		>39										125							nn
500		T		2800			>0.5		>39										125							nn
		BK		500^n	900	1							1-2	30-70	10-20							1				rr
		MC	0.9		1000	1		18.25			1			2700		150		1	100	0.004	0.015		0.05	90		d
		BK		1000^n	270	14-15								>10,000												
		BK		1000^n	270	14-15								>10,000												
		BK		1000^n	270	14-15								> 8,000												
		BK		1000^n	270	14-15								> 8,000												
		BK		1000^n	270	14-15								>50,000												
		BK		1000^n	270	14-15								>50,000												
		BK		1000^n	270	14-15								>30,000												
		BK		1000^n	270	14-15								>30,000												
		BK		1000^n	270	14-15								> 8,000												ss
		BK		1000^n	270	14-15								>40,000												ss
100		T		2600			0.5																20,000		>800	
100		T		2600			0.6																20,000		>800	
				1000^n	270	14-15								>10	20-30							>1				
100	5	T		3000			>0.05	>1								100	500			<0.2	<0.2				>4Mc	a
3000		T		2854			0.333		27.7										125							
3000		T		2854			0.333		27.7										85							e
3000		T		2854			0.333		27.7										125							

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TABLE 2: CHARACTERISTICS OF PHOTOVOLTAIC DIODES (Continued)

Manufacturer	Type Number	Material	Spectral Response: Spectral Limits (10% Points)	Spectral Response: Sensitivity Peak	Device Description	Physical Dimensions: Diameter	Physical Dimensions: Depth	Physical Dimensions: Length	Physical Dimensions: Width	Physical Dimensions: Dimensional Coding	Physical Dimensions: Sensitive Area	Package Description	Dark Characteristics: Reverse Voltage	Dark Characteristics: Max. Dark Current	Ambient Test Temp.	Light Characteristics, Forward: Short Circuit Current	Light Characteristics, Forward: Open Circuit Voltage	Light Characteristics, Forward: Power Output	Light Characteristics, Forward: Load Resistor	Light Characteristics, Forward: Load Photo Current	Light Characteristics, Reverse: Reverse Voltage	Light Characteristics, Reverse: Biased Photo Current	Conversion Efficiency
			micron	micron		in.	in.	in.	in.		sq. in.		v	µa	°C	ma	v	mw	K	ma	v	ma	%
Ferranti Electric, Inc. (Continued)	MS1BE	Si		0.85	PV		0.25	0.245	0.135	P	0.012	R	1	30ww	25	1	0.5	>0.19	0.45	>0.65			
	MS2A	Si		0.85	PV		<0.025	0.75	0.5	D	0.34	B			25	27	0.5	>4.33	0.015	>17			
	MS2AE	Si		0.85	PV		0.75	0.875	0.715	P	0.34	M			25	31	0.5	>6	0.015	>20			
	MS2B	Si		0.85	PV		<0.025	0.75	0.5	D	0.34	B			25	31	0.55	>6	0.015	>20			
	MS2BE	Si		0.85	PV		0.75	0.875	0.715	P	0.34	M			25	34	0.55	>7.6	0.015	>22.5			
	MS4A	Si		0.85	PV		<0.025	0.25	0.25	D	0.05	B			25	4	0.5	>0.9	0.1	>3			
	MS4B	Si		0.85	PV		<0.025	0.25	0.25	D	0.05	B			25	5	0.5	>1.6	0.1	>4			
	MS5A	Si		0.85	PV		<0.025	0.5	0.25	D	0.1	B			25	8	0.5	>1.51	0.05	>5.5			
	MS5B	Si		0.85	PV		<0.025	0.5	0.25	D	0.1	B			25	10	0.5	>2.82	0.05	>7.5			
	MS6A	Si		0.85	PV		<0.025	0.75	0.25	D	0.15	B			25	12	0.5	>2.25	0.033	>8.25			
	MS6B	Si		0.85	PV		<0.025	0.75	0.25	D	0.15	B			25	15	0.5	>3.98	0.033	>11			
	MS7A	Si		0.85	PV		<0.025	1.0	0.25	D	0.2	B			25	16	0.5	>3.03	0.025	>11			
	MS7B	Si		0.85	PV		<0.025	1.0	0.25	D	0.2	B			25	20	0.5	>5.26	0.025	>14.5			
	MS9A	Si		0.85	PV		<0.025	0.048	0.132	D	0.005	B	1	30ww	25	0.3	0.5	>0.072	1.8	>0.2			
	MS9AE	Si		0.85	PV		0.25	0.175	0.075	P	0.005	R	1	30ww	25	0.3	0.5	>0.072	1.8	>0.2			
	MS9B	Si		0.85	PV		<0.025	0.048	0.132	D	0.005	B	1	10ww	25	0.3	0.5	>0.072	1.8	>0.2			
	MS9BE	Si		0.85	PV		0.25	0.175	0.075	P	0.005	R	1	10ww	25	0.3	0.5	>0.072	1.8	>0.2			
	MS11A	Si		0.85	SC	1.0	<0.025			D	0.66	B			25	48	0.5	>11	0.009	>35			7
	MS11AE	Si		0.85	SC	1.325	0.73			P	0.66	M			25	54	0.5	>14.4	0.009	>40			7
	MS11B	Si		0.85	SC	1.0	<0.025			D	0.66	B			25	54	0.55	>14.4	0.009	>40			7
	MS11BE	Si		0.85	SC	1.325	0.73			P	0.66	M			25	60	0.55	>18.2	0.009	>45			7
	MS12	Si		0.85	SC	1.325	1.32			P	0.66	M			25	120	0.55	>28.1	0.005	>75			7
	MS20	Si		0.85	SC		<0.025	0.798	0.394	D	0.3	B			25	63	0.54						
Heliotek	HTA101-10	Si			SC		0.02	0.381	0.788	D		B			28								>10
	HTA101-11	Si			SC		0.02	0.381	0.788	D		B			28								>11
	HTA101-12	Si			SC		0.02	0.381	0.788	D		B			28								>12
	HTA101-13	Si			SC		0.02	0.381	0.788	D		B			28								>13
	HTA101-14	Si			SC		0.02	0.381	0.788	D		B			28								>14
	HTA102	Si			SC		0.02	0.394	0.788	D		B											
	HTA103-10	Si			SC		0.02	0.788	0.394	D		B			28								>10
	HTA103-11	Si			SC		0.02	0.788	0.394	D		B			28								>11
	HTA103-12	Si			SC		0.02	0.788	0.394	D		B			28								>12
	HTA103-13	Si			SC		0.02	0.788	0.394	D		B			28								>13
	HTA103-14	Si			SC		0.02	0.788	0.394	D		B			28								>14
	HTA111-9	Si			SC		0.02	0.381	0.788	D		B			28								>9
	HTA111-10	Si			SC		0.02	0.381	0.788	D		B			28								>10
	HTA111-11	Si			SC		0.02	0.381	0.788	D		B			28								>11
	HTA111-12	Si			SC		0.02	0.381	0.788	D		B			28								>12
	HTA111-13	Si			SC		0.02	0.381	0.788	D		B			28								>13
	HTA112	Si			SC		0.02	0.394	0.788	D		B											
	HTA113-9	Si			SC		0.02	0.788	0.394	D		B			28								>9
	HTA113-10	Si			SC		0.02	0.788	0.394	D		B			28								>10
	HTA113-11	Si			SC		0.02	0.788	0.394	D		B			28								>11
	HTA113-12	Si			SC		0.02	0.788	0.394	D		B			28								>12
	HTA113-13	Si			SC		0.02	0.788	0.394	D		B			28								>13
	HTA163	Si			SC		0.02	0.788	0.394	D		B											
	HTA179	Si			SC		0.06	0.285	0.285	D		B			28								>8
	HTA227	Si			PV		0.079	0.079	0.06	D		B			28			>0.28					
	HTA228	Si			SC		0.06	0.235	0.08	D		B	0.5	20	25			>0.45		>2.25			
HP Assoc.	4201	Si			PIN	0.22	0.58			P	0.000314	G	25	0.002	25								
	4203	Si			PIN	0.22	0.187			P	0.000314	G	25	0.002	25								
Hoffman Electronics Corp.	2A	Si			SC	1.125	0.025			D	0.79	B,K			28	155	0.55	>38		>95			
	51C	Si			SC		0.025	0.388	0.197	D	0.06	B,K			28	11	0.55	>3.1		>7.8			
	52C	Si			SC		0.025	0.788	0.197	D	0.12	B,K			28	23	0.55	>6.4		>16			
	55C	Si			SC		0.025	0.188	0.197	D	0.03	B,K			28	5.4	0.55	>1.5		>3.8			
	58C	Si			SC		0.025	0.088	0.197	D	0.014	B,K			28	2.5	0.55	>0.72		>1.8			
	110C	Si			SC		0.025	0.388	0.394	D	0.14	B,K			28	27	0.55	>7.1		>17.8			
	EA7E1	Si	0.44-1.12	0.85	PV	0.08	0.5			P	0.0065	A'	1	5	55	0.38	0.43		1	>0.3			
	EA7E2	Si	0.44-1.12	0.85	PV	0.08	0.5			P	0.0065	A'	1	10	55	0.38	0.43		1	>0.3			
	EA7E3	Si	0.44-1.12	0.85	PV	0.08	0.5			P	0.0065	A'	1	10	55	0.305	0.42		1	>0.25			
	HLSN-221	Si	0.42-1.1	0.84	NI		0.063	0.44	0.1	P		AA			25				10	0.025			
	HPC	Si		0.85	PV						0.0128	L	0.5	20	25				1	0.205-0.345			
	HSB	Si			PK										28			150		25			
	HSR	Si		0.85	PV						0.00375	L	0.5	10	25				1	0.1-0.14			
	HSSP-2-40	Si			PK			2.5	1.0	P					25			>72		>36			
	IN2175	Si			PDD	0.082	<0.5			P			±50	0.5	25						±10	>0.1	
	N120CG-8	Si	0.4-1.12	0.88	SC		0.015	0.788	0.394	D		B			28			>19.6		>45.5			>8
	N120CG-9	Si	0.4-1.12	0.88	SC		0.015	0.788	0.394	D		B			28			>22		>51.1			>9
	N120CG-10	Si	0.4-1.12	0.88	SC		0.015	0.788	0.394	D		B			28			>24.5		>56.9			>10
	N120CG-11	Si	0.4-1.12	0.88	SC		0.015	0.788	0.394	D		B			28			>27		>62.7			>11
	N120CG-12	Si	0.4-1.12	0.88	SC		0.015	0.788	0.394	D		B			28			>29.4		>68.2			>12
	N210CG-8	Si	0.4-1.12	0.88	SC		0.015	0.394	0.788	D		B			28			>20.2		>46.9			>8
	N210CG-9	Si	0.4-1.12	0.88	SC		0.015	0.394	0.788	D		B			28			>22.8		>53			>9
	N210CG-10	Si	0.4-1.12	0.88	SC		0.015	0.394	0.788	D		B			28			>25.3		>58.8			>10
	N210CG-11	Si	0.4-1.12	0.88	SC		0.015	0.394	0.788	D		B			28			>27.8		>64.6			>11
	N210CG-12	Si	0.4-1.12	0.88	SC		0.015	0.394	0.788	D		B			28			>30.4		>70.6			>12
	N220CG-8	Si	0.4-1.12	0.88	SC		0.015	0.788	0.788	D		B			28			>40.8		>95			>8
	N220CG-9	Si	0.4-1.12	0.88	SC		0.015	0.788	0.788	D		B			28			>45.9		>106.8			>9

World Radio History

Radiation Source							Sensitivity									Maximum Ratings				Response Times			Response Time Test Parameters			
Illumination	Irradiation	Type	Wavelength	Color Temperature	Chopping Frequency	Bandwidth	Illumination Sensitivity	Irradiation Sensitivity	Illumination Sensitivity per Unit Area	Irradiation Sensitivity per Unit Area	Noise Equivalent Power (NEP)	Noise Equivalent Input (NEI)	Detectivity (D*)	Detectivity at Spectral Peak (D_λ*)	Dynamic Resistance	Reverse Voltage	Power Dissipation at 25°C	Steady State Photo Current	Ambient Operating Temp.	Rise Time (10-90%)	Fall Time (90-10%)	Time Constant	Series Resistance	Supply Voltage	3db Cutoff Frequency	Notes
ft-c	mw/cm²		micron	°K	cps	cps	μa/ft-c	μa/(mw/cm²)	μa/ft-c/in.²	μa/(mw/cm²)/in.²	X10⁻¹² w/cps^½	X10⁻¹⁰ w/(cm² · cps^½)	X10⁸ (cm · cps^½)/w	X10⁸ (cm · cps^½)/w	ohms	v	mw	ma	°C	μsec	μsec	μsec	K	v	cps	
3000		T		2854			0.333		27.7										85							e
3000		T		2854			9		26.5										125							
3000		T		2854			10.35		30.5										85							f
3000		T		2854			10.35		30.5										125							
3000		T		2854			11.3		33.3										85							f
3000		T		2854			1.33		26.7										125							
3000		T		2854			1.67		33.3										125							
3000		T		2854			2.67		26.7																	
3000		T		2854			3.33		33.3																	
3000		T		2854			4		26.7										125							
3000		T		2854			5		33.3										125							
3000		T		2854			5.33		26.7										125							
3000		T		2854			6.67		33.3										125							
3000		T		2854			0.1		20										125							
3000		T		2854			0.1		20										85							e
3000		T		2854			0.1		20										125							
3000		T		2854			0.1		20										85							e
3000		T		2854			16		24.2										125							
3000		T		2854			18		27.3										85							f
3000		T		2854			18		27.3										125							
3000		T		2854			20		30.3										85							f
3000		T		2854			40		60.6										85							g
	140	XE						450		1500																h
	100	ESA		2800																						j
	100	ESA		2800																						j
	100	ESA		2800																						j
	100	ESA		2800																						j
	100	ESA		2800																						j
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	100	ESA		2800																						j
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	100	ESA		2800																						j
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	100	ESA		2800																						k
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																										k
	100	ESA		2800																						
	100	ESA		2800																						
	100	ESA		2800																						
																200	100						0.05	25	~1Gc	l
																200	100						0.05		~1Gc	y
	100	ESA		2800				1550		1960									125	<10						
	100	ESA		2800				110		1830									125	<10						
	100	ESA		2800				230		1915									125	<10						
	100	ESA		2800				54		1800									125	<10						
	100	ESA		2800				25		1785									125	<10						
	100	ESA		2800				270		1930									125	<10						
1250		T		2800			0.304		46.8							1			150	<10			1			w
1250		T		2800			0.304		46.8							1			150	<10			1			w
1250		T		2800			0.244		37.5							1			150	<10			1			w
280		T		2800												2			115							q
500		T		2800																<10						o
	100	SL																	100							
500		T		2800																<10						u
	100	SL																								
	9	TF						22.3								±50	250		125	2	45					
	140	ESD																								v
	140	ESD																								v
	140	ESD																								v
	140	ESD																								v
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	140	ESD																								v
	140	ESD																								v

TABLE 2: CHARACTERISTICS OF PHOTOVOLTAIC DIODES (Continued)

Manufacturer	Type Number	Material	Spectral Response		Device Description	Physical Dimensions						Package Description	Dark Characteristics		Ambient Test Temp.	Light Characteristics							Conversion Efficiency
																Forward					Reverse		
			Spectral Limits (10% Points)	Sensitivity Peak		Diameter	Depth	Length	Width	Dimensional Coding	Sensitive Area		Reverse Voltage	Max. Dark Current		Short Circuit Current	Open Circuit Voltage	Power Output	Load Resistor	Load Photo Current	Reverse Voltage	Biased Photo Current	
			micron	micron		in.	in.	in.	in.		sq. in.		v	μa	°C	ma	v	mw	K	ma	v	ma	%
Hoffman Electronics Corp. (Continued)	N220CG-10	Si	0.4-1.12	0.88	SC		0.015	0.788	0.788	D		B			28			>51		>118.7			>10
	N220CG-11	Si	0.4-1.12	0.88	SC		0.015	0.788	0.788	D		B			28			>56		>130.5			>11
	N220CG-12	Si	0.4-1.12	0.88	SC		0.015	0.788	0.788	D		B			28			>61		>142			>12
	N230CG-8	Si	0.4-1.12	0.88	SC		0.015	1.182	0.788	D		B			28			>61		>142			>8
	N230CG-9	Si	0.4-1.12	0.88	SC		0.015	1.182	0.788	D		B			28			>68.7		>160			>9
	N230CG-10	Si	0.4-1.12	0.88	SC		0.015	1.182	0.788	D		B			28			>76.4		>176.5			>10
	N230CG-11	Si	0.4-1.12	0.88	SC		0.015	1.182	0.788	D		B			28			>84		>195.5			>11
	N230CG-12	Si	0.4-1.12	0.88	SC		0.015	1.182	0.788	D		B			28			>91.5		>213			>12
International Electronics Corp. (Mullard)	BPY10	Si		0.8	PV		0.25	0.088	0.086	P	0.00435		1	10	25	>0.05							
	OAP12	Ge		1.55	PVm	0.11	0.315			P	0.00155		10	15	25								
International Rectifier Corp.	A2	Se		0.58	PV	0.25	0.047			D	0.045	B			25				0.1	0.012			
	A3	Se		0.58	PV	0.38	0.047			D	0.06	B			25				0.1	0.02			
	A5	Se		0.58	PV	1.13	0.047			D	0.78	B			25				0.1	0.25			
	A5-M	Se		0.58	PV	1.2	0.7			P		IM			25				0.1	0.22			
	A7	Se		0.58	PV	1.5	0.058			D	1.4	B			25				0.1	0.44			
	A7-M	Se		0.58	PV	1.7	0.7			P		IM			25				0.1	0.35			
	A10	Se		0.58	PV	1.75	0.058			D′	2.04	B			25				0.1	0.6			
	A10-M	Se		0.58	PV	1.9	0.7			P		IM			25				0.1	0.55			
	A15	Se		0.58	PV	2.0	0.058			D	2.58	B			25				0.1	0.77			
	A15-M	Se		0.58	PV	2.1	0.4			P		IM			25				0.1	0.7			
	A30	Se		0.58	PV	2.75	0.058			D	5.1	B			25				0.1	1.4			
	B1	Se		0.58	PV		0.047	0.59	0.24	D	0.12	B			25				0.1	0.032			
	B2	Se		0.58	PV		0.021	0.72	0.44	D	0.26	B			25				0.1	0.077			
	B4	Se		0.58	PV		0.047	0.88	0.54	D	0.39	B			25				0.1	0.12			
	B5	Se		0.58	PV		0.047	1.44	0.64	D	0.78	B			25				0.1	0.25			
	B10	Se		0.58	PV		0.058	1.69	0.88	D	1.26	B			25				0.1	0.38			
	B10-M	Se		0.58	PV		0.7	2.2	1.1	P		IM			25				0.1	0.32			
	B15	Se		0.58	PV		0.058	1.69	1.69	D	2.25	B			25				0.1	0.64			
	B17	Se		0.58	PV		0.021	6.0	0.5	D	2.6	B			25				0.1	0.71			
	B20	Se		0.58	PV		0.021	2.0	2.0	D	3.3	B			25				0.1	0.9			
	B30	Se		0.58	PV		0.021	3.25	3.25	D	9.41	B			25				0.1	2.2			
	DP-2	Se		0.58	PV		0.36	0.75	0.345	P	0.088	CR′			25				0.1	0.024			
	DP-3	Se		0.58	PV		0.925	0.75	0.345	P	0.21	CR′			25				0.1	0.066			
	DP-5	Se		0.58	PV		0.89	2.0	2.0	P	2.25	CM′			25				0.1	0.6			
	PC103	Se		0.58	PV		0.058			D	2.2	B			25				0.1	0.6			
	SAR-5-08BPL	Si			PV		0.15	0.415	0.2	P	0.0107	L	0.5	10	25	>0.225	0.325		1	>0.145			
	SAR-6-08BPL	Si			PV		0.15	0.502	0.2	P	0.0107	L	0.5	10	25	>0.225	0.325		1	>0.145			
	SAR-8-08BPL	Si			PV		0.15	0.676	0.2	P	0.0107	L	0.5	10	25	>0.225	0.325		1	>0.145			
	SAR-9-08BPL	Si			PV		0.15	0.763	0.2	P	0.0107	L	0.5	10	25	>0.225	0.325		1	>0.145			
	SAR-10-08BPL	Si			PV		0.15	0.85	0.2	P	0.0107	L	0.5	10	25	>0.225	0.325		1	>0.145			
	SAR-5-10BPL	Si			PV		0.15	0.48	0.2	P	0.0128	L	0.5	10	25	>0.25	0.325		1	>0.2			
	SAR-6-10BPL	Si			PV		0.15	0.58	0.2	P	0.0128	L	0.5	10	25	>0.25	0.325		1	>0.2			
	SAR-8-10BPL	Si			PV		0.15	0.78	0.2	P	0.0128	L	0.5	10	25	>0.25	0.325		1	>0.2			
	SAR-9-10BPL	Si			PV		0.15	0.88	0.2	P	0.0128	L	0.5	10	25	>0.25	0.325		1	>0.2			
	SO510E4	Si			SC			0.394	0.197	D	0.062	B			28			>1.6		3			>4
	SO510E5	Si			SC			0.394	0.197	D	0.062	B			28			>2		4			>5
	SO510E6	Si			SC			0.394	0.197	D	0.062	B			28			>2.4		5			>6
	SO510E7	Si			SC			0.394	0.197	D	0.062	B			28			>2.8		6			>7
	SO510E8	Si			SC			0.394	0.197	D	0.062	B			28			>3.2		7			>8
	SO510E9	Si			SC			0.394	0.197	D	0.062	B			28			>3.6		8			>9
	SO510E10	Si			SC			0.394	0.197	D	0.062	B			28			>4		9			>10
	SO510E11	Si			SC			0.394	0.197	D	0.062	B			28			>4.4		10			>11
	SO520E4	Si			SC			0.788	0.197	D	0.124	B			28			>3.2		7			>4
	SO520E5	Si			SC			0.788	0.197	D	0.124	B			28			>4		9			>5
	SO520E6	Si			SC			0.788	0.197	D	0.124	B			28			>4.8		10			>6
	SO520E7	Si			SC			0.788	0.197	D	0.124	B			28			>5.6		12			>7
	SO520E8	Si			SC			0.788	0.197	D	0.124	B			28			>6.4		14			>8
	SO520E9	Si			SC			0.788	0.197	D	0.124	B			28			>7.2		16			>9
	SO520E10	Si			SC			0.788	0.197	D	0.124	B			28			>8		17			>10
	SO520E11	Si			SC			0.788	0.197	D	0.124	B			28			>8.8		19			>11
	S1020E4	Si			SC			0.788	0.394	D	0.279	B			28			>7.2		16			>4
	S1020E5	Si			SC			0.788	0.394	D	0.279	B			28			>9		20			>5
	S1020E6	Si			SC			0.788	0.394	D	0.279	B			28			>10.8		23			>6
	S1020E7	Si			SC			0.788	0.394	D	0.279	B			28			>12.6		27			>7
	S1020E8	Si			SC			0.788	0.394	D	0.279	B			28			>14.4		31			>8
	S1020E9	Si			SC			0.788	0.394	D	0.279	B			28			>16.2		35			>9
	S1020E10	Si			SC			0.788	0.394	D	0.279	B			28			>18		39			>10
	S1020E11	Si			SC			0.788	0.394	D	0.279	B			28			>19.8		43			>11
	S1020E12	Si			SC			0.788	0.394	D	0.279	B			28			>21.6		47			>12
	S1020E13	Si			SC			0.788	0.394	D	0.279	B			28			>23.4		51			>13
	S2900E5M	Si	0.39-1.08	0.82	SC	1.25	0.875			P		BB			25			>24		>60			5
	S2900E7M	Si	0.39-1.08	0.82	SC	1.25	0.875			P		BB			25			>36		>90			7
	S2900E9.5M	Si	0.39-1.08	0.82	SC	1.25	0.875			P		BB			25			>48		>120			9.5
	SP2A40B	Si	0.39-1.08	0.82	PK							BB			25			>58		>36			
	SP2B48B	Si	0.39-1.08	0.82	PK							BB			25			>64		>40			
	SP2C80B	Si	0.39-1.08	0.82	PK							BB			25			>115		>72			
	SP2D96B	Si	0.39-1.08	0.82	PK							BB			25			>129		>80			
	SP4C40B	Si	0.39-1.08	0.82	PK							BB			25			>115		>36			
	SP4D48B	Si	0.39-1.08	0.82	PK							BB			25			>128		>40			
	SPR-5-08BPL	Si			PV		0.15	0.415	0.2	P		L	0.5	20	25	>0.225	0.325		1	>0.145			

World Radio History

Radiation Source							Sensitivity									Maximum Ratings				Response Times			Response Time Test Parameters			
Illumination	Irradiation	Type	Wavelength	Color Temperature	Chopping Frequency	Bandwidth	Illumination Sensitivity	Irradiation Sensitivity	Illumination Sensitivity per Unit Area	Irradiation Sensitivity per Unit Area	Noise Equivalent Power (NEP)	Noise Equivalent Input (NEI)	Detectivity (D*)	Detectivity at Spectral Peak (D_λ*)	Dynamic Resistance	Reverse Voltage	Power Dissipation at 25°C	Steady State Photo Current	Ambient Operating Temp.	Rise Time (10–90%)	Fall Time (90–10%)	Time Constant	Series Resistance	Supply Voltage	3 db Cutoff Frequency	Notes
ft-c	mw/cm²		micron	°K	cps	cps	μa/ft-c	μa/(mw/cm²)	μa/ft-c/in.²	μa/(mw/cm²)/in.²	X10⁻¹² w/cps½	X10⁻¹⁰ w/(cm² · cps½)	X10⁸ (cm · cps½)/w	X10⁸ (cm · cps½)/w	ohms	v	mw	ma	°C	μsec	μsec	μsec	K	v	cps	
	140	ESD																								v
	140	ESD																								v
	140	ESD																								v
	140	ESD																								v
	140	ESD																								v
	140	ESD																								v
	140	ESD																								v
	140	ESD																								v
186		T		2700			>0.269		62							1		10	100							w
		T		2500			0.537		347							30	30	3	60						50Kc	a
100																6										
100																6										
100																6										
100																6										x
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100																6										aa
500		T		2800			>0.45		42											10						t
500		T		2800			>0.45		42											10						t
500		T		2800			>0.45		42											10						t
500		T		2800			>0.45		42											10						t
500		T		2800			>0.45		42											10						t
500		T		2800			>0.5		39											10						s
500		T		2800			>0.5		39											10						s
500		T		2800			>0.5		39											10						s
500		T		2800			>0.5		39											10						s
	100	SL																								jj
	100	SL																								jj
	100	SL																								jj
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	100	SL																								jj
	100	SL																								jj
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	100	SL																								jj
	100	SL																								jj
	100	SL																								r
	100	SL																								r
	100	SL																								r
	100	SL																								y
	100	SL																								y
	100	SL																								y
	100	SL																								y
	100	SL																								y
	100	SL																								y
500		T		2800			>0.45		42											20						t

TABLE 2: CHARACTERISTICS OF PHOTOVOLTAIC DIODES (Continued)

Manufacturer	Type Number	Material	Spectral Response		Device Description	Physical Dimensions						Package Description	Dark Characteristics		Ambient Test Temp.	Light Characteristics							Conversion Efficiency
																Forward					Reverse		
			Spectral Limits (10% Points)	Sensitivity Peak		Diameter	Depth	Length	Width	Dimensional Coding	Sensitive Area		Reverse Voltage	Max. Dark Current		Short Circuit Current	Open Circuit Voltage	Power Output	Load Resistor	Load Photo Current	Reverse Voltage	Biased Photo Current	
			micron	micron		in.	in.	in.	in.		sq. in.		v	μa	°C	ma	v	mw	K	ma	v	ma	%
International Rectifier Corp. (Continued)	SPR-6-08BPL	Si			PV		0.15	0.502	0.2	P		L	0.5	20	25	>0.225	0.325		1	>0.145			
	SPR-8-08BPL	Si			PV		0.15	0.676	0.2	P		L	0.5	20	25	>0.225	0.325		1	>0.145			
	SPR-9-08BPL	Si			PV		0.15	0.763	0.2	P		L	0.5	20	25	>0.225	0.325		1	>0.145			
	SPR-10-08BPL	Si			PV		0.15	0.85	0.2	P		L	0.5	20	25	>0.225	0.325		1	>0.145			
	SPR-5-10BPL	Si			PV		0.15	0.48	0.2	P		L	0.5	20	25	>0.25	0.325		1	>0.2			
	SPR-6-10BPL	Si			PV		0.15	0.58	0.2	P		L	0.5	20	25	>0.25	0.325		1	>0.2			
	SPR-8-10BPL	Si			PV		0.15	0.78	0.2	P		L	0.5	20	25	>0.25	0.325		1	>0.2			
	SPR-9-10BPL	Si			PV		0.15	0.88	0.2	P		L	0.5	20	25	>0.25	0.325		1	>0.2			
National Semi-conductors, Ltd.	NSL-703P	Si		0.85	PV			0.394	0.197	D		H	1	50	25	>1.5	>0.42		1	>0.4			
	NSL-701-9P	Si		0.85	PV		0.14	0.88	0.2	P	0.0128	L	0.5	10	28	>0.3	>0.35		1	>0.275			
Nucleonic Products Co., Inc.	PHG-1	Ge	0.4-1.8	1.55	PVm	0.172	0.687			P	0.00155	A′	30	30	25								
	PHG-2	Ge	0.4-1.8	1.55	PVm	0.092	0.437			P	0.00155	A′	20	30	25								
	TP50	Ge		1.5	PV		0.234	0.234	0.109	P	0.00155	C	100	3.5	20								
Philco Corp.	GAU-401	GaAs	0.42-0.92	0.85	PV	<0.23	<0.21			P	0.00155	G			25								
	IAU-601	InAs		3.2	PV	<0.23	<0.21			P	0.00124	G			27								
	IAU-601A	InAs		3.2	PV	<0.23	<0.21			P	0.00124	G			27								
	IAU-601B	InAs		3.2	PV	<0.23	<0.21			P	0.00124	G			27								
	L-4412	Si		0.93	PV	0.08	0.5			P		A′	15	1	25		0.45				10	>0.04	
	L-4413	Si			PV	0.08				P		A′	15	1	25		0.45				10	>0.1	
	L-4414	Si			PV	0.08				P		A′	1	10	25		0.45				1	>0.12	
	L-4415	Si			PV	0.24				P		C′	15	1	25		0.45				10	>0.1	
	L-4416	Si			PV	0.24				P		C′	1	10	25		0.45				1	>0.12	
	L4501	Si			PV	0.575	1.09			P	0.00000465	GG			25				1	0.000075			
	L4502	Si			PV	0.575	1.09			P	0.0000155	GG			25				1	0.00025			
	L-4503	Si		0.85	PV	0.35	0.18			P	0.00543	C′			25				1	0.075			
	L-4504	Si		0.85	PV	0.35	0.18			P	0.00543	C′			25				1	0.075			
	L4530	InAs			PV	0.575	1.09			P	0.000201	GG			25								
Radio Corp. of America	SL2205	Si	0.38-1.08	0.86	PV			0.786	0.394	D	0.278	B			27			>17.9		>48			>10
	SL2206	Si	0.38-1.08	0.86	PV			0.786	0.786	D	0.586	B			27			>37.8		>101.5			>10
	SQ2516	Ge	0.35-1.87	1.55	PVm	0.37	0.18			P		C	45	35	25						45	0.3	
Siemens America, Inc.	APY10/1	Ge			PVm	0.0867	0.473			P		A	50	5	25								
	APY10/11	Ge			PVm	0.0867	0.473			P		A	50	5	25								
	APY11/1	Ge			PVm	0.0867	0.473			P		A	25	8	25								
	APY11/11	Ge			PVm	0.0867	0.473			P		A	25	8	25								
	BP100	Si			PV		0.0354	0.0867	0.187	P					25		0.23						
	BPY11	Si			PV		0.0354	0.0867	0.187	P					25		0.3						
	BPY43	Si			PV	0.0867	0.473			P		A	1	5	25		0.27						
	BPY44	Si			PV	0.0867	0.473			P		A	2	1	25		0.33						
	BPY45	Si			PV		0.0354	0.787	0.394	P					25		0.45						
	TP50/0	Ge			PVm		0.295	0.256	0.11	P			100	4.5	25								
	TP50/1	Ge			PVm		0.295	0.256	0.11	P			100	4.5	25								
	TP50/11	Ge			PVm		0.295	0.256	0.11	P			100	4.5	25								
	TP51/0	Ge			PVm		0.295	0.256	0.11	P			30	6.5	25								
	TP51/1	Ge			PVm		0.295	0.256	0.11	P			30	6.5	25								
	TP51/11	Ge			PVm		0.295	0.256	0.11	P			30	6.5	25								
	TP60	Si			PV	0.61	0.472			P					25		0.44						
	TP61	Si			PV	0.63	0.0492			P					25		0.44						
Solar Systems, Inc.	SS-10	Si	0.35-1.15	0.8	SC		0.025	0.788	0.394	D	0.279	B,K			25			>11.2		>28			
	SS-11	Si	0.35-1.15	0.8	SC		0.025	0.394	0.394	D	0.1395	B,K			25			>5.6		>14			
	SS-12	Si	0.35-1.15	0.8	SC		0.025	0.197	0.394	D	0.0697	B,K			25			>2.8		>7			
	SS-20	Si	0.35-1.15	0.8	SC		0.025	0.788	0.197	D	0.124	B,K			25			>4.8		>12			
	SS-21	Si	0.35-1.15	0.8	SC		0.025	0.394	0.197	D	0.062	B,K			25			>2.4		>6			
	SS-22	Si	0.35-1.15	0.8	SC		0.025	0.197	0.197	D	0.031	B,K			25			>1.2		>3			
	SS-23	Si	0.35-1.15	0.8	SC		0.025	0.0985	0.197	D	0.0155	B,K			25			>0.6		>1.5			
	SS-30	Si	0.35-1.15	0.8	SC	1.125	0.025			D	0.744	B,K			25			>30		>75			
	SS-31	Si	0.35-1.15	0.8	SC	0.281	0.025			D	0.186	B,K			25			>7.2		>18			
	SS-200A	Si	0.35-1.15	0.8	SC	1.312	0.906			P		IM			25			>24		>60			
	SS-200B	Si	0.35-1.15	0.8	SC	1.312	0.906			P		IM			25			>36		>90			
	SS-200C	Si	0.35-1.15	0.8	SC	1.312	0.906			P		IM			25			>48		>120			
	SS-200D	Si	0.35-1.15	0.8	SC	1.312	0.906			P		IM			25			>60		>150			
	SS-300-1	Si	0.35-1.15	0.8	PV	0.36	0.4			P		D	0.5	20	25	>1.1	>0.4		1	>0.37	0.2	>1.1	
	SS-300-2	Si	0.35-1.15	0.8	PV	0.36	0.4			P		D	0.5	20	25	>1.1	>0.4		1	>0.37	0.2	>1.1	
	SS-300-3	Si	0.35-1.15	0.8	PV	0.36	0.275			P		F	0.5	20	25	>1.1	>0.4		1	>0.37	0.2	>1.1	
	SS-300-4	Si	0.35-1.15	0.8	PV	0.36	0.275			P		F	0.5	20	25	>1.1	>0.4		1	>0.37	0.2	>1.1	
	SS-400-1	Si			PV	0.08	0.5			P		A′	1	10	55				1	>0.3			
	SS-400-2	Si			PV	0.08	0.5			P		A′	1	20	55				1	>0.3			
	SS-400-3	Si			PV	0.08	0.5			P		A′	1	10	55				1	>0.25			
	SS-400-4	Si			PV	0.08	0.5			P		A′	1	20	55				1	>0.25			
	SS-400-5	Si			PV	0.08	0.5			P		A′	1	50	55				1	>0.25			
	SS-400-6	Si			PV	0.08	0.5			P		A′			55				1	>0.2			
	SSM-410	Si			PK							I			25			>58		>36			
	SSM-510	Si			PK		0.343	1.9	0.9	P		I			25			>72		>36			
	SSM-920	Si			PK							I			25			>61		>17			
	SSM-1020	Si			PK							I			25			>68		>17			
	SSR-4-001	Si	0.35-1.15	0.8	PV		0.03	0.38	0.2	P	0.0128	JL	0.5	20	25	>0.25	0.325		1	>0.2			
	SSR-5-001	Si	0.35-1.15	0.8	PV		0.03	0.48	0.2	P	0.0128	JL	0.5	20	25	>0.25	0.325		1	>0.2			
	SSR-6-001	Si	0.35-1.15	0.8	PV		0.03	0.58	0.2	P	0.0128	JL	0.5	20	25	>0.25	0.325		1	>0.2			
	SSR-7-001	Si	0.35-1.15	0.8	PV		0.03	0.68	0.2	P	0.0128	JL	0.5	20	25	>0.25	0.325		1	>0.2			
	SSR-8-001	Si	0.35-1.15	0.8	PV		0.03	0.78	0.2	P	0.0128	JL	0.5	20	25	>0.25	0.325		1	>0.2			
	SSR-9-001	Si	0.35-1.15	0.8	PV		0.03	0.88	0.2	P	0.0128	JL	0.5	20	25	>0.25	0.325		1	>0.2			
	SSR-10-001	Si	0.35-1.15	0.8	PV		0.03	0.98	0.2	P	0.0128	JL	0.5	20	25	>0.25	0.325		1	>0.2			

World Radio History

Radiation Source							Sensitivity									Maximum Ratings				Response Times			Response Time Test Parameters			
Illumination	Irradiation	Type	Wavelength	Color Temperature	Chopping Frequency	Bandwidth	Illumination Sensitivity	Irradiation Sensitivity	Illumination Sensitivity per Unit Area	Irradiation Sensitivity per Unit Area	Noise Equivalent Power (NEP)	Noise Equivalent Input (NEI)	Detectivity (D*)	Detectivity at Spectral Peak (Dλ*)	Dynamic Resistance	Reverse Voltage	Power Dissipation at 25°C	Steady State Photo Current	Ambient Operating Temp.	Rise Time (10-90%)	Fall Time (90-10%)	Time Constant	Series Resistance	Supply Voltage	3 db Cutoff Frequency	Notes
ft-c	mw/cm²		micron	°K	cps	cps	μa/ft-c	μa/(mw/cm²)	μa/ft-c/in.²	μa/(mw/cm²)/in.²	X10-12 w/cps½	X10-10 w/(cm² · cps½)	X10⁸ (cm · cps½)/w	X10⁸ (cm · cps½)/w	ohms	v	mw	ma	°C	μsec	μsec	μsec	K	v	cps	
500		T		2800			>0.45		>42											<20						t
500		T		2800			>0.45		>42											<20						t
500		T		2800			>0.45		>42											<20						t
500		T		2800			>0.45		>42											<20						t
500		T		2800			>0.5		>39											<20						s
500		T		2800			>0.5		>39											<20						s
500		T		2800			>0.5		>39											<20						s
500		T		2800			>0.5		>39											<20						s
500		T		2800			>3									2			150	<15						
500		T		2800			>0.6		46.8										150	<8						qq
							>0.753		>486							30	30								>300Kc	
930		T		2650			>0.323		>208							30	30	4								
		T		2400			0.323		208							100	50								>100Kc	cc
		BK		1200n	400	1					800	800	1.25		1.5M							1000	10,000			dd
		BK		500n	900	1					<894	<1120	>1	70	>12							1				ee
		BK		500n	900	1					<447	<558	>2		>20							1				ee
		BK		500n	900	1					<298	<373	>3		>20							1				ee
600		T		2900			>0.067									20			125	0.075	2.5		1	10		
600		T		2900			>0.167									20			150							w
600		T		2900			>0.2									2			150							w
600		T		2900			>0.167									20			150							
600		T		2900			>0.2									2			150							
600		T		2800											500M	6		10	85						>5Gc	y
600		T		2800											500M	6		10	85						>5Gc	y
600		T		2800	2400	1					0.75		2500			50		25	85						300Mc	y
600		T		2800	2400	1					0.75		2500			90		25	85						600Mc	y
															500	1		10	85						0.5Gc	y
	100	ESC					14.5		52.2										125							k
	100	ESC					29		49.5										125							k
1000		T		2870			>0.3									50	30[hh]		50							y
							0.646									50	40[xx]									
							1.076									50	40[xx]									
							0.646									25	40[xx]									
							1.076									25	40[xx]									
93		T		2400			0.376																			
93		T		2400			0.431																			
93		T		2500			0.161									2										
93		T		2500			0.215									5										
930		T		2500			10.76																			
							>0.269									100	50[xx]									
							>0.484									100	50[xx]									
							>0.591									100	50[xx]									
							>0.269									30	50[xx]									
							>0.484									30	50[xx]									
							>0.591									30	50[xx]									
930		T		2400			10.76																			
930		T		2400			10.76																			
	100	ESB														1			175	<20						
	100	ESB														1			175	<20						
	100	ESB														1			175	<20						
	100	ESB														1			175	<20						
	100	ESB														1			175	<20						
	100	ESB														1			175	<20						
	100	ESB														1			175	<20						
	100	ESB														1			175	<20						
	100	ESB														1			175	<20						
	100	ESB																								f
	100	ESB																								f
	100	ESB																								f
	100	ESB																								f
1000		T					>1.1									0.7			175							y
1000		T					>1.1									0.7			175							ii
1000		T					>1.1									0.7			175							y
1000		T					>1.1									0.7			175							ii
1250		T		2800																						w
1250		T		2800																						w
1250		T		2800																						w
1250		T		2800																						w
1250		T		2800																						w
1250		T		2800																						w
	100	ESB																								
	100	ESB																								
	100	ESB																								
	100	ESB																								
500		T		2800			>0.5		>39.1							0.7			175							s
500		T		2800			>0.5		>39.1							0.7			175							s
500		T		2800			>0.5		>39.1							0.7			175							s
500		T		2800			>0.5		>39.1							0.7			175							s
500		T		2800			>0.5		>39.1							0.7			175							s
500		T		2800			>0.5		>39.1							0.7			175							s
500		T		2800			>0.5		>39.1							0.7			175							s

TABLE 2: CHARACTERISTICS OF PHOTOVOLTAIC DIODES (Continued)

Manufacturer	Type Number	Material	Spectral Response: Spectral Limits (10% Points)	Spectral Response: Sensitivity Peak	Device Description	Physical Dimensions: Diameter	Physical Dimensions: Depth	Physical Dimensions: Length	Physical Dimensions: Width	Physical Dimensions: Dimensional Coding	Physical Dimensions: Sensitive Area	Package Description	Dark Characteristics: Reverse Voltage	Dark Characteristics: Max. Dark Current	Ambient Test Temp.	Light Characteristics, Forward: Short Circuit Current	Light Characteristics, Forward: Open Circuit Voltage	Light Characteristics, Forward: Power Output	Light Characteristics, Forward: Load Resistor	Light Characteristics, Forward: Load Photo Current	Light Characteristics, Reverse: Reverse Voltage	Light Characteristics, Reverse: Biased Photo Current	Conversion Efficiency
			micron	micron		in.	in.	in.	in.		sq. in.		v	μa	°C	ma	v	mw	K	ma	v	ma	%
Solar Systems, Inc. (Continued)	SSR-10-002	Si	0.35-1.15	0.8	PV		0.03	0.85	0.2	P	0.0107	JL	0.5	20	25	>0.225	0.325		1	>0.145			
	SSRC-9-001	Si	0.35-1.15	0.8	PV		0.25	1.5	0.5	P		W			25	>0.07	0.3		1	>0.065			
Standard Telephones and Cables, Ltd.	PG40A	Ge		1.7	PVm	0.093	0.25			P	0.00012	C′	25	200	35								
	PG50A	Ge		1.7	PVm	0.219	0.469			P	0.00024	C′	50	250	35								
Texas Instruments, Inc.	IN2175	Si		0.97	PDD	0.082	<0.5			P			±50	0.5	25						±10	>0.1	
	H-11	Si			PDD	0.082	<0.5			P			±50	0.5	25						±10	>0.04	
	H-35	Si			PDD	0.082	<0.5			P			±50	0.5	25						±10	>0.06	
	H-38	Si			PDD	0.082	<0.5			P			±50	10	25						±10	>0.1	
	H-60	Si			PDD	0.082	<0.5			P			±50	0.5	25						±10	>0.1	
	H-61	Si			PDD	0.082	<0.5			P			±50	0.5	25						±10	>0.2	
	H-62	Si			PDD	0.082	<0.5			P			±50	0.5	25						±10	>0.3	
	LS221	Si		0.8	NI		0.063	0.44	0.1	P		U			25				10	>0.025			
	LS222	Si		0.8	PV	0.082	<0.5			P		A′	1	10	28	0.12	0.45	0.034		0.1			
	LS223	Si		0.8	PV	0.24	0.275			P		C′	1	10	28	0.325	0.41		1	0.27			
	LSX900	Si		0.75	PVm	<0.062	<0.093			P		E	50	0.009	25						30	>0.006	
United Detector Technology	PIN-10	Si	0.3-1.13	0.85	PVm	0.975	1.0			P	0.467		6	1	25								
Vactec, Inc.	R1	Se	0.26-0.69	0.57	PV	1.13	0.035			D	0.7	V			24				0.15	0.22			
	R5	Se	0.26-0.69	0.57	PV	1.375	0.035			D	1.18	V			24				0.15	0.305			
	R10	Se	0.26-0.69	0.57	PV	1.5	0.035			D	1.35	V			24				0.15	0.36			
	R10M	Se	0.26-0.69	0.57	PV	1.75	0.75			P	1.35	I			24				0.15	0.36			
	R10M1	Se	0.26-0.69	0.57	PV	1.75	0.406			P	1.35	I			24				0.15	0.36			
	R75	Se	0.26-0.69	0.57	PV	1.77	0.035			D	1.83	V			24				0.15	0.4			
	R100	Se	0.26-0.69	0.57	PV	2.0	0.035			D	2.4	V			24				0.15	0.75			
	R100M	Se	0.26-0.69	0.57	PV	2.25	0.75			P	2.4	I			24				0.15	0.75			
	RX5	Se	0.26-0.69	0.57	PV	0.25	0.035			D	0.05	V			24				0.15	0.012			
	RX10	Se	0.26-0.69	0.57	PV	0.375	0.035			D	0.11	V			24				0.15	0.02			
	RX15	Se	0.26-0.69	0.57	PV	0.5	0.035			D	0.16	V			24				0.15	0.03			
	RX80	Se	0.26-0.69	0.57	PV	1.0	0.035			D	0.52	V			24				0.15	0.13			
	RX80H	Si	0.26-0.69	0.57	SC	1.26	0.265			P	0.52	I			24				0.15	0.13			
	S1	Se	0.26-0.69	0.57	PV		0.035	0.73	0.44	D	0.31	V			24				0.15	0.08			
	S2	Se	0.26-0.69	0.57	PV		0.035	0.765	0.654	D	0.48	V			24				0.15	0.11			
	S3	Se	0.26-0.69	0.57	PV		0.035	1.118	0.622	D	0.66	V			24				0.15	0.15			
	S4	Se	0.26-0.69	0.57	PV		0.035	1.16	0.654	D	0.74	V			24				0.15	0.25			
	S5	Se	0.26-0.69	0.57	PV		0.035	0.875	0.535	D	0.45	V			24				0.15	0.1			
	S7	Se	0.26-0.69	0.57	PV		0.035	0.875	0.843	D	0.69	V			24				0.15	0.205			
	S8	Se	0.26-0.69	0.57	PV		0.035	0.875	0.875	D	0.74	V			24				0.15	0.21			
	S10	Se	0.26-0.69	0.57	PV		0.035	1.459	0.64	D	0.87	V			24				0.15	0.2			
	S11	Se	0.26-0.69	0.57	PV		0.035	1.118	0.89	D	0.97	V			24				0.15	0.215			
	S13	Se	0.26-0.69	0.57	PV		0.035	1.5	1.5	D	2.21	V			24				0.15	0.75			
	S14	Se	0.26-0.69	0.57	PV		0.035	1.937	1.437	D	2.68	V			24				0.15	0.73			
	S17	Se	0.26-0.69	0.57	PV		0.035	0.875	0.281	D	0.24	V			24				0.15	0.075			
	S50	Se	0.26-0.69	0.57	PV		0.035	4.188	0.25	D	1.12	V			24				0.15	0.305			
	S55	Se	0.26-0.69	0.57	PV		0.035	5.859	0.5	D	2.75	V			24				0.15	0.72			
	S56	Se	0.26-0.69	0.57	PV		0.035	6.0	0.437	D	2.43	V			24				0.15	0.8			
	S100	Se	0.26-0.69	0.57	PV		0.035	1.689	0.886	D	1.35	V			24				0.15	0.36			
	S100M	Se	0.26-0.69	0.57	PV		0.25	1.906	1.062	P	1.35	I			24				0.15	0.36			
	S150	Se	0.26-0.69	0.57	PV		0.035	6.0	0.25	D	1.31	V			24				0.15	0.38			
	SX10	Se	0.26-0.69	0.57	PV		0.035	0.484	0.25	D	0.06	V			24				0.15	0.022			
Weston Instruments, Inc.	594B	Se			PV	2.312	1.0				1.7	XX			25				0.2	0.07			
	594BB	Se			PV	2.312	1.0				1.7	XX			25				0.2	0.058			
	594GB	Se			PV	2.312	1.0				1.7	XX			25				0.2	0.07			
	594R	Se			PV	2.312	1.0				1.7	XX			25				0.2	0.09			
	594RB	Se			PV	2.312	1.0				1.7	XX			25				0.2	0.096			
	594RR	Se			PV	2.312	1.0				1.7	XX			25				0.2	0.088			
	594Y	Se			PV	2.312	1.0				1.7	XX			25				0.2	0.05			
	594YG	Se			PV	2.312	1.0				1.7	XX			25				0.2	0.01			
	594YR	Se			PV	2.312	1.0				1.7	XX			25				0.2	0.08			
	594YY	Se			PV	2.312	1.0				1.7	XX			25				0.2	0.052			
	856B	Se			PV	2.01	0.43				1.7	CM′			25				0.2	0.07			
	856BB	Se			PV	2.01	0.43				1.7	CM′			25				0.2	0.058			
	856GB	Se			PV	2.01	0.43				1.7	CM′			25				0.2	0.07			
	856R	Se			PV	2.01	0.43				1.7	CM′			25				0.2	0.09			
	856RB	Se			PV	2.01	0.43				1.7	CM′			25				0.2	0.096			
	856RR	Se			PV	2.01	0.43				1.7	CM′			25				0.2	0.088			
	856Y	Se			PV	2.01	0.43				1.7	CM′			25				0.2	0.05			
	856YG	Se			PV	2.01	0.43				1.7	CM′			25				0.2	0.01			
	856YR	Se			PV	2.01	0.43				1.7	CM′			25				0.2	0.08			
	856YY	Se			PV	2.01	0.43				1.7	CM′			25				0.2	0.052			
	9971-C1	Se			PV	0.282					0.03	B			25		0.4		0.1	0.018			
	9971-C2	Se			PV	0.625					0.2	B			25		0.4		0.1	0.075			
	9971-C3	Se			PV	1.125					0.7	B			25		0.4		0.1	0.25			
	9971-C4	Se			PV	1.75					1.85	B			25		0.4		0.1	0.675			
	9971-R1	Se			PV			0.5	0.5		0.2	B			25		0.4		0.1	0.075			
	9971-R2	Se			PV			0.875	0.5		0.35	B			25		0.4		0.1	0.105			
	9971-R3	Se			PV			0.875	0.875		0.55	B			25		0.4		0.1	0.225			
	9971-R4	Se			PV			1.75	0.875		1.1	B			25		0.4		0.1	0.34			
	9971-R5	Se			PV			1.75	1.75		2.45	B			25		0.4		0.1	0.825			

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Radiation Source							Sensitivity									Maximum Ratings				Response Times			Response Time Test Parameters			
Illumination	Irradiation	Type	Wavelength	Color Temperature	Chopping Frequency	Bandwidth	Illumination Sensitivity	Irradiation Sensitivity	Illumination Sensitivity per Unit Area	Irradiation Sensitivity per Unit Area	Noise Equivalent Power (NEP)	Noise Equivalent Input (NEI)	Detectivity (D*)	Detectivity at Spectral Peak (D_λ*)	Dynamic Resistance	Reverse Voltage	Power Dissipation at 25°C	Steady State Photo Current	Ambient Operating Temp.	Rise Time (10-90%)	Fall Time (90-10%)	Time Constant	Series Resistance	Supply Voltage	3db Cutoff Frequency	Notes
ft-c	mw/cm^2		micron	°K	cps	cps	μa/ft-c	μa/(mw/cm^2)	μa/ft-c/in.^{2}	μa/(mw/cm^2)/in.^{2}	X10^{-12} w/cps$^{1/2}$	X10^{-10} w/(cm^2 · cps$^{1/2}$)	X10^8 (cm · cps$^{1/2}$)/w	X10^8 (cm · cps$^{1/2}$)/w	ohms	v	mw	ma	°C	μsec	μsec	μsec	K	v	cps	
500		T		2800			>0.5		>42							0.7			175							t
500		T		2800			>0.45																			pp
		T		2500			0.025		208						0.5Mkk	50	1588							>50Kc		y
		T		2500			0.05		208						1Moo	100	5088							>50Kc		y
	9	TF						>11.1								±50	250		125	2	45				20Kc	ll
	9	TF						>4.44								±50	250		125							ll
	9	TF						>6.67								±50	250		125							ll
	9	TF						>11.1								±50	250		125							ll
	9	TF						>11.1								±50	250		125							ll
	9	TF						>22.2								±50	250		125							ll
	9	TF						>33.4								±50	250		125							ll
280		T		2500			>0.14									2			115							q
500		T		2800			0.24									2			175							w
1250		T		2800			0.26									2			175							y
	20	T		2870				>0.3								125	50		125						>2Gc	a
		·						600		1285						50				>0.01			1,000	6		p
100		T		2850																					10Kc	
100		T		2850																					10Kc	
100		T		2850																					10Kc	
100		T		2850																					10Kc	
100		T		2850																					10Kc	
100		T		2850																					10Kc	
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100		T		2850																					10Kc	
100		T		2850																					10Kc	
100		T		2850																					10Kc	
20							3.5		2.06										60							yy
20							2.9		1.71										60							yy
20							3.5		2.06										60							yy
20							4.5		2.65										60							yy
20							4.8		2.82										60							yy
20							4.4		2.59										60							yy
20							2.5		1.47										60							yy
20							0.5		0.294										60							yy
20							4		2.35										60							yy
20							2.6		1.53										60							yy
20							3.5		2.06										60							yy
20							2.9		1.71										60							yy
20							3.5		2.06										60							yy
20							4.5		2.65										60							yy
20							4.8		2.82										60							yy
20							4.4		2.59										60							yy
20							2.5		1.47										60							yy
20							0.5		0.294										60							yy
20							4		2.35										60							yy
20							2.6		1.53										60							yy
100		T		2700															60							tt
100		T		2700															60							tt
100		T		2700															60							tt
100		T		2700															60							tt
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100		T		2700															60							tt
100		T		2700															60							tt

Abbreviations used in Table 2

Material

GaAs—Gallium Arsenide
Ge—Germanium
InAs—Indium Arsenide
Se—Selenium
Si—Silicon

Device Description

NI—Two-element photovoltaic null indicator.
PDD—Photo-duo-diode.
PIN—PIN reverse biased photovoltaic diode.
PK—Power pack.
PV—PN photovoltaic diode.
SC—Solar cell.

Dimensional Coding

P—Specified dimensions refer to the package and/or mount. For devices in transistor type cans, the package diameter includes the flange. Device depth excludes flexible leads.

D—Specified dimensions refer to the unencapsulated device. Length is measured along the metal contact strip.

Package Description

Primed quantities designate the device is hermetically sealed in the specified package.

A —Glass encapsulated.
AA —Nylon case.
B —No encapsulation, case, or coating.
BB —Cells embedded in epoxy resin, stud mounted.
C —Metal case.
CM —Metal case, stud mounted.
CR —Metal case, plug-in type.
D —TO-5 case.
E —Microminiature metal ceramic case.
F —TO-11 case.
G —TO-18 case.
GG —UG-88/U coaxial connector, BNC type plug.
H —Plastic coating.
I —Plastic case.
IM —Plastic case, stud mounted.
J —Epoxy coating.
JL —Epoxy coating, readout case assembly.
K —Special encapsulations available on request.
L —Readout case assembly.
M —Stud mounted.
R —Plug-in type.
U —Dielectric case mount.
V —Cells with leads are dipped in clear epoxy resin.
W —Lexan* polycarbonate resin.
X —Varnish encapsulation or coating.
XX —Bakelite** case.

Radiation Source Type

BK—Blackbody.

ESA—Equivalent sunlight, tungsten filament source at 2800°K color temperature at an irradiation level which corresponds to 100 mw/cm² of sunlight.

ESB—Equivalent sunlight, converters measured at an irradiation level equivalent to 100 mw/cm² of sunlight.

ESC—Equivalent sunlight, tungsten filament source at 2800°K color temperature filtered through 1.75 in. of water at an irradiation level equivalent to 100 mw/cm² of sunlight.

ESD—Equivalent sunlight, converters measured at an irradiation level equivalent to 140 mw/cm² of earth-orbit sunlight.

MC—Monochromatic.

SL—Sunlight.

T—Heated tungsten filament (incandescent lamp).

TF—Tungsten filament source filtered through a Corning‡ CS7-69 filter (9 mw/cm² filtered equivalent to 20 mw/cm² unfiltered).

XE—Xenon arc lamp.

*Trademark of General Electric Co., Pittsfield, Mass.
**Trademark of Bakelite Co., A Div. of Union Carbide and Carbon Corp., N. Y. 17, N. Y.
‡Corning Glass Work, Corning, N. Y.

Notes for Table 2 (Characteristics of Photovoltaic Diodes)

a. Glass lens.
b. Calcium fluoride window.
c. Photo output per segment specified. Center-to-center spacing of readout assembly is 0.1 in. Last digit of type number specifies the number of readout positions.
d. Corning 7052 glass window. A-c sensitivity parameters specified at 10 v reserse bias.
e. Depth includes pins.
f. Depth includes stud.
g. Integral molded lens. Depth includes stud.
h. Radiation resistant, gridded solar cell.
i. Excludes flange.
j. P/N, gridded solar cell.
k. N/P, gridded solar cell.
l. Device uses a fiber optic light guide.
m. Designed for operation in the reverse biased mode.
n. Absolute temperature of the blackbody radiator.
o. Photo output per segment specified. Center-to-center spacing of 3 to 10-segment readout assembly is 0.1 in.
p. Mounted in a lens holder.
q. Imbalance between sensitive elements, maximum output: 50 mv.
r. Glass window. Depth includes stud.
s. Photo output per segment specified. Center-to-center spacing of readout assembly is 0.1 in. Center digit of type number specifies the number of readout positions.
t. Photo output per segment specified. Center-to-center spacing of readout assembly is 0.087 in. Center digit of type number specifies the number of readout positions.
u. Photo output per segment specified. Center-to-center spacing of 3 to 10-segment readout assembly is 0.087 in.
v. N/P, gridded, radiation resistant solar cell.
w. Side illuminated.
x. Plastic window. Depth includes stud.
y. Glass window.
z. Glass window. Side illuminated.
aa. Circular device. Outside diameter is 2 in. Inside diameter is 0.69 in.
bb. Frames with open window available for this type.
cc. Built-in lens.
dd. Glass window. Sensitivity parameters and time constant measured with 10 meg. load resistance and 250 pf load capacitance.
ee. Quartz window.
ff. Photo characteristics specified for standard type, type N. Various other types available on request.
gg. Specified at 35°C ambient test temperature.
hh. Specified at 50°C ambient test temperature.
ii. Glass window. Three-pin case.
jj. Gridded cells may be ordered by adding G to the part number—e.g. S1020GE10. Load photo current is the approximate value at 0.46 v.
kk. Specified at 25 v reverse bias.
ll. NPN diffused.
mm. Photo output per segment specified. Center-to-center spacing of 10-segment readout assembly is 0.087 in.
nn. Photo output per segment specified. Center-to-center spacing of readout assembly is 0.1 in. First digit of type number specifies the number of readout positions.
oo. Specified at 50 v reverse bias.
pp. Photo output per segment specified. Center-to-center spacing of the glass covered, 9-segment readout assembly is 0.1 in.
qq. Photo output per segment specified. Center-to-center spacing of 9-segment readout assembly is 0.1 in. Similar cells with 5 to 8 readout positions available.
rr. Sapphire window.
ss. Ultra-low capacitance photovoltaic diode. Maximum capacitance with negative 2 v bias is 11 pf. Detectivity at spectral peak measured with zero bias.
tt. Also available in metal (Models 857 and 859) or Bakelite (Model 596) cases.
uu. Square sensitive area.
vv. Round sensitive area.
ww. Typical value.
xx. Specified at 20°C ambient test temperature.
yy. Quartz or glass window. Sensitivity parameters specified with an external circuit resistance of 200 ohms. Available with a Viscor# filter which matches the spectral response to the standard luminosity curve (with filter the sensitivity is reduced 40%).

#Trademark of Weston Instruments, Inc., Newark, N. J.

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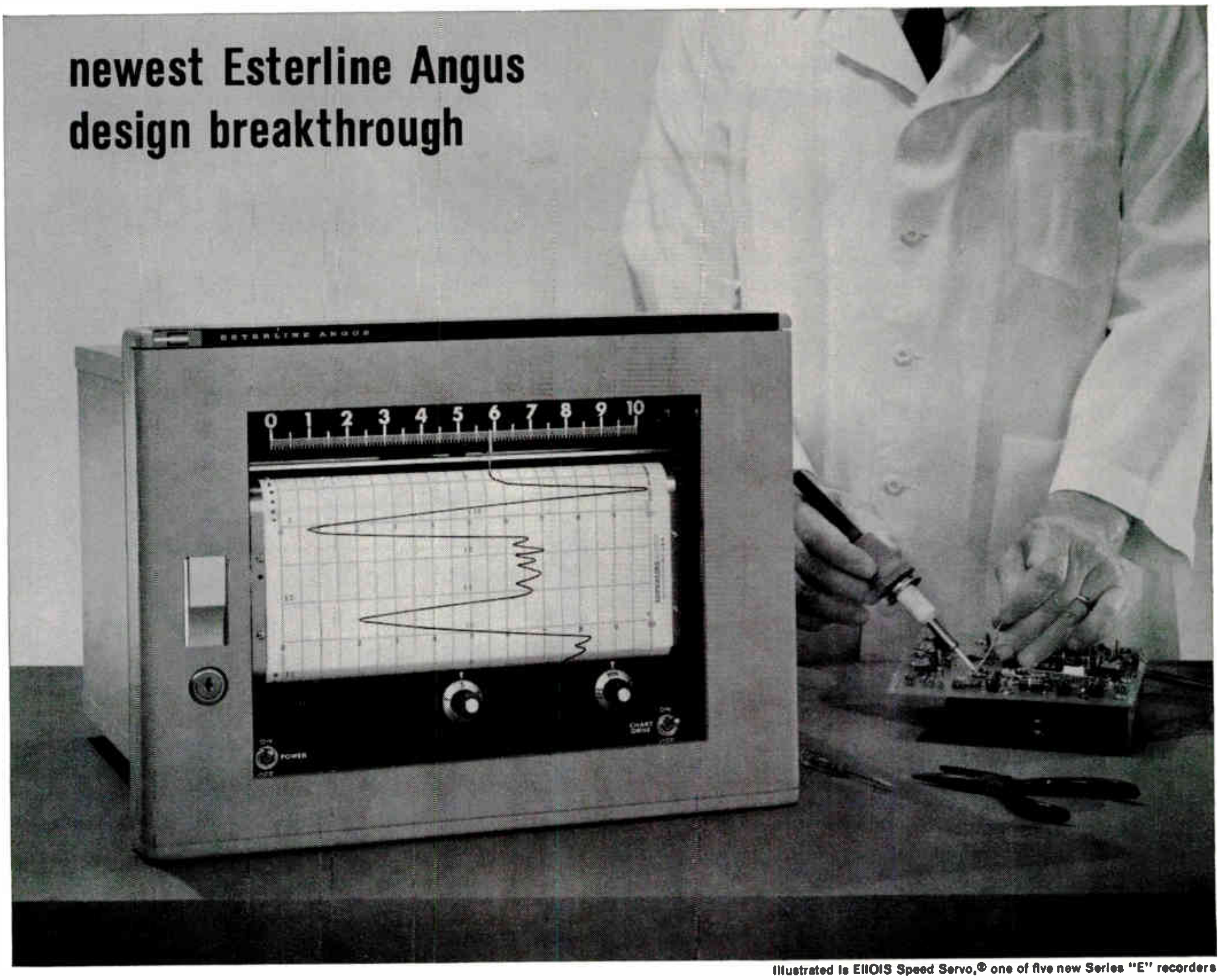

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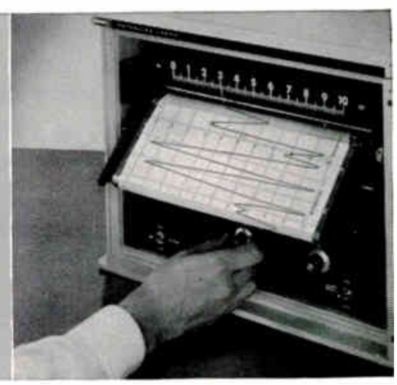

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#79 Calculating Coefficient of Coupling

By MAX H. APPLEBAUM, Head, T.V. Lab.
Warwick Electronics, Inc.,
8345 Hayvenhurst, Sepulveda, Calif. 93662

THIS NOMOGRAPH SIMPLIFIES calculation of coefficient of coupling K for transformers from the equation

$$K = \sqrt{1 - \frac{f_o^2 C_o}{f_s^2 C_s}}$$

where: C_o is the resonating capacitance of winding No. 1 with winding No. 2 open.
C_s is the resonating capacitance of winding No. 1 with winding No. 2 shorted.
f_o is the frequency with winding No. 2 open.
f_s is the frequency with winding No. 2 shorted.

Any unit may be used for the scales provided that both the f_o scale and f_s scale use the same unit, and that both the C_o scale and C_s scale use the same unit.

The following example will illustrate the use of the nomograph.

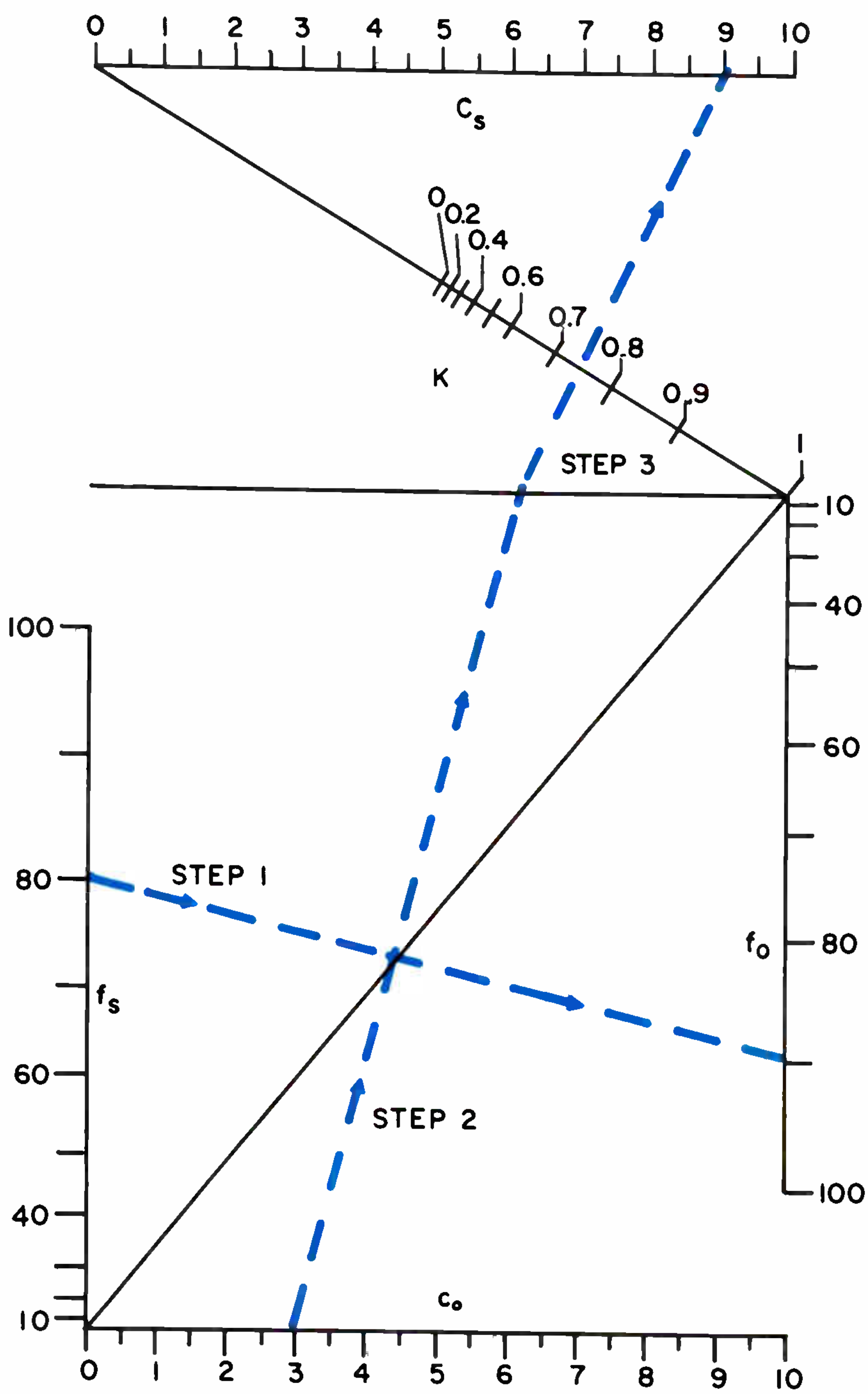
Example: Find the coefficient of coupling K of a transformer which has a resonating capacitance of 3 pf at a frequency of 90 KC with the secondary winding open, and a resonating capacitance of 9 pf at a frequency of 80 KC with the secondary winding shorted.

Solution: (1) Draw a straight line from 80 on the f_s scale to 90 on the f_o scale.

(2) Draw a second line from 3 on the C_o scale to the point where the first line crossed the diagonal scale and extend it to the pivot line.

(3) From the junction of the second line and the pivot line, draw a third line to 9 on the C_s scale.

(4) $K = 0.76$ is found where the third line crosses the K scale.



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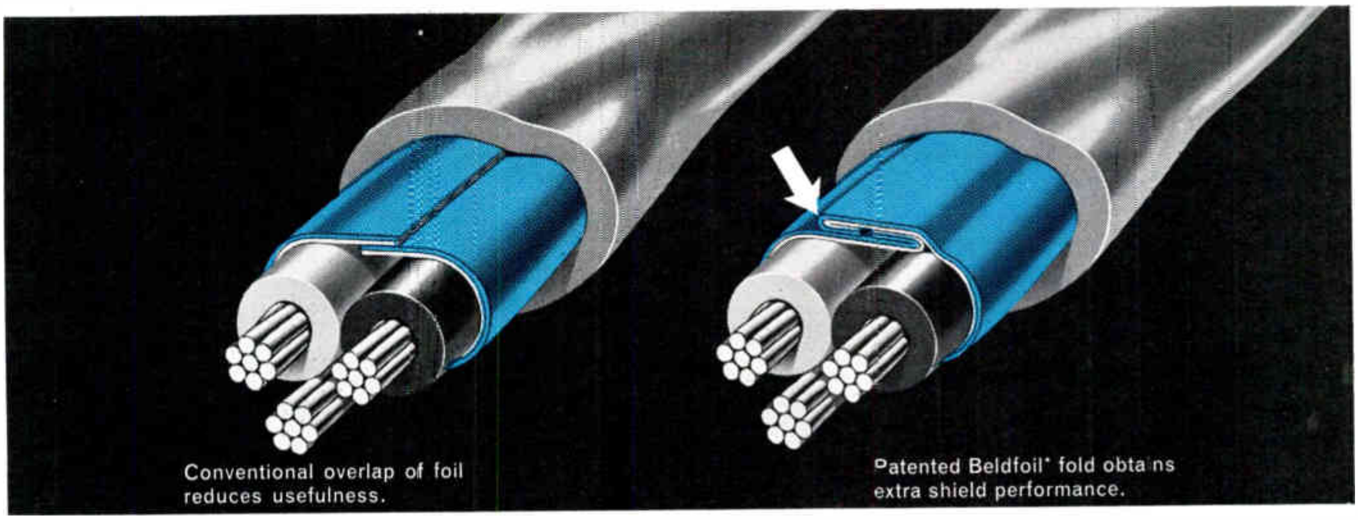


It's in the fold!

By Frank Timmons, Chief Engineer, Electronics Division, Belden Manufacturing Company

There are a number of cables on the market today which utilize Mylar† Aluminum Shielding to eliminate noise, hum and cross-talk. These cables have been developed to meet the needs of equipment engineers who have found that standard braided and spiral shields are inadequate in reducing pick-up and transmitted noise.

There is a big difference in the various cables available . . . and the big difference is in the manner by which the Mylar Aluminum Shielding is applied to the cable. The cable which does the most effective job of eliminating noise, hum and cross-talk uses a unique, patented wrapping process that "folds back" one or both edges of the Mylar Aluminum Shielding. It provides "total shielding" and was introduced in 1957 by the Belden Manufacturing Company under the trade name, "Beldfoil."

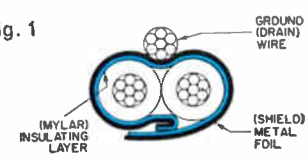
It is evident that many interested persons do not completely understand the manner in which Mylar Aluminum Shielding is used in the manufacture of Beldfoil cable. Therefore, Frank Timmons, Chief Engineer of the Electronics Division at Belden's Richmond, Indiana plant answers some of the more frequently asked questions, and points up some of the more important benefits offered by Beldfoil.

Q. *You talk about a patented process wherein the Mylar Aluminum Shielding is folded back . . . on one or both edges. Just how is this done?*

A. First, let us define Mylar Aluminum Shielding . . . it is a lamination of Mylar insulation film from 0.0005″ to 0.001″ thick and aluminum foil of .00035″ to .001″ thickness, applied spirally around the shielded conductor or conductors to give 100% shield coverage.

In some instances the wires are wrapped with the metal foil on the outside as shown in the cross-sectional drawing Fig. 1.

Fig. 1



Note the heavy black line showing the foil edge folded back so that a full layer of Mylar "bonus insulation" is provided between the conductors and the foil shield, increasing the reliability of the cable.

Cables to be used at radio frequencies, or sensitive to radio frequency interference, may need the fold shown in Fig. 2. This fold creates a metal-to-metal connection which eliminates any possible inductive effect, and makes the shield the electrical equivalent of a solid aluminum tube.

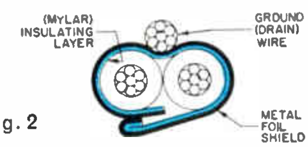


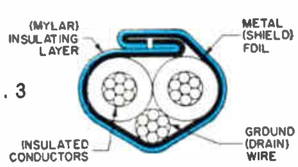
Fig. 2

Shields shown in Fig. 1 and 2 are used for cables with one pair of conductors.

For cables carrying multiple pairs of conductors, a different technique is used. On each pair, the aluminum foil is placed on the *inside*, with the Mylar layer on the *outside* (See Fig. 3). This is important because if the aluminum surface were on the outside we would have random metallic contact between the shields on the different pairs of wires. This would permit the voltages existing on one shield to generate currents in the adjacent shield, creating a transfer of energy or cross-talk between circuits.

Note that the outer edge of the shield is folded to tuck the edge of foil out of the way where it cannot short to the adjacent shield.

Fig. 3



The inner fold again provides the electrical equivalent of a solid aluminum tube. Belden calls this combination of two folds in one shield a "Z" fold because an end view of the unwrapped tape looks like the letter "Z".

Q. *How much signal isolation results between pairs, when aluminum foil is on the inside, and Mylar layer outside?*

A. This type of construction obtains isolation of more than 100 db between pairs, per thousand feet of cable, at 10 Kc. The short-circuited tape shield makes the cable quite suitable for use at frequencies ranging from audio to RF.

Q. *Do any contact-resistance problems arise between the drain wire and the aluminum foil shield on Beldfoil?*

A. No. Belden design and field service experience on millions of cable-feet in wide service environment have proved this point of reliability.

Q. *Can Beldfoil shields be used over small single conductors as well as over large complex cables?*

A. Yes. Belden applies it on groups from .050″ to 1.25″ OD.

Q. *Design engineers are constantly faced with miniaturization problems. What about the size of Beldfoil shielded cables?*

A. Beldfoil definitely reduces the diameter of multi-conductor cables . . . in some instances by as much as 66⅔%. The small diameter provides design engineers with extra conduit space, extra raceway, extra console and rack space.

Q. *How can I determine which type of shield I should choose for a given cable?*

A. Belden application engineers are available for engineering assistance. Or, you can obtain preliminary printed information by writing to Belden Manufacturing Company, Advertising Department, P.O. Box 5070-A, Chicago, Illinois 60680.

Better Built... Better Buy...

Belden
WIREMAKER FOR INDUSTRY SINCE 1902 CHICAGO

8-7-5

*Belden Trademark Reg. U.S. Pat. Off. †duPont Trademark

Circle 39 on Inquiry Card

World Radio History

SELECTED FOR THE MINUTEMAN PROJECT

More than 6 million El-Menco Dipped Mica Capacitors have been used in the Minuteman ground support and control equipment.

After 64,000,000 ACTUAL TEST unit-hours at 85°C with 225% of the rated DC voltage applied, no failures of any type occurred.

The accumulated 64 x 10^6 test unit-hours without any failures can be used to calculate many different failure rates depending upon the confidence level desired. However, we shall explore the meaning of the results at a 90% confidence level.

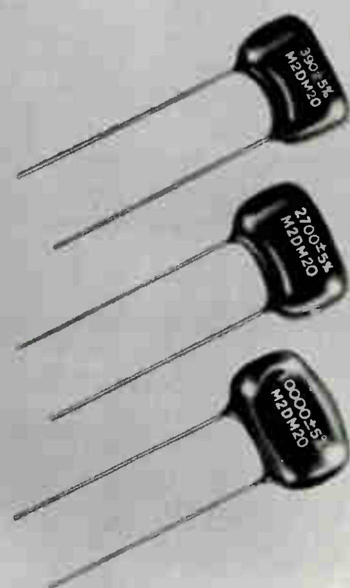
Assuming no acceleration factor for either temperature or voltage, we have verified a failure rate of less than 0.004% per 1000 hours. (Actually, there is a temperature effect and it has been found that, with the DC voltage stress remaining constant, the life decreases approximately 50% for every 10°C rise in temperature. There is also a voltage effect such that, with the temperature stress remaining constant, the life is inversely proportional to the 8th power of the applied DC voltage.)

Assuming no temperature acceleration factor and assuming the voltage acceleration exponent is such as to yield an acceleration factor as low as 100, we have nevertheless verified a failure rate of less than 0.00004% per 1000 hours.

Assuming no temperature acceleration factor and assuming the voltage acceleration factor is on the order of 250 (test results are available to confirm this) we have accumulated sufficient unit-hours to verify a failure rate of less than 0.000015% per 1000 hours!

All above failure rates are calculated at a 90% confidence level!

Write for a complete reliability study on your company letterhead.



DIPPED MICA CAPACITORS TYPE M2DM

THE ELECTRO MOTIVE MFG. CO., INC.

WILLIMANTIC, CONNECTICUT

Dipped Mica • Molded Mica • Silvered Mica Films • Mica Trimmers & Padders
Mylar-Paper Dipped • Paper Dipped • Mylar Dipped • Tubular Paper

MANUFACTURERS OF El-Menco *Capacitors*

ARCO ELECTRONICS, INC., Community Drive, Great Neck, L. I., New York
Exclusive Supplier to Jobbers and Distributors in the U. S. and Canada

West Coast Manufacturers Contact:
COLLINS & HYDE CO., 1020 Corporation Way
Palo Alto, California
5380 Whittier Boulevard, Los Angeles, California

World Radio History

NEW TECH DATA

"... STATE-OF-THE-ART information on Components and Equipment."

MOS Brochure

A booklet entitled "The MOST . . . A Revolution in Electronic Systems," is a comprehensive view of the integrated metal-oxide silicon transistor. The book reviews the history of the integrated MOST from its early stage until present. It also discusses its development, fabrication techniques, reliability data, analog and digital implementation, and major advantages of the new technology. The book is loaded with circuits and characteristic curves. General Micro-electronics Inc., 2920 San Ysidro Way, Santa Clara, Calif.

Circle 170 on Inquiry Card

Hall Effect Manual

This 64-page technical manual covers areas such as basic theory; h-f operation; voltage driven Hall generator circuits; and Hall effect applications in power measurement, dc to ac converters, function generators, multipliers, clip-on ammeters, modulators and gaussmeters. A bibliography lists over 275 articles, papers and reports on Hall effect. Helipot Div., Beckman Instruments, Inc., 2500 Harbor Blvd., Fullerton, Calif.

Circle 171 on Inquiry Card

Conversion Chart

This revised pocket conversion chart should be useful in solving engineering problems. It includes conversion of micro-inches to angles and inches to millimeters, microns and angstroms. Also shown are wavelengths of monochromatic radiations for gage interferometry, selected physical constants, and other data of time-saving value. *On company letterhead* send requests to Engis Equipment Co., Div. of Engineering Instrumentation, 8035 Austin Ave., Morton Grove, Ill.

Test Equipment Catalog

This revised and expanded catalog contains data on over 1200 standard waveguide and coaxial instruments and components. They cover the freq. range of 2.0 to 40.0GC. Also given are a number of engineering reports on noise measurement, attenuators, directional couplers, and filters, as well as charts of standard waveguide data. Waveline Inc., Caldwell, N. J.

Circle 172 on Inquiry Card

IC Devices

This detailed 12-page catalog provides full technical data on Quik/Sert sockets, carriers and contactors for IC devices. Included are several new products designed to speed loading, increase reliability and lower costs. Sockets cover virtually every application, including all types of production, testing, breadboarding and aging. Full specs. and schematics are provided on each series. Barnes Development Co., Lansdowne, Pa.

Circle 173 on Inquiry Card

Alloy Wall Chart

The 2-color Select-A-Rod chart lists welding, brazing, soldering, cutting and tinning alloys. Color contrast permits easy reference and quick reading. Most alloys and fluxes for use in maintenance and production applications are represented. All-State Welding Alloys Co., Inc., 249-55 Ferris Ave., White Plains, N. Y.

Circle 174 on Inquiry Card

Instrument Catalog

This 20-page catalog describes instruments for educational purposes and research of the various effects of magnetism. The products include many economical instruments for EPR and NMR observations, the investigation of magneto-resistance effects and magneto-optical effects, and general purpose laboratory magnets. Complete description of experiments which may be performed, with theoretical background, is included. Alpha Scientific Laboratories, Inc., 940 Dwight Way, Berkeley, Calif.

Circle 175 on Inquiry Card

Potentiometer Guide

Standard wirewound precision potentiometer inspection and testing procedures are given in this 52-page manual. All data was developed by the Precision Potentiometer Manufacturers' Assoc. The testing procedures cover all characteristics of a precision potentiometer which may be measured without seriously affecting its remaining life. Purpose of the manual is to obtain better correlation of inspection results between potentiometer manufacturers and users. Amphenol Controls Div. of Amphenol Corp., 120 S. Main St., Janesville, Wis.

Circle 176 on Inquiry Card

Introduction to Resolvers

A 4-page bulletin dealing with precision servo components is available. Designed to be published quarterly, the first issue contains a basic introduction to resolvers, how they are used and the principal types of resolver inputs. Subsequent issues will deal with transformation ratio, phase angle errors, resolver application factors, typical resolver calculations, etc. Solvere, Inc., 1902 W. Chestnut St., Santa Ana, Calif.

Circle 177 on Inquiry Card

Application Note

Application Note #66, 11 pages, details techniques for making swept SWR measurements in coaxial systems at X-Band. It provides less uncertainty than is usually achieved even with point-to-point slotted line measurements. With this technique, the low ambiguity which is ordinarily associated only with point-to-point devices of residual SWR under 1.06 is achieved in coax at X-Band with swept measurements. Hewlett Packard, 1501 Page Mill Rd., Palo Alto, Calif.

Circle 178 on Inquiry Card

Equation Solver

The SDS DES-1 Differential Equation Solver brochure describes a new approach to the real time solution of simulation problems involving differential equations. Available in 2 editions, 44-page brochure 64-42-01C details DES-1 operation and theory, and 8-page brochure 64-42-04A presents a succinct description of characteristics. The unit solves systems of differential equations in real time, using general purpose digital computer techniques. Scientific Data Systems, 1649 17th St., Santa Monica, Calif.

Circle 179 on Inquiry Card

Relay Booklet

"News and Views," 16 pages, is devoted to a description of the micropositioner ultra-sensitive polarized relay. Circuit versatility makes it useful for detecting acceleration (in remote positioning systems), for temp. control (as a battery reverse current detector), and for numerous photoelectric uses. Barber-Colman Co., Electro-Mechanical Products Div., Rockford, Ill.

Circle 180 on Inquiry Card

Galvanometer Handbook

Bulletin 7300, 24 pages, tells how to select the proper recording galvanometer; how to calculate damping networks; and other valuable information, including operating tips and performance specs. Consolidated Electrodynamics Corp. subs. of Bell & Howell, 360 Sierra Madre Villa, Pasadena, Calif.

Circle 181 on Inquiry Card

Product Catalog

New Product Supplement 3-65, 24 pages, contains complete data on several Series of ultra-miniature and miniature rotary and pushbutton switches. Catalog includes a rotary switch reference chart, plus data on a new transistor socket, pencil tube socket, bi-pin lamp socket, and thermosetting plastic module cases and headers. Grayhill, Inc., 561 Hillgrove Ave., La Grange, Ill.

Circle 182 on Inquiry Card

Chopper Catalog

Catalog F-5186, 2 colors, illustrates and describes a line of 10 solid-state photo-electric chopper/relays using photoresistive cells and associated light sources. Called the Photocom chopper, it may be used as a signal modulator and comparator. Thermal offset is less than 1μv and electrostatic noise is less than 3μv RMS into a 1 megohm load. The catalog explains the fundamentals of photo-electric signal modulation, principles of operation, input circuits, recommended drive circuitry, and origin of noise in photochoppers. Drive circuit diagrams, temp. vs. efficiency curves, and noise test chart are included. James Electronics, Inc., 4050 N. Rockwell Ave., Chicago, Ill.

Circle 183 on Inquiry Card

World Radio History

Circle 41 on Inquiry Card

Limitron Fuses

...for the Protection of Semi-Conductor Rectifiers

LIMITRON fuses provide extremely fast opening on overload and fault currents, with a high degree of restriction of the let-thru current.

If each SCR and individual diode is protected by a proper size Limitron fuse, the fuse will open to protect the unit when the current drawn exceeds the rating of the unit. Thus the SCR or individual diode is taken out of the circuit before damage can be done to other diodes in the rectifier.

For full information and opening time charts ask for BUSS Bulletin HLS.

See us at the Wescon Show Booth 2525

MORE BUSS QUALITY FUSES

BUSSMANN MFG. DIVISION
McGraw-Edison Co., St. Louis, Mo. 63107

... For Protection of ....

Wire Catalog

Catalog W-5, 108 pages, contains detailed data on more than 7000 wire, cable and tubing items. In addition to product descriptions, the catalog contains helpful charts on decimal-equivalents, stranding construction and hook-up wire to enable simple, rapid selection of desired products. Alpha Wire, 711 Lidgerwood Ave., Elizabeth, N. J.

Circle 186 on Inquiry Card

Soldering Techniques

Bulletin TR1014 gives the proper soldering techniques for assuring economical, reliable soldered connections. It contains detailed information on each of the 4 major points involved: consideration of soldered joint properties; careful selection of materials; geometric design of the soldered connections; and determination of production methods. Alpha Metals, Inc., 56 Water St., Jersey City, N. J.

Circle 187 on Inquiry Card

Pots/Switches Catalog

This 32-page catalog shows an entire line of industrial and military products. The catalog is designed for ready reference to everything from TV replacement controls to military quality metal film precision resistors. Included are composition element potentiometers, wire-wound element potentiometers, power rheostats, sound system controls, etc. Clarostat Distributor Div., Dover, N. H.

Circle 190 on Inquiry Card

Cable Selector

Bulletin C-265 gives a complete list of coaxial and special-purpose cables, with tables to aid in selection for specific uses. The brochure lists coaxial and other electronic cables by both type number and characteristic impedance. Also given is a tatable of special r-f cables for commercial uses. ITT Wire and Cable Div., 172 Sterling St., Clinton, Mass.

Circle 185 on Inquiry Card

Connector Catalog

Bulletin 681 is a 20-page catalog describing the Pyle-Star-Line, Venus Series, connectors per NAS 1599 specs. Dimensional drawings are shown for the flange-mounted and D-hole mounted receptacles, as well as the straight plugs and their various cable supports. The Pyle-National Co., 1334 N. Kostner Ave., Chicago, Ill.

Circle 188 on Inquiry Card

Ceramic Trimmers

Ceramic trimmers for Mil-C-81A uses are described in catalog C-4. The catalog describes how the smooth, linear capacitance change/degree of rotation is obtained. This linearity is said to provide adjustment precision beyond that of compression type trimmers where capacitance change is largely non-linear. Complete dimensional drawings and electrical specs. as well as a chart of Mil-C-81A temp. coefficient tolerances are included. Centralab, div. of Globe-Union Inc., P. O. Box 591, Milwaukee, Wisc.

Circle 189 on Inquiry Card

Varactor Diodes

Data sheet #4500A describes a line of silicon parametric amplifier varactor diodes. They are available in 3 package styles, and in 3 capacitance ranges from 0.2pf to 1.59pf @ 0v. bias. Cutoff freqs. are listed up to 300GC @ —6v. Micro Optics Div. of Alpha Industries, Inc., 381 Elliot St., Newton Upper Falls, Mass.

Circle 184 on Inquiry Card

Cermet Technology

Bulletin 701 entitled, "The Story of Cermetology," 12 pages, presents the case for cermet film hybrid circuits and discusses techniques and applications of cermetology. Typical circuitry is shown with outline drawings, schematics and reliability data. Columbia Technical Corp., Woodside, N. Y.

Circle 191 on Inquiry Card

Selection Guide

Application Guide 007, "Selecting Your Clutch-Brake Motor," provides a simplified step-by-step approach for choosing the proper clutch-brake motor to drive virtually any clutch-controlled load. It will allow the user to pick the clutch-brake motor which best meets his particular needs with a minimum of cut-and-try time. The 20-page guide has full-page nomographs which provide the machine designer with a fast and convenient method for analysis and selection. Diehl Div., The Singer Co., Finderne Plant, Somerville, N. J.

Circle 192 on Inquiry Card

World Radio History

Specifying Oscillators

This 2-color brochure entitled, "How to Specify Low Frequency Oscillators," provides a complete breakdown and analysis of the important parameters in the specifying l-f oscillators. Accutronics, Inc., 12 South Island, Batavia, Ill.

Circle 194 on Inquiry Card

E/I Programmer

Model 594 can be programmed by dry contacts or logic to provide either a precise constant-voltage or constant-current output. It gives a simultaneous readout of current or voltage, respectively, using Kelvin connections. It was originally designed for operation in a high-speed test system for integrated circuits. It can be programmed to operate within 1-2msec. Data sheets are available from Aerotronic Associates, Inc., Contoocook, N. H.

Circle 196 on Inquiry Card

Determining Inductance

A brochure entitled, "A Production Technique for Determination of Inductance for Toroidal Powered Iron Cores," tells how to construct a special-purpose permeameter designed for production line use. It describes the method for testing inductors to provide high-quality, uniform production runs. The brochure also explains how a standard test instrument can be modified to make a permeameter that has the simplicity of use, speed, accuracy, and ruggedness needed for production use. The Arnold Engineering Co., Box G, Marengo, Ill.

Circle 195 on Inquiry Card

Cable Systems

Bulletin E-5, 16 pages, describes flat conductor cable systems. Connectors for round wire to flat cable, flat cable to flat cable, flat cable wire to wire-wrap methods, and PC board connectors are described and illustrated. Also shown are uses of completed systems indicating time and cost savings. Advanced Circuits International, 206 Center, Princeton, N. J.

Circle 199 on Inquiry Card

Crystals/Filters

This product catalog highlights a complete line of both high and low freq. quartz crystals and filters. A bound section, entitled Precision Frequency Regulation, describes the properties of crystals and manufacturing procedures, together with background data on crystal cutting, lapping, cleaning, plating and encapsulation. McCoy Electronics Co., Mt. Holly Springs, Pa.

Circle 198 on Inquiry Card

Toroidal Inductors

Bulletin 2721A, 28 pages, contains design and performance data on encapsulated, wax-dipped and unimpregnated inductors. Available in 7 sizes, they are for use at freqs. up to 500kc over the range of 1mh to 30.40h. Illustrations are used throughout the bulletin to emphasize typical performance characteristics. Outline dimension drawings and terminal location charts are included to assist design engineers in planning the layout of PC boards. Sangamo Electric Co., Box 359, Springfield, Ill.

Circle 200 on Inquiry Card

Circuit Attenuators

Bulletin 341-A describes the Type 1020 printed circuit attenuators. Featuring low torque, a specific use of this type PC attenuator would be as mixer or master controls in broadcast or recording consoles. Specs. and schematics are given. Daven, Livingston, N. J.

Circle 193 on Inquiry Card

Screwdriver Set

Bulletin N365 describes a compact, multiple-spline screwdriver set designed to simplify service and assembly work. Specs. are given for the 9 interchangeable blades, extension shaft and handle contained in the set. Xcelite, Inc., Orchard Park, N. Y.

Circle 197 on Inquiry Card

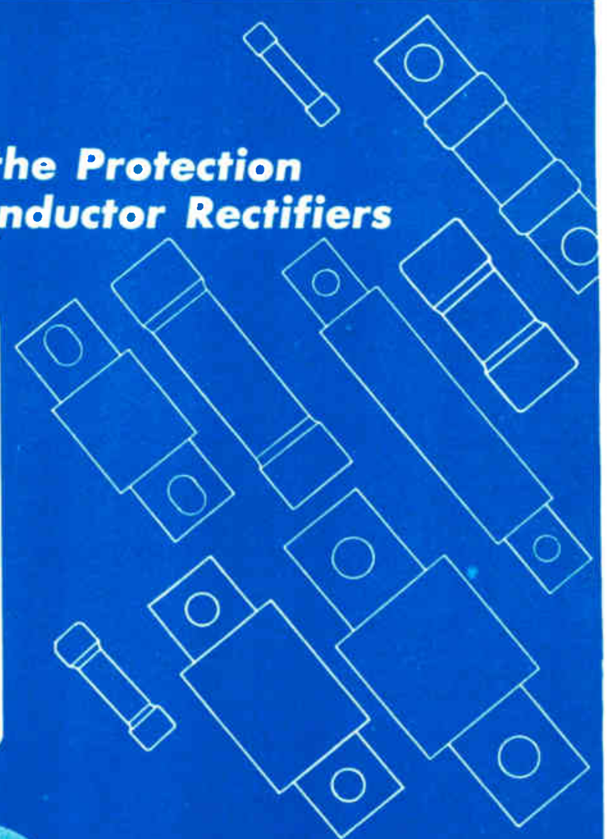
Amplifier Textbook

"Generalized Instrumentation for Research and Teaching—a Primer in the Art of Using Operational Amplifiers in General Utility Instrumentation" is a 104-page illustrated textbook. It describes the use of the techniques of electronic circuits, feedback, and analog computing to chemical instrumentation and automated measurement. Outlined are opportunities and pitfalls inherent in the use of analog technology. It explains actual working instruments in sufficient detail to enable the reader to construct them. The free book may be obtained by writing *on your letterhead* to George A. Philbrick Researches, Inc., Allied Drive at Route 128, Dedham, Mass.

. . Semi-Conductor Rectifiers

Limitron Fuses

...for the Protection of Semi-Conductor Rectifiers



LIMITRON fuses are available in ampere sizes up to 800 and voltages up to 600.

They come in various types and sizes to fit various types of application.

Should you have a special problem, our staff of fuse engineers is ready to assist you at any time.

For full information on LIMITRON fuses for the Protection of Semi-Conductor Rectifiers ask for BUSS Bulletin HLS.

SEE US AT THE WESCON SHOW BOOTH 2525

MORE BUSS QUALITY FUSES

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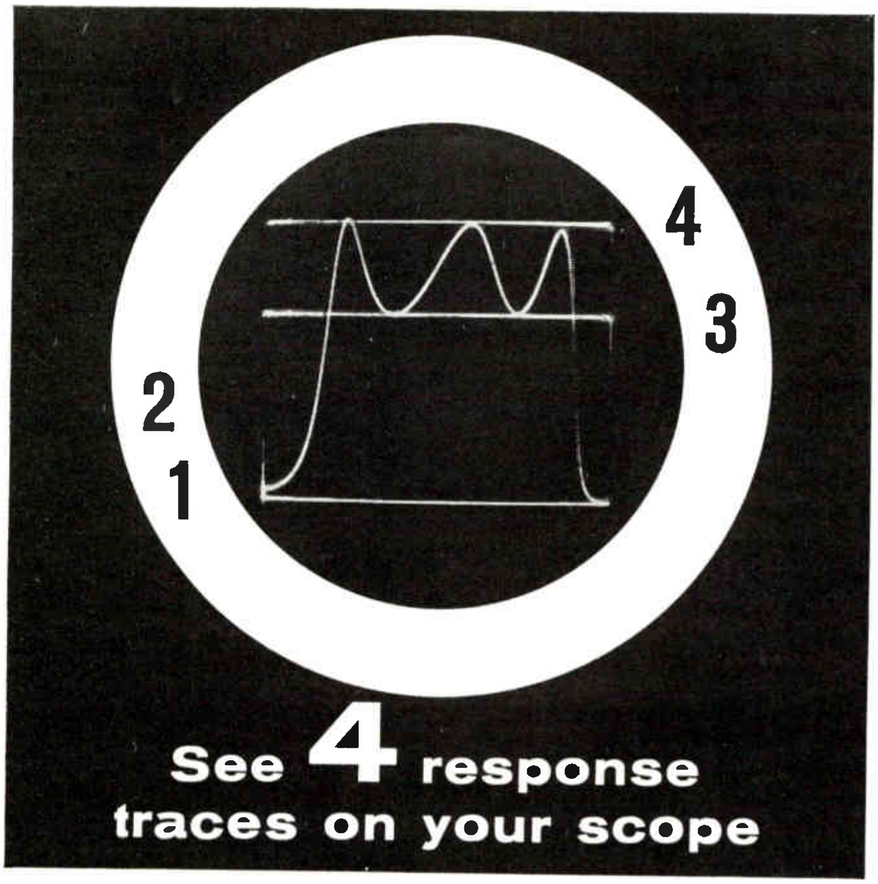
McGraw-Edison Co., St. Louis, Mo. 63107

Circle 41 on Inquiry Card

World Radio History



Fast, accurate measurements by comparison up to 1,200 mc

New Jerrold 3-Position Coaxial Switcher Model TC-3

$295.00

The new Jerrold Solid-State 3-position coaxial switcher turns any single-trace oscilloscope into a 4-trace scope, letting you insert two reference traces automatically in addition to the test trace and baseline. These reference traces have the distinct advantage of permanent relative accuracy over hand-scribed or painted reference lines.

Results are repeatable, and as accurate as the reference attenuators. Generator and scope drift do not affect the accuracy of the measurements. The wide frequency range from dc to 1,200 mc extends the usefulness of the comparison technique well into the UHF band. At only $295, the TC-3 Coaxial Switcher can save you thousands of dollars in speed and accuracy of laboratory and production rf measurements.

Jerrold also offers the sweep generators, attenuators, and other equipment needed for fast, accurate measurement of loss, gain, and VSWR. Write for literature.

JERROLD ELECTRONICS

Industrial Products Division, Philadelphia, Pa. 19132
In Canada: Jerrold Electronics, 60 Wingold Ave., Toronto 19, Ont.
Export: Rocke International, 13 E. 40th St., New York, N. Y. 10016

SEE US AT WESCON BOOTHS #3509-10-11

Circle 42 on Inquiry Card

NEW TECH DATA

Coil Selection Chart

This product news bulletin describes a wide variety of standard wound coils. Also included is a convenient coil-form correlation chart for quick, efficient coil selection, as well as graphs, helpful technical data and engineering information. Cambridge Thermionic Corp., 445 Concord Ave., Cambridge, Mass.

Circle 201 on Inquiry Card

Design Manual

"TFE Design Data by Sparta" is a collection of technical data for design engineers who should be specifying TFE-fluorocarbon resins in the fabrication and design of parts. The brochure is consolidated into 28 pages with 67 technical photographs, illustrations, data charts and test graphs. Sparta Mfg. Co., Dover, Ohio.

Circle 202 on Inquiry Card

Amplifier Catalog

Catalog 381 contains descriptions and specs. on the series 3000 data amplifiers. The direct-coupled amplifiers have gains from 0.2 to 2500, and are available for wideband uses. Units with switch-selectable passbands ranging from 10 cps to 50KC are available. Dana Laboratories, Inc., Irvine, Calif.

Circle 203 on Inquiry Card

Diode Logic

Bulletin HDM 101 describes unique microcircuit silicon diode arrays. They perform logic functions including counters, multiplexing operations, machine control and monitoring systems, etc. The arrays allow the circuit designer a high degree of flexibility since logic or counting function is changed by simply rearranging the diode pattern, with the external circuitry remaining the same in many cases. Gulton Industries, Technical Publications, 212 Durham Ave., Metuchen, N. J.

Circle 204 on Inquiry Card

Photocell Forum

"Photocell Forum," a new periodical, is the first issue in the series that describes the use of light in operating contactless relays. Future issues will contain design and application data on photocells, replies to reader questions and comments, and technical articles by leading engineers in the photoelectric field. Clairex Corp., 8 W. 30th St., New York, N. Y.

Circle 205 on Inquiry Card

Pulse Generators

Tech. bulletin 108 describes the model 108 solid-state pulse generator. It has a 5.5nsec. rise time, 10MC repetition rate and exceptionally clean waveform. The generator features linear rise and fall times from 12nsec. at pulse outputs to 50v. and repetition rates to 10MC. Specs., waveform photos, and applications data are included. Datapulse Inc., 509 Hindry Ave., Inglewood, Calif.

Circle 206 on Inquiry Card

World Radio History

NEW TECH DATA

Differential Amplifier

This data sheet describes the use of dc differential amplifiers. In particular, undesired feedback loops are discussed. Secondary feedback loops are described and illustrated with block diagrams. Other feedback problem areas noted involve feedback loops in the common lead and feedback in power supply lines. Melcor Electronics Corp., 1750 New Highway, Farmingdale, L. I., N. Y.

Circle 207 on Inquiry Card

Low-Freq. Filter

Data is available on a new series of l-f band-pass filters for interstage and other uses. Typical of the series is model BP840 which has a center freq. of 60 cps with a gain of 2/1. The filter is hermetically sealed. Electronics Div., Bulova Watch Co., Inc., 61-20 Woodside Ave., Woodside, N. Y.

Circle 208 on Inquiry Card

Coaxial Relay

Bulletin #465 describes a wide selection of r-f switching relays, including varied mounting arrangements, integrated with extensive choice of relay structures. It contains design data concerning relay operation, performance tables, r-f electrical characteristics, and definitions of coaxial relay terms. Fifteen variations of 5 basic styles of coaxial relays are pictured. Magnecraft Electric Co., 5575 N. Lynch, Chicago, Ill.

Circle 209 on Inquiry Card

Connector Brochure

Brochure GM-4, 16 pages, describes and illustrates various missile connectors and interconnection systems. One section lists general design requirements, including types of disconnect mechanisms and physical specs. and features. In addition, a cable restoration program is described. ITT Cannon Electric, 3208 Humboldt St., Los Angeles, Calif.

Circle 210 on Inquiry Card

Digital Clock

Data is available on an electromechanical digital clock that provides visual readout continuously and remote electrical readout on command. The clock is designed for use in data reduction systems. Each digit has an isolated 11 line readout, which can be made available to computers, printers and controls. Durant Mfg. Co., North Cass St., Milwaukee, Wisc.

Circle 211 on Inquiry Card

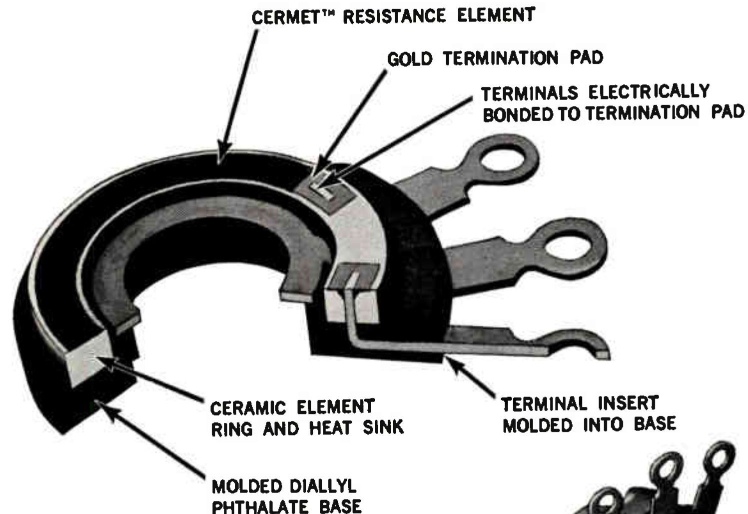
Amplifier Catalog

A short-form catalog is available which describes a complete line of all silicon dc operational amplifiers. The line includes differential input, differential output, single ended and power booster operational amplifiers for military, commercial, industrial and research uses. General and special purpose models are described with detailed design specs. Burr-Brown Research Corp., P. O. Box 6444, Tucson, Ariz.

Circle 212 on Inquiry Card

BIG POWER
SMALL PACKAGE
CERMET™ STABILITY
UNDER $2.00 each

(in production quan.)



Series 550 has long life—
no catastrophic failures

New 2-watt, 3/4" diameter CERMET Variable Resistor

Applications: computers, instruments, medical electronics, communications equipment, electronic machine controls, electronic processing equipment, aerospace electronics, microwave transmission, etc.

Outstanding features:

Closed construction—Cover entirely protects against dust and dirt.
Exceeds MIL-R-23285 (Navy) metal film, Cermet; also far exceeds MIL-R-94B.
Extreme stability under severe environmental conditions.
Resistance range—50 ohms through 1 Megohm.
Infinite resolution.
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Excellent high frequency characteristics.

CTS ®
Founded 1896

Request data sheet 3550.

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BERNE, INDIANA

a subsidiary of CTS Corporation, Elkhart, Indiana

World Radio History

WITH THE NEW VARO BATTERY CHARGER-ANALYZER

You can automatically discharge and charge 22 Ni-Cad batteries in one operation

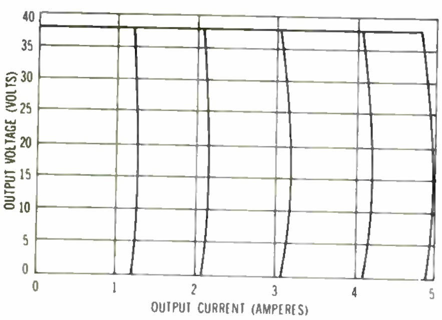
For reliable battery performance, this battery charger-analyzer allows you to discharge, analyze, and fully recharge 22 Ni-Cad batteries automatically. Originally designed for security-surveillance operations, the Varo Model 3171 is now available for industrial applications.

Versatility is provided by three modes of operation. The **discharge** mode fully discharges and analyzes batteries. A no-go light indicates if a battery cannot take a full charge. The **charge** mode can charge 22 Ni-Cad cells to 140% of rated capacity and remove them from the charging circuit. The **automatic discharge-charge** mode performs all these functions in sequence.

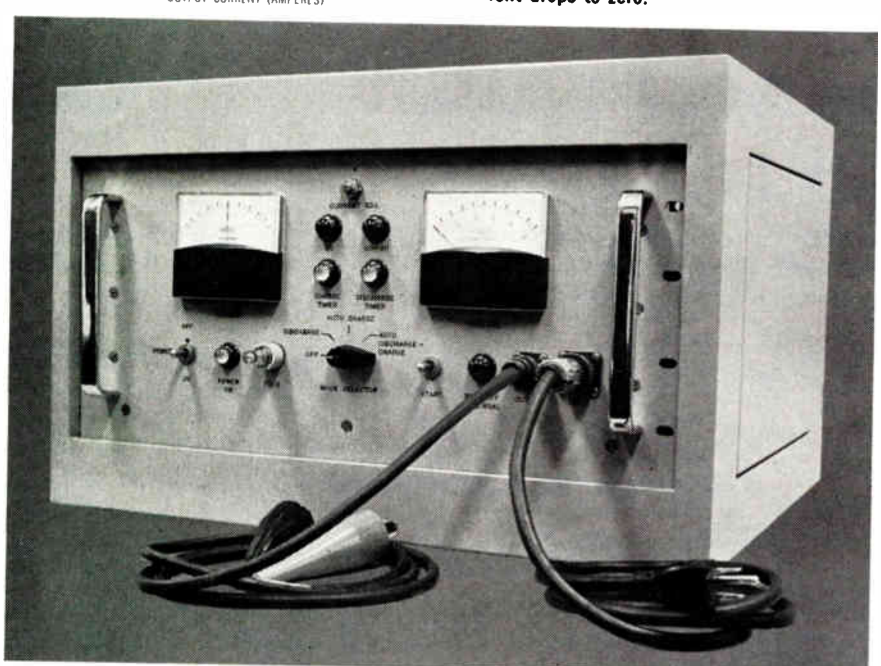
FEATURES & BRIEF SPECIFICATIONS

- Fail-safe
- Polarity reversal alarm
- Overload protection
- Automatic shut-off
- Go, no-go indicators
- Reliable, solid-state design
- Self-cooling

INPUT:	115 VAC ±10%, 60 cps ±5 cps, single phase, 50-70 amps.
OUTPUT:	38 VDC, 0.07 to 20.0 amps
WEIGHT:	85 lbs.
HWD:	13" x 21" x 18"



The ability of the charger to control both charging rate and voltage level is shown by the chart on the left. For an uncharged battery, the current level is limited to the charging rate which may be set between 1 and 5 amps. As charging begins, the voltage level across the battery rises but is limited to a pre-set level which may be between 15 and 40 volts. When the battery charge reaches this level, the charger goes into a voltage limited condition and charging current drops to zero.



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NEW TECH DATA

Fiberglass Cases

Catalog 650, 14 pages, covers a complete line of over 30 standard fiberglass cases for instrument and hand portable equipment. The catalog contains complete dimensional data for case shells, hardware, and accessories as well as detailed data on standard case modifications available. Skydyne, Inc., River Rd., Port Jervis, N. Y.

Circle 213 on Inquiry Card

High-Gain Amplifiers

Data is available on a new line of low level pnp differential amplifier transistors with typical gains of 100 to 200 @ 10μa. The devices contain 2 electrically isolated PNP silicon triode transistors designed primarily for small signal, low power uses. Sperry Semiconductor, Norwalk, Conn.

Circle 214 on Inquiry Card

Power Supplies/Transformers

This short form catalog covers isolated-output power supplies, isolation transformers, integrators, signal conditioners and pulse filters. It contains data on 16 basic products, as well as information on their various uses. Elcor, 2431 Linden Lane, Silver Spring, Md.

Circle 215 on Inquiry Card

Circuit Modules

Low cost answers to 99% of digital needs are illustrated in the 1965 Q series digital circuit module catalog. The 17-page booklet includes the latest pricing information for all 25KC, 100KC, and 1MC modules. All logic elements are illustrated by symbol along with definitions. Schematics are given. Engineered Electronics Corp., 1441 E. Chestnut Ave., Santa Ana, Calif.

Circle 216 on Inquiry Card

Magnetic Shields

Manual 176, 12 pages, contains detailed listings of 114 types of photo-multiplier tubes made by 13 manufacturers. Included is a discussion on the need for magnetically shielding photomultiplier tubes, shield design considerations, an explanation of the part numbering system used, and dimensional drawings. Magnetic Shield Div., Perfection Mica Co., 1322 No. Elston Ave., Chicago, Ill.

Circle 217 on Inquiry Card

Semiconductor Brochure

Reliability '65, 32 pages, illustrated with 4-color photographs details steps taken in the manufacture of silicon semiconductor devices to assure their reliability. Five major sections deal with reliability in operation; maintaining reliability by tight process control; assuring reliability by comprehensive testing; designing reliability into the product; and other factors affecting product reliability. Many photomicrographs give unusual views of the inner workings of transistors and integrated circuits. Fairchild Semiconductor, 313 Fairchild Dr., Mountain View, Calif.

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NEW TECH DATA

Switching Transistor

Data is available on a npn diffused silicon planar epitaxial transistor that performs effectively as a universal switching transistor. It is suitable for both logic and high speed memory uses in a broad variety of computer and data processing systems. The 2N3862 has a $t_s < 10$nsec. at 10/10/10; $t_{off} < 30$nsec. at 200ma, B = 10; $V_{CE} < 0.7$v. @ 200ma/20ma; $f_T > 600$MC; and $V_{CEO} > 20$v. @ 10ma. Transitron Electronic Corp., 168 Albion St., Wakefield, Mass.

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Porcelain Capacitors

Data sheet P 10A describes space-saving VY® Thin Line porcelain capacitors offered with a 0 ±25 ppm/°C as a standard option. Data sheet includes a photo and specs. of axial, edge radial, and face radial configurations; dimensional drawings; typical curves; and complete instructions on how to order units with your choice of lead materials, lead configurations, and temp. coefficients. Vitramon, Inc., P.O. Box 544, Bridgeport, Conn.

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Drafting Aid

"Tape-Lift" Centerless Pad is designed for use with transparent tape for fast, accurate, distortion-free PC drafting. The "press-and-peel" application requires a short strip of cellophane tape to be pressed firmly over the centerless pad, and then peeled off the release paper. The pad transfers to the cellophane tape and can be applied to the circuit drawing. Free samples and new cross reference catalog are available. By-Buk Co., 4326 W. Pico Blvd., Los Angeles, Calif.

Circle 221 on Inquiry Card

Circuit Board Extractor

Data is available on a circuit board inserter-extractor designed especially to handle small integrated circuit mother boards. However, it is just as useful on regular PC boards. This tool is adjustable and will fit boards ranging from 1 to 4 in. in width. It grips the edges of the board and allows for easy handling insertion, and extraction. Hewson-Waltz Corp., 3851 Sepulveda Blvd., Culver City, Calif.

Circle 222 on Inquiry Card

Capacitor Bulletin

Micromodule ceramic variable capacitors are described in Bulletin MT-65-1. The illustrated bulletin shows typical Model MT 100 and introduces new MT 200 Modutrim ceramic variable capacitors. It lists features and specs., gives characteristics of each of the 14 types, and contains outline drawings showing dimensions of these micromodule ceramic variable capacitors. Capacitance ranges covered are 1.6 to 50pf at a dc working voltage of 50. JFD Electronics Corp., 15th Ave. at 62nd St., Brooklyn, N. Y.

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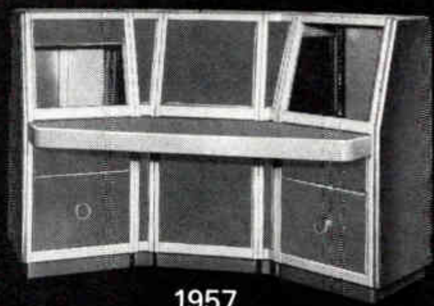

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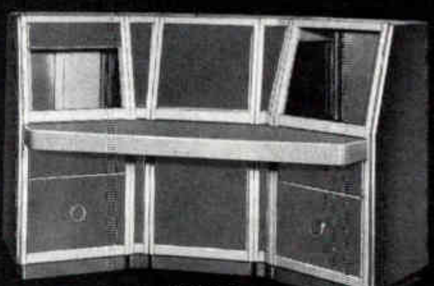

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Circle 224 on Inquiry Card

Rectifier Columns

Bulletin SR-373X describes ultra compact silicon rectifier columns with up to 160kv PRV and 8.5a. average. The columns are suitable for laser pump supplies, radar modulators, broadcast transmitters, and other uses requiring rugged, compact, medium current, high-voltage rectifiers. Higher density packaging enables the new columns to handle 5kva/cu. in. International Rectifier Corp., 233 Kansas St., El Segundo, Calif.

Circle 225 on Inquiry Card

Silicon Transistors

Data is available on a family of epitaxial planar transistors, designed to operate at very low collector current in uses requiring a high current gain. The V222 delivers a min. dc current gain of 140 with a collector current of 0.1ma and a V_{ce} of 5v. The T_s is typically 20nsec. Solid State Laboratories, Vector Dept. Norden Div., United Aircraft Corp., Southampton, Pa.

Circle 226 on Inquiry Card

Computer Circuits

This catalog describes a fully coordinated set of transistorized digital computer circuits in 3 speed lines (500KC, 5MC, and 10MC. The catalog contains logic diagrams and detailed specs. for over 45 modules and accessories. Also included is a 64-page insert, "the Laboratory Module Handbook," which may be used as a basic primer or text on digital logic and applications. Digital Equipment Corp., 146 Main St., Maynard, Mass.

Circle 227 on Inquiry Card

Semiconductor Catalog

This 48-page catalog is divided in separate chapters devoted to: the Amperex Reliability and Quality Program, with a Quality Control Flow Chart; a Quick Reference List of Types Recommended for New Design and Original Equipment; How to Choose a Photosensitive Device; Circuits Device; Circuits Utilizing Amperex Semiconductors; and a full listing of available application reports. The catalog also describes and illustrates the 3 semiconductor manufacturing processes. Send requests on company letterhead to Amperex Electronic Corp., Slatersville, R. I.

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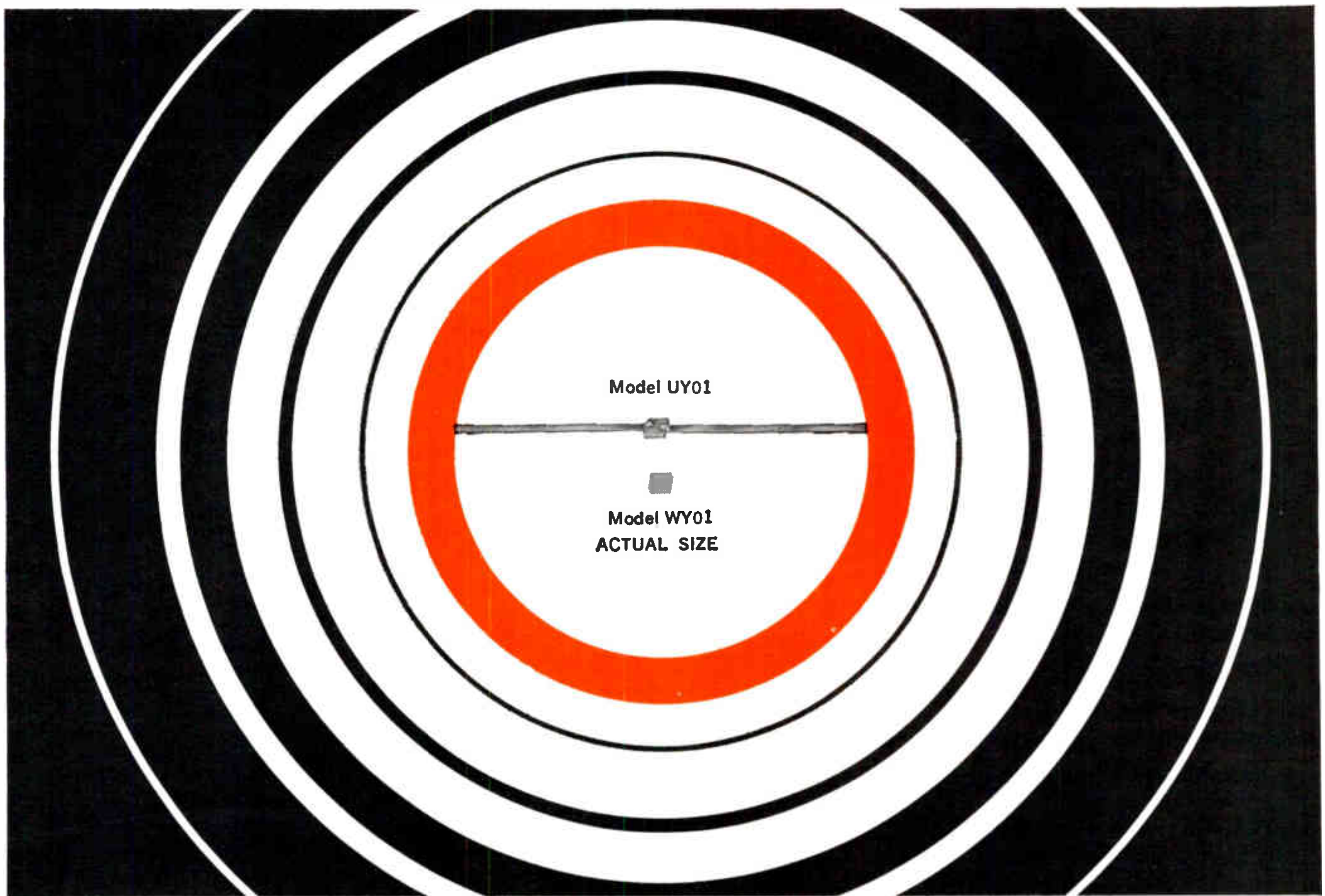

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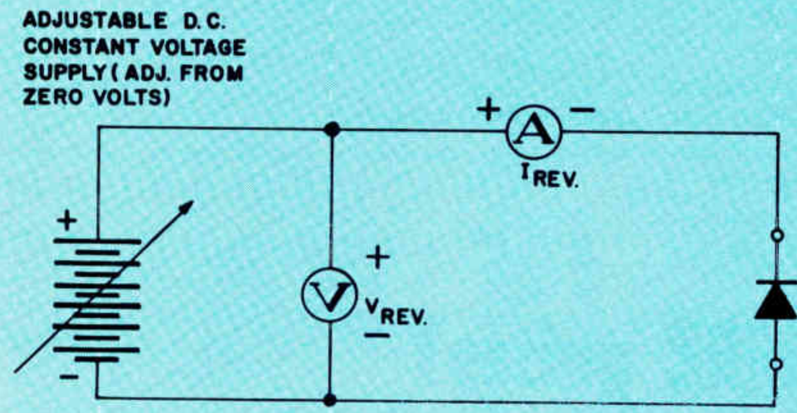
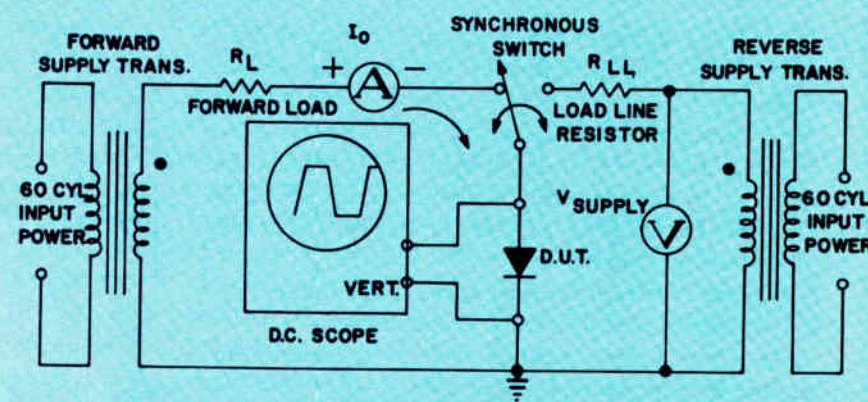


Fig. 6: Final dc reverse voltage blocking test.

Fig. 7: Basic operational load line test circuit.



TESTING RECTIFIERS (Continued)

Operational Load Line Test

The operational load line test method to be described was developed to overcome some of the disadvantages of conventional testing outlined above. The load line testing method uses all operating parameters of the device under test and stresses these parameters to maximum rated conditions. The basic circuit used is shown in Fig. 7. The test conditions are determined by establishing the forward rectified current and operating temperature values, maximum reverse power handling capabilities, and a load line resistor value and reverse supply voltage.

To determine the maximum reverse power handling capability for the devices to be load line tested, a sample of the desired highest voltage units is first subjected to the test circuit shown in Fig. 8. In preparation for this test, heat the diode in an ambient equivalent to the maximum rated operational temperature. For most silicon rectifier diodes this is 175°C. Next, increase the reverse current by means of the constant-current power supply until a maximum stabilized voltage is reached. This is the point where an increase in current would create a rapid decrease of reverse voltage (reverse thermal runaway). In performing this test on axial lead devices, it is important that specific lead lengths from the mounting terminals to the body of the device be maintained, and also that the mass of the mounting terminals be controlled. The reverse power that the device is capable of dissipating is then as follows:

$$P_{reverse} = I_{critical} \times V_{max} \text{ watts,}$$

where, $I_{critical}$ is the reverse current in amps just prior to reverse thermal runaway; and V_{max} is the voltage at $I_{critical}$. The median value of reverse power is taken as the maximum power handling capability for the given device family.

The next step is to calculate the values of test circuit load line resistor and supply voltage. In calculating the value of load line resistor, assume that the wave shape of the reverse voltage is a half sinewave. The maximum power transfer will take place when:

$$R_{RD} = R_{LL};$$

where, R_{RD} = reverse resistance of the rectifier diode; and, R_{LL} = resistance of the load line resistor.

The load line resistor, R_{LL}, can now be calculated by the following formula:

$$R_{LL} = \frac{(0.5\ V_{pk})^2}{P_{reverse}} \text{ ohms.}$$

The reverse power supply half sinewave voltage required under these conditions would be:

$$V_{reverse} = 2V_{pk} \text{ volts;}$$

where, V_{pk} = highest rated voltage limit for the device family under test.

The reverse power supply voltage available in turn determines the power rating needed for the load line resistor, R_{LL}; and

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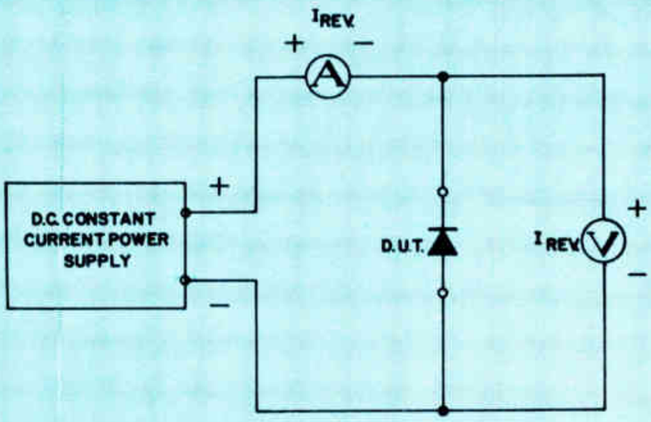


Fig. 8: Reverse power dissipation test circuit.

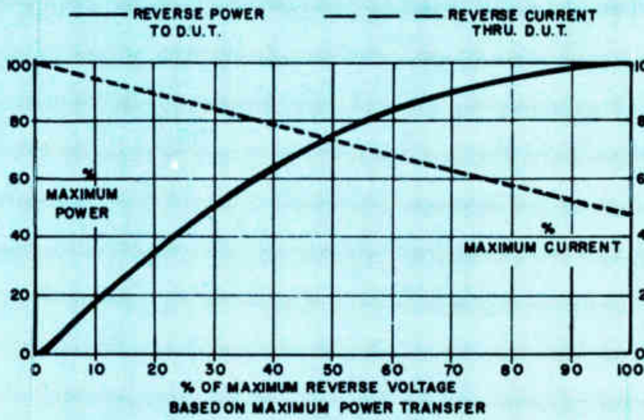
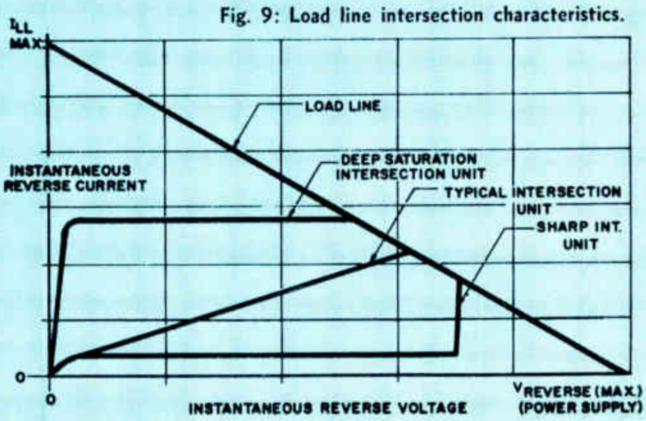


Fig. 10: Reverse power and current relationship for a linear load line resistor having maximum power transfer at 100% reverse voltage.

Fig. 9: Load line intersection characteristics.



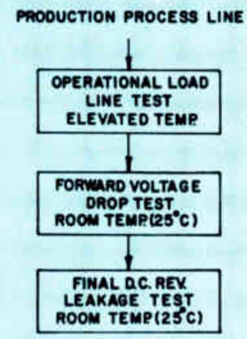


Fig. 11: Operational load line test flow chart.

$$P_{R_{LL}} = \frac{(V_{pk})^2}{R_{LL}} \text{ watts.}$$

Under actual operation, the reverse voltage characteristic of a device under test can intersect the load line under various conditions as shown in Fig. 9. With the load line resistor and reverse supply voltage established, PRV classification can be made on any rectifier diode belonging to the device family. The PRV categories should be established with at least a 20% guard band voltage over and above rated voltage. With this safety factor, rated blocking voltage at room or sub-zero temperatures will be maintained.

Fig. 10 shows the per cent of maximum power transfer for a linear load line resistor versus the per cent of reverse voltage with the maximum power transfer occurring at 100% reverse voltage. Also shown is the reverse leakage current relationship in respect to the per cent of reverse voltage.

When relating the operational load line test results to the normal operational test reverse leakage limits, a square wave of reverse current can be assumed. In this case, the normally specified maximum value of reverse leakage current will be:

$$I_{av} = \tfrac{1}{2} I_{LL};$$

where, I_{av} = full cycle average reverse current under normal half wave operational conditions; and I_{LL} = the value of load line intersection current.

The complete testing program is outlined in Fig. 11. It is economically feasible to have the operational load line test first in the program when the forward voltage drop parameter is well in control in the production process. But, even when a unit with a high forward voltage drop is tested on the load line test, it will simply "slide" down the load line to a point where it may be able to support some reverse voltage. To do this on the normal operational test would mean a catastrophic loss of the unit under test, plus the chance of possible equipment damage.

As indicated in Fig. 11, the actual overall testing steps needed are decreased from a minimum of four in the "time proven" plan shown in Fig. 1, to a maximum of three in the load line method. Advantages of the load line method can be summarized as:

(1) A combination operational and PRV test requiring the handling of a device only once;

(2) A forward voltage drop test after a hot test;

(3) A method of testing that can be readily adapted to high speed automatic testing; and

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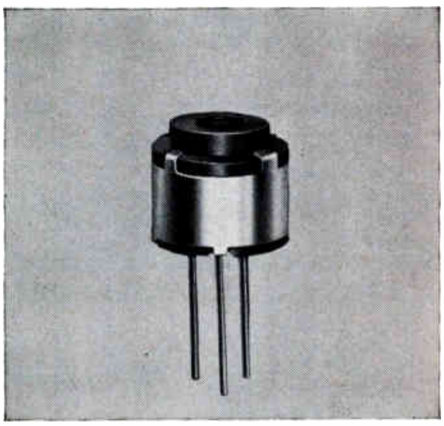

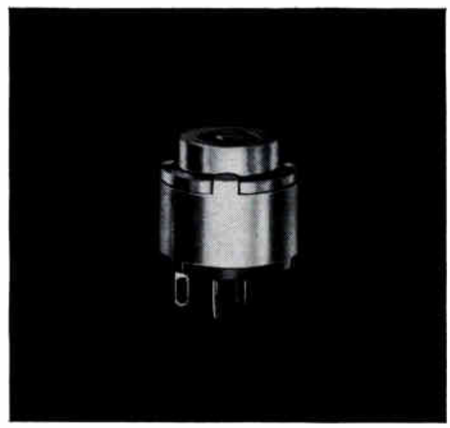

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INTERNATIONAL NEWS

London—Improved TV sets, including color, research microscopes and hearing aids—and even washing machines—were foreshadowed by new electronic "bits and pieces" shown at the Radio and Electronic Component Show at Olympia in May.

High Wycombe, Bucks—A portable uhf wattmeter introduced by Airmec, Ltd. measures the modulation depth of a transmitter's output, as well as the sideband carrier wave power. Range is 10 to 1,000MC power is 10 to 300mw, and 30w with attenuators.

Chelmsford, Essex—A new oscillator modern atomic frequency standard, and with high-stability, is reported by Marconi Co. The device has a variation of 30/millionths per cycle at 100KC.

Glasgow—A laser rangefinder, said to be first commercially available, is being produced in Scotland by Barr & Stroud Ltd. Range resolution is five meters. Maximum range depends on visibility. Fully sealed and dessicated unit uses a Q-switched ruby laser.

Southampton—A symposium of more than 30 papers on applications of micro-electronics will be held at the University of Southampton, September 21-23, 1965. The meeting is sponsored by the University and sections of English engineer associations.

Bolton, Lancashire — British Broadcasting Corp. has engaged EMI Electronics Ltd. to construct a Band III antenna at Winter Hill to improve BBC 1 TV coverage in West Lancashire.

Dublin—Irish International Airlines has begun operation of a fully automated system by The Bunker-Ramo Corp. that keeps track of passenger reservations and available seating.

Paris—New microelectronic division of Marconi Company was formed in time to exhibit a selection of microelectronic components and circuitry at the exhibition at the Salon International des Composants Electroniques.

Paris — M-O Valve Co. Ltd. displayed the "world's largest travelling wave tube (TWC827) specially designed for satellite ground stations" at the international electronic components show at Porte de Versailles. It is rated at 8kw at 6300MC.

Berlin—Telefunken has disclosed its computer RA 800 with 100 post-card size transistor amplifiers, which can amplify the weakest voltages 100 million times without distortion. This analog device is the major part of a moon landing simulator.

Frankfurt—German Study Group on Cybernetics (DAGK) will meet at Kiel from August 31 to September 3 to discuss the state of the art in cybernetics. Papers are being invited on a score of topics and sub-topics.

Munich—According to the German Electronic Trade Exhibition committee the new subtitle for Electronica 1966 is "International Trade Exhibition of Electronic Components and Related Measuring and Production Equipment."

Stuttgart—The array of products at the 1965 German Radio Products Fair (August 27 to September 5) is expected to emphasize "leadership of West Germany in post-war television." With 10 million TV subscribers, the republic says it ranks second in Europe.

Hong Kong—A marketing seminar was held for all far eastern distributors of the RCA International Division in May. Representatives from 13 nations attended the seminar, which focused on semiconductors and communications equipment.

Moscow—A. C. Cossor Ltd. has concluded arrangements with USSR's State Trading Organization V/O Aviaexport to supply 50 systems based on the Cossor SSR.1600 ATC Airborne Transponder for the Soviet Airline Aeroflot and others.

Cape Province, South Africa—South African Air Force has ordered a Precision Approach Radar Simulator (Type SY .2022) from Solartron Electronic Group Ltd., Farnborough, Hants, to be used for air traffic control training.

Montreal — Canadian Marconi Co. announced Radio Elcom Corp. as the new name of its subsidiary, formerly Canadian Marconi (U.S.A.) Inc. The name according to the company suggests the firm's activities in radio, electronics and communications.

Jesselton, Malaysia — An English company of ITT is supplying about $22.4 million in equipment for the SEACOM undersea telephone cable project, part of the British round-the-world telephone cable system. A section linking Hong Kong and Malaysia has been put in operation.

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341 Watertown Street/WO 9-8900
CLIFTON, N. J.—Eastern Radio Corporation
312 Clifton Avenue/471-6600
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BALTIMORE 1, MD.—Radio Electric Service Company
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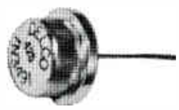

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EDITOR'S NOTEBOOK

ONE-MAN BAND has nothing over this new British development that allows a single technician at a central point to control all equipment of a large radio station. The firm, Marconi Co. Ltd., claims the equipment is so much smaller that costs of installation and maintenance can be reduced greatly. A single control monitor handles the works from line inputs to final radiation.

SOLID-STATE fire detector, called a "major advance in detection of invisible hydrogen gas fires," has been developed by Convair Division of General Dynamics Corp. The device, using an IR heat sensitive system, is in use at Union Carbide's Linde Division to "watch" a liquid hydrogen immersion pump atop a 13,000-gallon hydrogen tank. A portable unit is also available.

DATA ANALYSIS and photointerpretation plus aerial photography will help archeologists find more of America's past. Itek Corporation's Data Analysis Center, near Washington, D. C., will conduct a special photo-interpretation study of aerial photos of ancient Indian remains in the Dakotas. Photos will be in several film types including IR. Itek Center will interpret the photo data for archeological evidence.

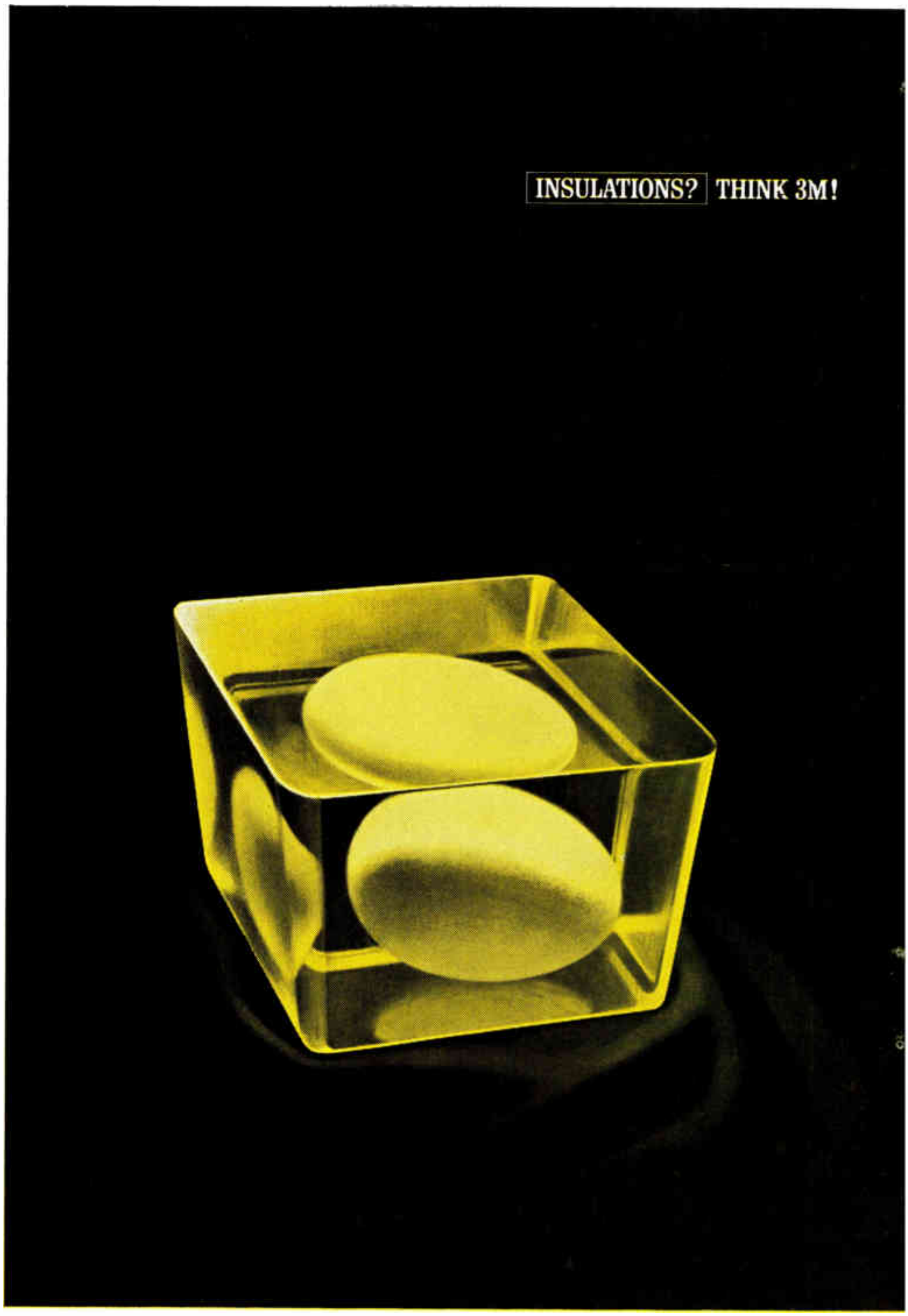
BROADCAST of a single item continuously — an English language recording of a female voice singing something called "Kiss Me, Honey"—had been heard over a wide U. S. area. FCC long-range monitors and direction finders pinpointed the sender in a Middle East nation, apparently trying to jam another station in the same region. Both had been operating on a frequency outside the recognized international hf broadcast band.

DENTAL DATA and billing is now being done by two upstate New York dental offices using telephone circuits provided by General Telephone Co. and tied in with an accounting firm. Nurses once a day dial the firm and insert pre-punched patient data cards in a desk sending unit. The accounting firm receives data at 12 characters a second. The day's billing and accounting functions now take only about 10 minutes and add about an extra hour to nail-filing time.

CENTRALIZED CONTROL of all operations using a digital process system as the "nerve center" is foreseen by Honeywell, Inc., for the brewery of the future. The process would include pushbutton routing of grain and hops, programming of ingredients, weights, temperature cycles, and fermentation control.

HOME-TO-OFFICE data system is helping a Los Angeles stationery supplier minimize his own use of stationery. Atlas Stationers has installed Order-Mation® in homes of its salesmen to reduce administration, and improve customer service by trimming order-delivery cycles from days to hours. Evening orders sent from a salesman's home to Atlas are followed up first thing in the morning. Basis of the system is Bell System's Data-Phone and an IBM card reader

HIGHWAY ELECTRONICS, no longer peculiar to the American scene, is growing in the United Kingdom. The Home Office in London has ordered 50 more Marconi PETA (Portable Electronic Traffic Analyser) systems to augment the 34 already in use around the country.



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BOOKS

Principles of Inverter Circuits

By B. D. Bedford & R. G. Hoft. Published 1964 by John Wiley & Sons, Inc., 605 Third Ave., New York, N.Y. 10016. Price $12.75. 413 pages.

Fundamental principles and techniques of inverter circuits are explained. The authors progress step-by-step from the simplest concepts and circuits to the most advanced methods and uses. Primary concentration is on SCR inverters, and a major portion of the book is devoted to alternate commutating circuits.

Dynamic Circuit Theory

By H. K. Messerle. Published 1965 by Pergamon Press Inc., 44-01 21st St., Long Island City, New York, N. Y. Price $15.00. 657 pages.

Book provides an introduction to the field of electromechanical energy conversion and electromechanical systems. The approach to the field of electromechanical energy conversion is based on an extension of circuit theory. It is introduced with the aid of simple transducers such as solenoids and capacitor microphones, leading up to rotating machines, generalized machine theory and plasma converters. Systems of transducers are also dealt with, covering multiphase systems and control systems.

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Field-Effect Transistors

By Leonce J. Sevin, Jr. Published 1965 by McGraw-Hill Book Co., 330 West 42nd St., New York, N.Y. 10036. Price $10.00. 136 pages.

Book serves as an introduction to the physical theory, electrical characterization, and circuit application of FET's. The presentation of physical theory is based on Maxwell's equations applied to the motion of charged particles in a semiconductor. From this theory a lumped linear electrical model or equivalent circuit is developed and used to describe the electrical interaction between the device and its electrical environment.

The book describes the physical behavior of the FET; discusses the electrical characteristics of field effects important in circuit uses; covers development of the FET as a circuit element in low-level linear, nonlinear, and power circuits; and discusses field effect structures applied to integrated-circuit techniques-including both unipolar and MOS-type field effects.

Principles of Electron Tubes

By James W. Gewartowski and Hugh A. Watson. Published 1965 by D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N.J. Price $18.50. 655 pages.

In this comprehensive study of electron tubes emphasis is placed on the basic principles involved. Complicated and rigorous mathematical analyses are avoided when simpler analyses are possible.

Book begins with a study of electrostatics, magnetostatics and the basic laws of electron motion. It goes on to cathodes, electron guns, lenses, and methods of beam confinement. Normal diodes and grid-controlled tubes are described, and their h-f limitations explored by means of the concept of induced currents. Microwave tubes are analyzed and noise in electron tubes discussed. Also discussed are gas discharge devices including the Townsend discharge in a gas diode, cold-cathode tubes, hot-cathode gas tubes, and gas lasers.

Books Received

Charts & Nomographs for Electronics Technicians & Engineers

By Donald W. Moffat. Published 1965 by Gernsback Library, Inc., 154 West 14th St., New York, N.Y. 10011. Price $5.95. 96 pages.

Television Engineering & Television Electronics—Technical Dictionary In English, German, French and Russian

Edited by Peter Neidhardt. Published 1965 by Pergamon Press Ltd. and distributed by The Macmillan Co., 60 Fifth Ave., New York 11, N.Y. Price $20.00. 340 pages.

The Founder's Touch—The Life of Paul Galvin of Motorola.

By Harry Mark Petrakis. Published 1965 by McGraw-Hill Book Co., 330 West 42nd St., New York, N.Y. Price $4.95. 240 pages.

Fundamentals of Data Processing

By Allan Lytel. Published 1964 by Howard W. Sams & Co., Inc., 4300 West 62nd St., Indianapolis 6, Ind. Price $6.95. 320 pages, paperback.

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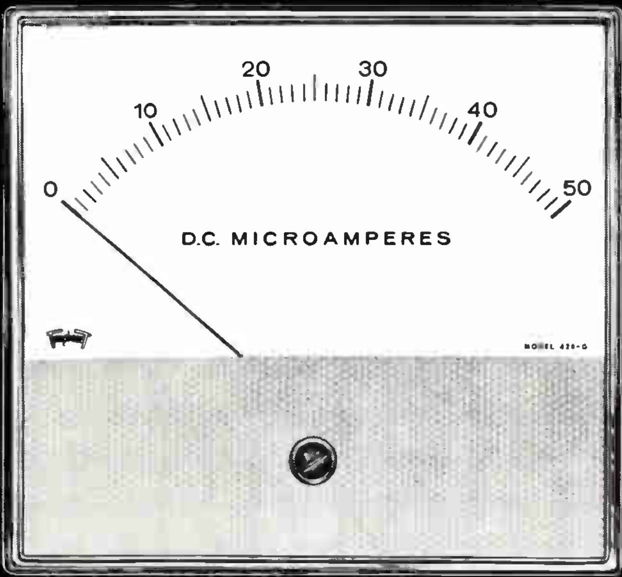

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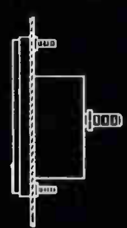

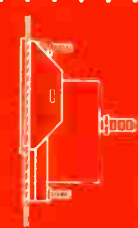

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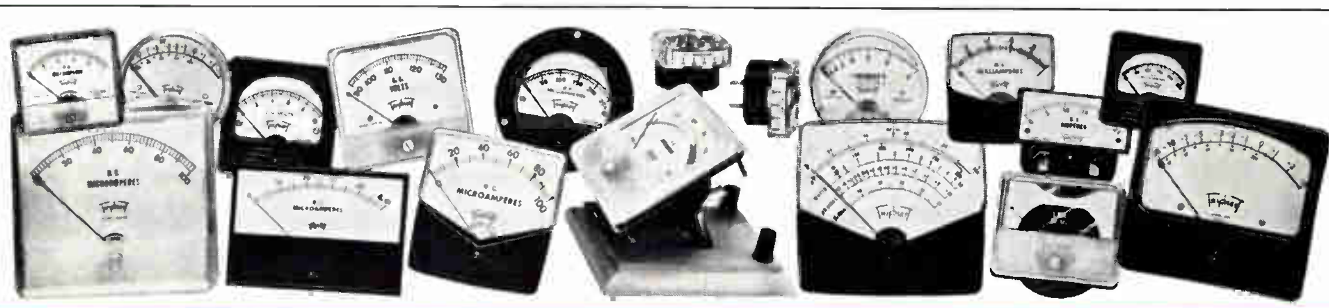

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PROFESSIONAL GUIDELINES

Reporting late developments affecting the employment picture in the Electronic Industries

BARGAINING NOT NEEDED FOR EMCP BENEFITS

Federal engineers do not need union-style collective bargaining for benefits under the Employment - Management Cooperation Program, according to Leonard T. Crook, National Director of the National Society of Professional Engineers.

He reports that the NSPE Professional Engineers in Government section has given assistance in the setting up of 19 local organizations of Federal engineers seeking Government recognition under the program set up by Presidential Executive Order 10988.

According to Mr. Crook, a collective bargaining type of relationship could be avoided altogether by seeking only formal recognition, rather than exclusive recognition.

ENGINEER LAYOFF SURVEY UNDERWAY IN BAY AREA

Unemployment experience of engineers and scientists, laid off by defense-oriented firms in the Bay Area of California, is being surveyed by Dr. R. P. Loomba, associate professor of electrical engineering, San Jose State College, under a grant from the U. S. Department of Labor.

Survey investigators will analyze the impact of recent layoffs on a sampling of 1,250 scientists and engineers laid off by 29 aerospace and electronic firms in 1964. From the results and conclusions of the survey, Dr. Loomba hopes to make recommendations for future manpower policy.

STRONG DEMAND CONTINUES FOR TECHNICAL MANPOWER

Heavy recruiting activity continued in April, indicating a sustained strong demand for engineers and scientists. The Engineer/Scientist Demand Index, maintained by Deutsch & Shea, Inc., of New York, registered 113.0 for April.

This is the second highest figure this year and is 41.8 points above April 1964. Though the Index is down six points from March, Deutsch & Shea indicates that this is seasonal.

COMPUTERS IN THE KINDERGARTEN

George G. Heller, IBM engineer, suggests that children may be able to learn about computers very early. Here Mr. Heller explains elements of System/360 to pre-school children at IBM's Poughkeepsie, N.Y., Laboratory, using candy to explain binary arithmetic.

ENGINEER SURVEY PREVIEWS CHANGES IN EDUCATION

Big changes in engineering teaching may be foreshadowed by some results from a national study of engineering practice and education as related to our future needs.

Based at Purdue, the study is sponsored by the National Science Foundation, under the aegis of the American Society for Engineering Education, and will be completed in 1966. In the undergraduate phase, faculties from 180 engineering schools are being polled plus a cross-section of some 4,000 engineers in industry and government.

One of the points so far is that traditional departmental boundaries in engineering schools should be lowered or eliminated. Future national problems will need solutions from engineers broadly trained in several disciplines.

Despite pressure for more science, and consequent crowding of the student's already heavy schedule, the ASEE review board is studying recommendations for more courses in humanities and social sciences. A report on the survey so far notes in part that engineers will take an increasing responsibility in urban planning and other enterprises for the systems they design. Study in economics, sociology, political science, and others, will be more and more important.

The report also discusses the four-year degree and arguments favoring the five-year degree, owing to the added scientific knowledge required. The report says that the ASEE board reviewed the growing trend toward the graduate program as the professional, or specialized program, with the undergraduate program as the general one. Gist of survey opinions favored keeping the four-year degree as the professional one.

Prominent in curriculum debates is "how to bring the teaching of design back into engineering teaching." Some critics opine that design has become so theoretically oriented as to lose sight of the basic training engineers need.

EJC, BATTELLE SCHEDULE INDEXING/ABSTRACT COURSE

Engineers Joint Council indexing and abstracting course conducted by Battelle Memorial Institute has been scheduled for 14 major cities through March 1966. The first 5-day course opens in Chicago on September 20, 1965. Since April, 1963, nearly 600 persons have completed the course in the U. S., Canada, Sweden, England, France and Switzerland.

FOR MORE INFORMATION . . . on opportunities described in this section fill out the convenient resume form, page 126.

← Circle 53 on Inquiry Card

World Radio History

ELECTRONIC INDUSTRIES Professional Profile

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The ELECTRONIC INDUSTRIES Job Resume Form for Electronic Engineers

Name ______________________ Tel. No. __________

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☐ Single ☐ Married ☐ Citizen ☐ Non-Citizen Date of Birth __________

Will Relocate ☐ Yes ☐ No. If Yes ☐ Another City ☐ Another State

Salary Desired to Change Jobs in present area__________

Salary Desired to Change Jobs and relocate in another area__________

Professional Memberships ______________________

College or University	Major	Degree	Dates

RECENT WORK EXPERIENCE

Company	Div. or Dept.	Title	Dates

SIGNIFICANT EXPERIENCE AND OBJECTIVES

STATE ANY FACTS ABOUT YOURSELF THAT WILL HELP A PROSPECTIVE EMPLOYER EVALUATE YOUR EXPERIENCE AND JOB INTERESTS. INCLUDE SIGNIFICANT ACHIEVEMENTS, PUBLISHED PAPERS, AND CAREER GOALS.

Mail to: ELECTRONIC INDUSTRIES—Professional Profile—56th & Chestnut Sts.—Philadelphia, Pa. 19139. This resume is confidential. A copy will be sent only to those Companies advertising for engineering personnel in this issue, whose number you circle below.

800 801 802 803 804 805 806 807 808 809 810

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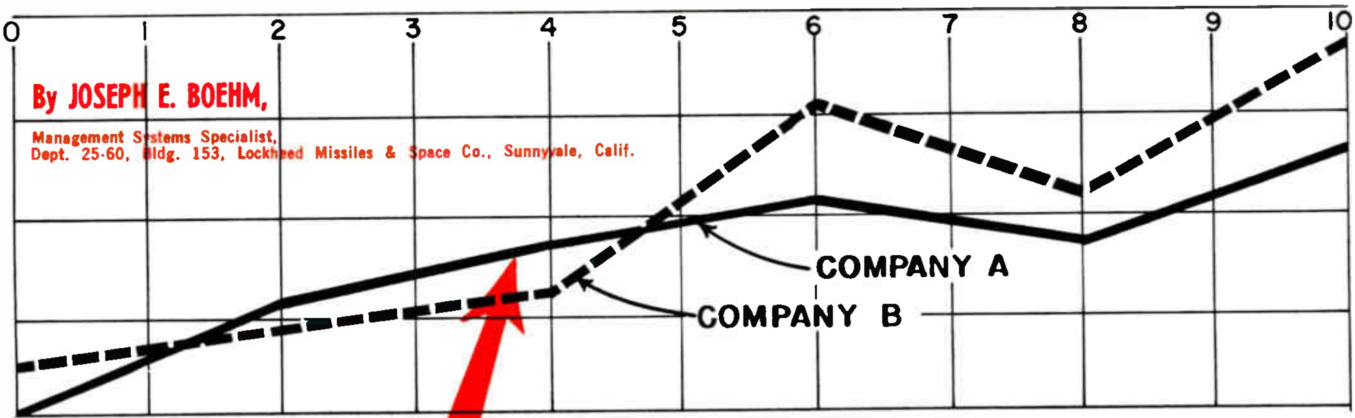


By JOSEPH E. BOEHM,
Management Systems Specialist,
Dept. 25-60, Bldg. 153, Lockheed Missiles & Space Co., Sunnyvale, Calif.

Don't Overlook the Competition

No matter how successful a company is, the competition cannot be minimized.
To do so is to invite catastrophe.
Management must constantly evaluate the competition.
How this may be done effectively is told here.

Reports of record sales and increased earnings are everyday occurrences in today's economy. Business, in general, is good.

However desirable and ideal this climate may be, it can spell trouble. Success breeds complacency. And, management is often lulled into a false sense of security. Results of such an attitude can be catastrophic.

Every company wanting to stay in business and make a profit must continually scrutinize its position in relation to its competitors. Unless management is clairvoyant (and some would have you believe they are), competition cannot be minimized, much less ignored.

Type of Information Needed

Data needed for an effective competitor evaluation includes every aspect of business. Although some types of data are more important than others, intelligence of lesser importance cannot be ignored.

J. E. Boehm

Management must first identify the critical, decision-making areas of the industry. Every industry has distinguishing features; no two industries are alike.

The number of companies that make electronic devices totals several thousands. Range of products made varies from small semiconductors to large-scale computers. And, the size of companies ranges from small, single product manufacturers to large, complex, multi-product organizations.

Despite these complexities, such factors as reliability, cost, miniaturization and operating life of the product are the major considerations common to all elements of the industry in measuring the success of products. These are the critical areas for the electronic industry, and must receive the most attention in competitor analyses.

At the same time less significant factors should not be ruled out. Competing firms require much the same type of technically qualified personnel, marketing outlets and manufacturing processes, peculiar to the products themselves. Where one firm uses a different approach, such differences must be noted and evaluated.

Step by Step Evaluation

FIRST—IDENTIFY THE COMPETITION. Every firm that has been in business for any period of time can usually compile a list of leading competitors in a matter of minutes. But, the examination should not stop there.

Companies which have the capability of, or perhaps already are, making comparable products must also be included.

The organization structure and management ability of each competitor merit thorough investigation and appraisal.

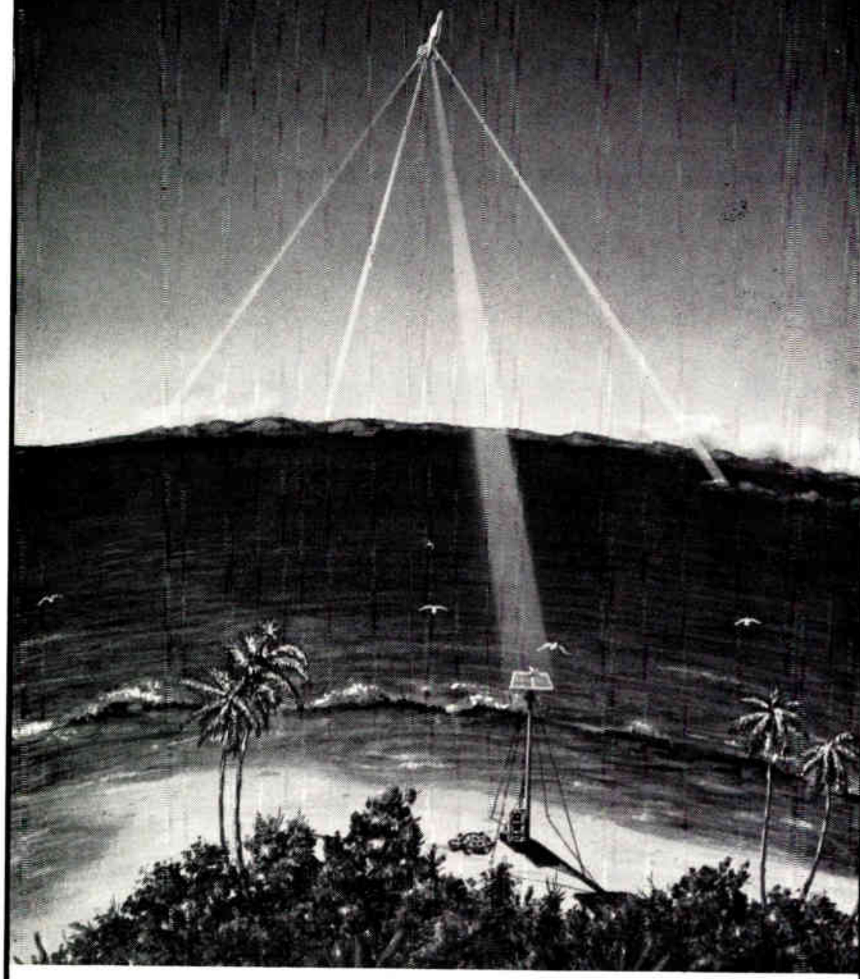
SECOND—LIST THEIR PRODUCTS. Beginning with a tabulation of its own products, an arrangement of competitor products should be made in a similar fashion so that similarities and differences among individual items can be noted.

NEXT—ANALYZE THE CUSTOMERS. The most valuable asset a business can have is the good opinion of its customers. This relationship is a matter of primary concern, for a satisfied customer means repeat business.

(Continued on following page)

World Radio History

TRACKING IN REVERSE



The NASA Marshall Space Flight Center at Huntsville, Alabama, has awarded a new R & D contract to *Motorola's Military Electronics Division Western Center*. It calls for systems engineering and developing equipment for a *new concept* in high-accuracy measurement of spacecraft position and velocity. Using integrated circuitry the tracking equipment is being miniaturized into a small, lightweight package that can be installed in manned or unmanned spacecraft instead of being ground based in large manned complexes. Thus, navigational data will be provided directly to on-board control equipment. Ground stations will consist only of small highly mobile electronic equipment to return signals to the spacecraft from remote, unmanned sites if desired. This AROD (Airborne Ranging Orbital Determination) System is typical of the exciting aerospace programs which offer outstanding opportunities to qualified engineers and scientists at Motorola.

Specific opportunities are:

Antennas & Propagation
Solid State R.F.
Microwave Techniques
Missile & Space Instrumentation
Operational Support
Integrated Circuitry

Equipment Reliability Analysis
Parts Reliability
Data Acquisition, Processing & Display
CW Transponders
Radar & Radar Transponders
Fuzes

Guidance & Navigation
Command & Control
Space Communications
Signal Processing
ECM, CCM & Surveillance
Tracking & Telemetry

Contact Phil Nienstedt, Manager of Recruitment, Department 698

MOTOROLA in PHOENIX

Military Electronics Division • Western Center • P.O. Box 1417, Scottsdale, Arizona

MOTOROLA ALSO OFFERS OPPORTUNITIES AT CHICAGO, ILLINOIS — AN EQUAL OPPORTUNITY EMPLOYER

THE COMPETITION (Continued)

The types of customers and the rapport that exists between competitor firms and consumers should be carefully reviewed and assessed.

THEN—REVIEW DISTRIBUTION METHODS. The nature of the product and type of customers determine methods of distribution. This can be a simple procedure or may involve many complexities.

Methods of distribution can be, and continually are being, streamlined. It is important to be aware of any changes in distribution methods competitors may be instituting.

EXAMINE — EQUIPMENT AND FACILITIES. Antiquated plants and outmoded methods of production are serious impediments when labor saving devices or improved methods can cut costs and speed product availability.

Unused space brought about by over-expansion in facilities creates serious overhead cost problems if not quickly and economically used.

These factors detected among any competitor provide an insight into their overall well-being, and should be closely watched.

ALSO—EVALUATE FINANCIAL AND SALES DATA. The results of a business are reflected in audited financial and sales reports. To be more meaningful, such data must be compared with past performances. A trend is the important consideration. Thus current and historical data covering the past five years' activities of each competitor should be examined.

Inconsistencies in reporting financial and sales data are common in every industry, including electronics. Despite these pitfalls a professional interpretation of competitor reports using such special calculations as ratios, percentages and unit cost is encouraged.

LASTLY—OTHER FACTORS. The broad categories just discussed cover those areas generally found to be most critical in a competitor analysis. But, a variety of other factors remain which should not be disregarded, e.g. advertising, sales promotion, labor relations, community image, etc. Depending upon the circumstances involved any of these items could occupy a commanding position.

The Competitor Questionnaire shown in Fig. 1 covers the seven categories outlined. It poses over 60 questions that should be reviewed while the analysis is being made. Of necessity, product line peculiarities will dictate variations in some areas.

How to Assimilate the Data

A separate matrix should be prepared for each of the seven categories. For example, Fig. 2 shows a format that can be used in analyzing products. Strong and weak points of each commodity should be named and weighed.

A simple rating system can be developed to offer a better means of comparison. Excellent position could equal 10 points; good position, five points; poor, zero points. If possible, a cross-section of customers should be queried. This would lend greater validity to the analysis, and reduce

(*Continued on following page*)

Fig. 1: **COMPETITOR QUESTIONNAIRE**

COMPETITOR FIRMS:

- How many traditional competitors are there? Who are they?
- Have any new firms entered the field?
- How long has each competitor been in business?
- Are any competitors dwindling out, or diversifying from the industry?
- How is each competitor organized?
- What is background of key competitor personnel?
- Are senior executives of any competitor the majority stockholders?
- Which competitors do not belong to industry associations or one rival to your own?

PRODUCT LINE:

- Is your product line as complete as your competitors?
- On which products do competitors principally depend for survival?
- What standard production items can competitors deliver on short notice?
- Does your product line perform better than others?
- How do competitors price their products?
- Are your products priced competitively?
- Do any competitors have advantages due to patent position?
- What products do your competitors have under development?
- What size inventories do competitors maintain?
- Is inventory turnover rate of each competitor better than your own?
- Do competitors make deliveries on schedule?
- Do competitors have same source, availability and cost of raw materials?
- How reliable is service of competitors?

CUSTOMERS:

- What type of customers are your competitors servicing?
- Do any competitors enjoy an edge with customers due to historical relationships?
- Which competitors have a high reputation in specific geographical areas or type of customers?
- Does the management staff of any competitor enjoy close personal relations with any large accounts?
- Which competitors appear to be in disfavor due to poor customer relations or product quality?
- In specific areas what share of the market have competitors enjoyed in the past?
- Is your customer coverage as complete as that of your competitors?

DISTRIBUTION METHODS:

- How do competitors distribute their products?
- Where are field offices and/or distribution outlets set up by each competitor?
- Are competitors distribution centers close to your market?
- Are any competitors setting up distribution outlets where none existed before?
- How strong and dependent are your competitors in foreign markets?
- Which competitors have a high reputation in specific areas?

EQUIPMENT AND FACILITIES:

- What is the plant capacity of each competitor installation? (Consider number, location, square footage, age)
- How much of each competitor's facilities are owned? Leased?
- How much plant capacity has each competitor added in past five years?
- Is plant capacity of each competitor in full use?
- Are competitor plants close to major markets?
- Are competitors building new manufacturing plants in cost or surplus labor areas?
- Does any competitor have facilities or equipment especially constructed to do a specialized job?
- What type of new equipment are competitors buying?

FINANCIAL AND SALES DATA:

- What has been the rate of growth of each competitor?
- What share of your total market has each competitor been capturing?
- If defense oriented, are any competitors making inroads in commercial markets, or vice versa?
- Are the selling costs of any one competitor less than the others?
- What is the return on investment of each competitor?
- How do your competitors finance capital improvements?
- What is current capitalization of each competitor?
- What do competitors spend annually on Research and Development?
- Do any competitors have excess cash available?
- Is backlog of each competitor rising or falling?

OTHER FACTORS:

- Is any rival contemplating mergers or acquisitions?
- How much do your competitors spend on advertising?
- What advertising media do your competitors use?
- Are all companies in your industry unionized?
- Are your fringe benefits comparable to the competition?
- Have any competitors instituted profit-sharing plans to reach the lower employee ranks?
- Are wage scales similar throughout the industry?
- Do any competitors have a high labor turn-over rate?
- What is the community image of your competitors?

World Radio History

HOW TO IMPROVE A SYSTEM'S NOISE FIGURE

– With the Latest TWT Ultra-Low-Noise Amplifiers

Low-noise amplifiers have steadily improved their position as proper devices to increase the sensitivity and range of advanced telemetry, radar, reconnaissance and communications systems. The very lowest figures at S-, C- and X-band are at W-J right now, represented by the WJ-355, the WJ-349-3 and the WJ-345-2. Here is reliability along with a new opportunity for the TWT amplifier to demonstrate its suitability in areas previously dominated by complex devices requiring tuning, adjustments, protective devices and so forth. And W-J's 3500-hour warranty applies.

Ask about W-J's 355, 349 and 345 series TWT low-noise amplifiers. They offer the lowest noise figures available today.

Typical Specifications

	Frequency Range	Noise Figure	Power Output	Gain
WJ-355	2.2 - 2.3 Gc	3.7 db	1 mW	25 db Min.
WJ-349-3	5.4 - 5.9 Gc	4.5 db	1 mW	25 db Min.
WJ-345-2	8.5 - 9.6 Gc	5.5 db	1 mW	25 db Min.

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THE COMPETITION (Concluded)

proprietary prejudices. Points can be shown under each product. Total points would be entered in the last column.

After each of the remaining six categories have been similarly completed, the results should be summarized as in Fig. 3.

Where Data is Found

An abundance of good information is available in technical and trade journals, U. S. Government reports, association news, private research reports, and annual reports.

Technical talks given by engineers and management personnel of competing firms at conventions, seminars and symposiums can provide good intelligence. This is especially true when new products or concepts are being discussed.

District sales offices through daily customer contacts can supply information on competitor pricing schedules, the introduction and performance of new products, and consumer reactions.

Occasional direct contacts of company executives with their counterparts in social, community or professional meetings can result in disclosures of generally reliable data.

Summary

There are many elements which affect the well-being of a company. The competition is only one of these factors. But, it is a major consideration. To neglect or minimize competitor activity at best will restrict growth. To ignore it completely can easily eliminate a firm from business.

Every firm should strive to be the leader in its industry and not a follower. To achieve this, it must be aggressively aware of the environment in which it competes and the forces that restrict its growth.

Have you ever wondered . . . *How much do your competitors know about your company?*

• A REPRINT of ANY ARTICLE in this issue is available from ELECTRONIC INDUSTRIES Reader Service Department.

World Radio History

Fig. 2: COMPETITOR PRODUCT LINE COMPARISON

	PRODUCT #1	PRODUCT #2	PRODUCT #3	PRODUCT #4	PRODUCT #5	POINT TOTAL
YOUR OWN COMPANY						
COMPETITOR A						
COMPETITOR B						
COMPETITOR C						
COMPETITOR D						
COMPETITOR E						

Fig. 3: SUMMARY REVIEW OF COMPETITION

	MANAGEMENT & ORGANIZATION	PRODUCTS	CUSTOMERS	DISTRIBUTION METHODS	EQUIPMENT & FACILITIES	FINANCIAL & SALES PERFORMANCE	OTHER FACTORS	POINT TOTAL
YOUR OWN COMPANY								
COMPETITOR A								
COMPETITOR B								
COMPETITOR C								
COMPETITOR D								
COMPETITOR E								

World Radio History

THIN-FILM/IC COMPUTER

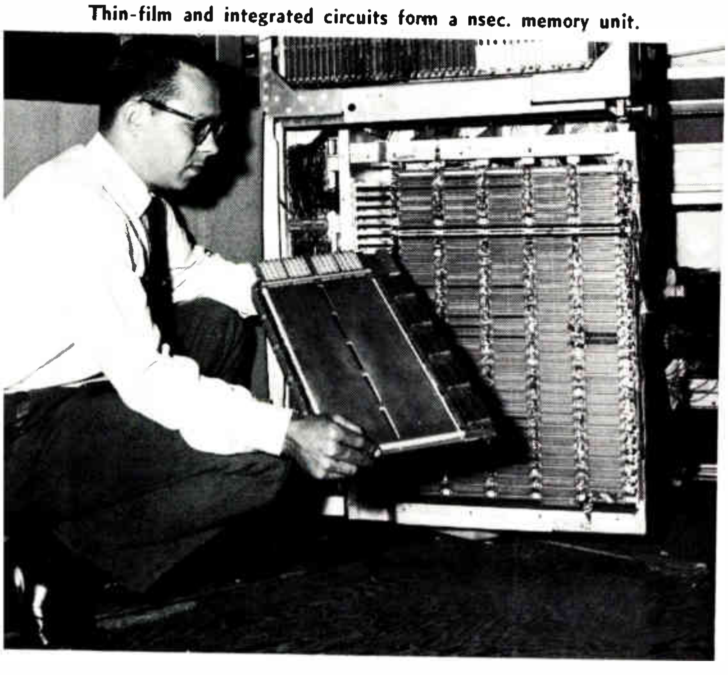
THE B8500 USES INTEGRATED AND THIN-FILM CIRCUITS to achieve an extremely fast and versatile machine.

The Burroughs Computer employs a modular approach. Processor, memory, and I/O modules can be added and begin operation immediately without system interruption. The software, which is also modular, is written to use the equipment available at a given moment in any system configuration.

The system uses multi-programming. Programs are run when all necessary data has been assembled on the high-speed disk file. But while any given program is waiting for additional input from disk, other jobs can be activated. Waiting time is therefore not wasted time. Multi-programming also occurs when programs are shared by more than one user program. During periods of extensive compiling, for instance, two or more compile jobs might be multi-programmed at the same time from a single copy of the compiler in main memory.

Multi-processing, another feature, occurs at many levels in the B8500. I/O operations occur almost independently of the processor module, and in parallel with processor module operations. Multi-processing occurs in multiple processor installations, so that two processor modules almost double the throughput of the system. In addition, its internal organization permits multi-processing within a single processor module and gives more efficient execution of single and multiple programs. Memory processor operations can also occur independently of the other system operations. The B8500's instructions facilitate such operations as list searching.

Thin-film and integrated circuits form a nsec. memory unit.



The computer input/output module is capable of handling up to 512 peripheral devices such as card readers, magnetic tape units, teletype equipment, display devices, etc. The I/O module contains an independent processing capability which minimizes the amount of computer monitoring. One of the primary functions of the I/O module is to automatically enter into high-speed disk files the low-speed data coming from external peripheral devices. The central processor thus services peripheral devices from the high-speed disk file, thereby increasing the total efficiency of the system.

Additional information about the B8500 may be obtained from Burroughs Corp., Communications Svs., Paoli, Penna.

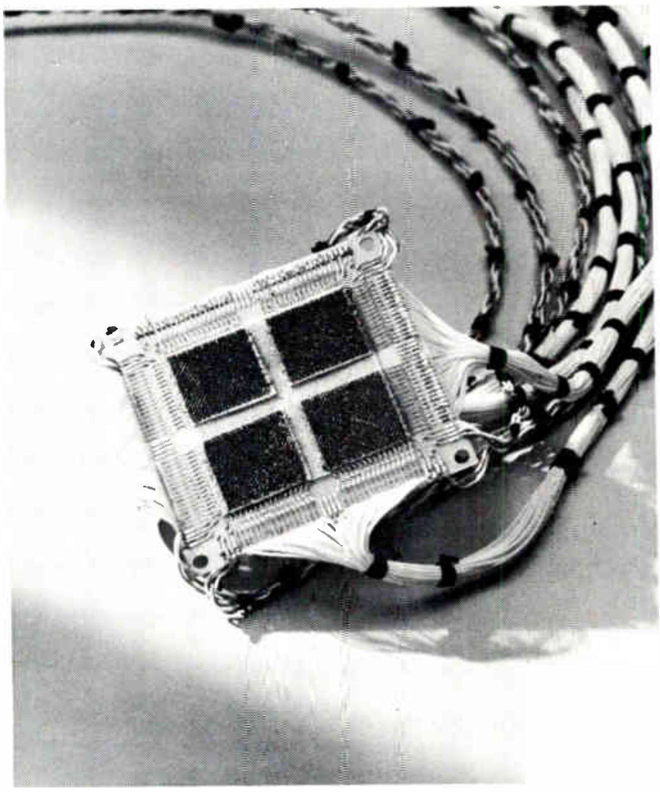
NEW SCALE ESTABLISHED FOR LOW TEMPERATURES

A SIGNIFICANT ADVANCE IN LOW-TEMPERATURE THERMOMETRY has been achieved at the NBS Institute for Basic Standards (U. S. Department of Commerce, Washington, D. C.) with the establishment of a scale of temperature for the region between 4 and 14°K. Based on the acoustical thermometer, this new absolute scale bridges the gap between the lower limit (10°K) of the NBS 1955 Provisional Scale and the temperatures (2-5°K) defined by the T_{58} Helium 4 Vapor Pressure Scale. As a result, NBS is now able to calibrate thermometers for industry at 1° intervals over the range from 2 to 20°K.

For measuring temperatures below 20°K, germanium resistance thermometers are commonly used. Those that are submitted for the new NBS calibration service are compared with standard germanium resistance thermometers of high sensitivity that have been calibrated with reference to the acoustical thermometer. This instrument uses the principle that absolute temperature is proportional to the square of the speed of sound in an ideal gas (a gas at zero pressure). It consists essentially of a resonant (variable path, fixed-frequency sound wave) tube which determines the wavelength and thus the speed. In practice a real gas must be used and consideration given to the effect of pressure. However, the speed of sound is determined at pressures sufficiently low that a plot of speed vs. pressure is linear and can be extrapolated to zero pressure. This procedure eliminates the need for pressure corrections and gives the speed in an ideal gas.

Since the acoustical thermometer is an entirely new approach to precision thermometry, comparison of the scale based on this instrument with overlapping scales gives an independent check of the existing scales.

World Radio History



SINGLE-STACK CORE MEMORY

LOW COST, RUGGED COMPACTNESS, AND HIGH RELIABILITY are features of a new core memory stack from Ampex Corp., Redwood, Calif. Called the INCA (INcremental CApacity), it is intended for business or military data processing systems.

The INCA array functions as a stack in itself. This differs from other memories in that they require more than one array or cores to compose a full memory stack. Each single-array INCA stack is double-sided and can provide up to 8 bits/array in word sizes from 128 through 1024, or as many as 18 bits/array in word sizes of 2048 and 4096. Price of a 4096-word stack is 3½-4¢/bit.

The line is designed to use 50-mil, 30-mil or 22-mil cores, which can provide switching times as fast as 200nsec. All interconnecting circuitry between the matrices is etched directly on the array frame. This permits continuous drive lines, thus reducing the number of standard solder joints by ½ or more. Stack connections have been minimized by making optimum use of the geometry of each array and by a unique PC pattern on the array board.

With INCA only one core stack is needed to form an array.

ELECTRON MICROSCOPE USES SCANNING TECHNIQUE

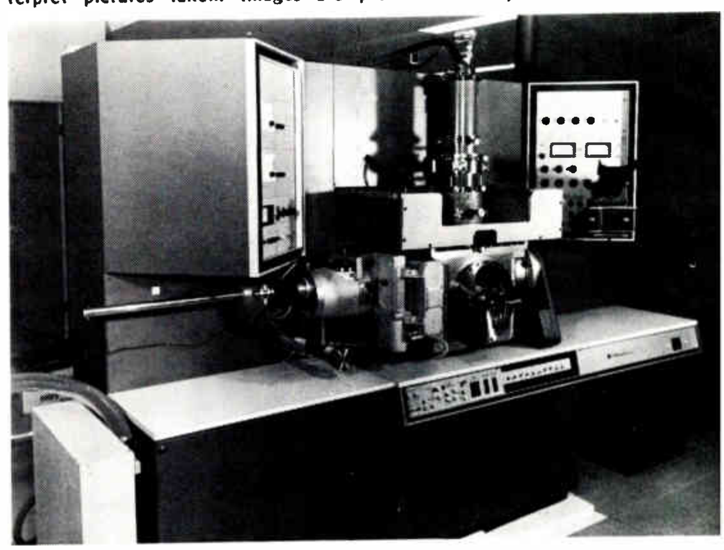
A HIGH-MAGNIFICATION SCANNING ELECTRON MICROSCOPE has been developed which uses TV-type scanning techniques and presents the picture just as the eyes would see it. The instrument offers 3 distinct advantages over other magnification methods: (1) It presents data as an easily understood photographic enlargement of the original; (2) it needs no special sample preparation; and (3) it has a depth of focus so great it can look down the length of a hypodermic needle and photograph the magnified image of the inside of the needle tip.

The instrument contains an electron gun and magnetic lenses that can focus the beam to a spot less than 0.25 micron in dia. Magnification is variable from 40X to 25,000X.

In operation a beam of electrons, accelerated by an applied voltage, is focused with magnetic lenses onto the specimen. Magnetic deflection coils guide the beam repeatedly across the surface of the specimen in a scanning sequence. When the primary electrons strike the surface, they cause the material to emit low-energy secondary electrons in accordance with the nature of the material and the angle of incidence. These secondary electrons are collected and used to control the brilliance of a display cathode-ray tube whose own electron beam is moved in synchronism with the primary beam on the specimen. The display tube then represents an image of the surface topography of the specimen.

According to the manufacturer, Westinghouse Electric Corp., Pittsburgh, Pa., the scanning electron microscope makes the tedious and time-consuming task of sample preparation unnecessary. Samples are manually placed on an accessible platen which is semiautomatically inserted and removed from the high-vacuum chamber without breaking the vacuum in the electron optical column. Once the specimen is in the chamber, it is accurately positioned by means of a mechanical system that permits ±1.000 in. movement in three independent directions.

This microscope needs no specially trained personnel to interpret pictures taken. Images are presented as eyes see them.



World Radio History

Tung-Sol subminiature lamps are available in a wide variety of configurations. More than sixty years of lamp manufacturing experience assures quality and performance of the highest order.

Special Basing and Harnessing. These Tung-Sol services provide numerous advantages to the customer—(1) Eliminates shrinkages resulting from processing operations. (2) Reduces inventories. (3) Conserves production time. (4) Cuts costs.

Describe your application to us for free suggestions about how Tung-Sol can solve your lamp problem at a saving.

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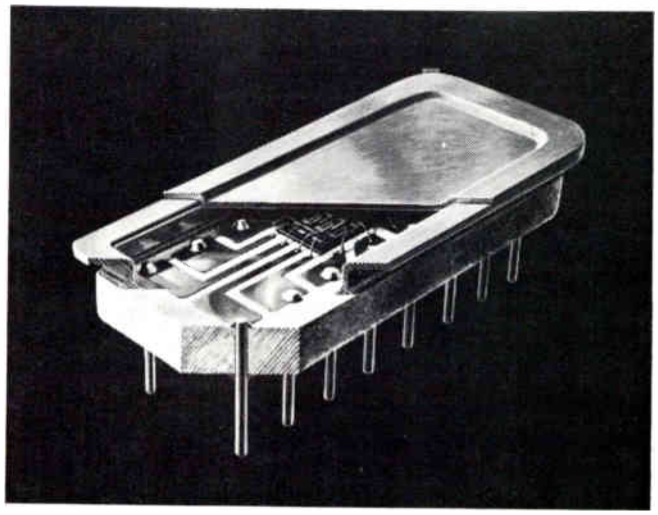
WHAT'S NEW

PLUG-IN FLAT PACKS

A NEW FAMILY OF INTEGRATED-CIRCUIT PACKAGES featuring plug-in pins on a 100-mil grid spacing has been announced by Texas Instruments Incorporated, P.O. Box 5012, Dallas, Tex. The modular family of plug-in flat packs includes units with 10, 16, 24, and 40 pins. The larger packages are designed to accommodate complex logic arrays.

The 16-pin package has two rows of sturdy pins coming out of the bottom, with rows spaced 200 mils apart. The ceramic-to-metal, hermetically sealed version has dimensions of 390 x 890 mils. A subsequent version using other materials will be 290 x 790 mils, but pin spacings will remain the same.

Packages include 10, 16, 24, and 40-pin units



A flange tab is provided as a means of indexing. As an option, customers may specify a missing pin for positive indexing. The packages are adaptable to low-cost assembly techniques, including high-volume manual or automatic insertion, flow and wave soldering, and the use of less-expensive circuit boards with 100-mil grid spacings.

CRYOGENICALLY-COOLED RECEIVER

THIS COMPACT, LIGHTWEIGHT, LOW-NOISE, REMOTELY TUNABLE receiver is designed for use in the transportable ground terminals of the military satellite communication system. The system has an overall noise temperature below 40°K, an overall bandwidth of 50MC, and operates continuously in excess of 2500 hrs. between maintenance periods. Such performance allows the receiving antenna size to be reduced to 15 ft. or less, thus making lightweight, air-transportable terminals practical. (*Continued on page* 136)

World Radio History

BURNDY LABORATORY—MC35 PRINTED CIRCUIT CONNECTORS (35 CONTACTS)

Connectors tested: 172
Hours accumulated per connector: 1500
Connector operating hours (T): 258,000
Contact operating hours (T): 9,030,000
Number of contact failures observed (C): 0
From Poisson distribution for C: 0
and 60% confidence level T: 0.915

connector failure rate $= \lambda \text{ connector} = \frac{\lambda T}{T} = \frac{0.915}{258{,}000} = 0.0000036$

$= \lambda\ 0.36\%/1000 \text{ hrs.}$

contact failure rate $= \lambda \text{ contact} = \frac{\lambda T}{T} = \frac{0.915}{9{,}030{,}000} = 0.00000010$

$= \lambda\ 0.01\%/1000 \text{ hrs.}$

FAILURE: Criteria for failure were open circuits or voltage drop in excess of 30.0 millivolts (45.0 MV after salt spray.)

BURNDY RELIABILITY TESTS ARE RELIABLE (HERE'S ABSOLUTE PROOF)

FIELD CONFIRMATION—MC35 PRINTED CIRCUIT CONNECTORS (35 CONTACTS)

Connectors in operation: 9451
Average number of hours accumulated to date: 1422
Connector operating hours (T): 13,439,322
Contact operating hours: 241,907,800
Number of failures observed (C): 0
From Poisson distribution for C: 0
and 60% confidence level λT: 0.915

connector failure rate $= \lambda \text{ connector} = \frac{\lambda T}{T} = \frac{0.915}{13{,}439{,}322} = 0.000000068$

$= \lambda\ .0068\%/1000 \text{ hrs.}$

contact failure rate $= \lambda \text{ contact} = \frac{\lambda T}{T} = \frac{0.915}{241{,}907{,}800} = 0.0000000038$

$= \lambda\ 0.00038\%/1000 \text{ hrs.}$

Two years ago a large systems manufacturer installed 9,451 Burndy MC35 printed circuit connectors to be used in a naval weapons system.

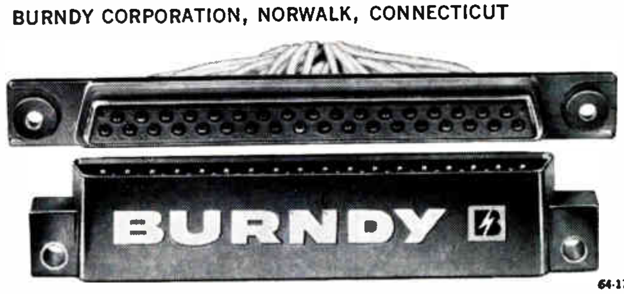
Their engineers reported not a single failure in more than 13 million connector operating hours—not one single contact failure in Burndy printed circuit connectors. In operation, not just the lab. 1422 hours per connector!

Just as Burndy reliability tests predicted, the rate of failure under vibration, varying temperature levels, and other environmental conditions was almost non-existent . . . performance far in excess of field expectations.

The operating performance proves Burndy connectors reliable in every way: millivolt drop, insulation resistance, connector separation force, individual contact separation, crimp-joint strength, capacitance, dielectric strength, resistance to test prod damage. Just as Burndy reliability tests predicted.

The field tests mark our MC35 printed circuit connectors as reliable as we claim. More important—they prove you can rely on Burndy reliability tests.

BURNDY CORPORATION, NORWALK, CONNECTICUT

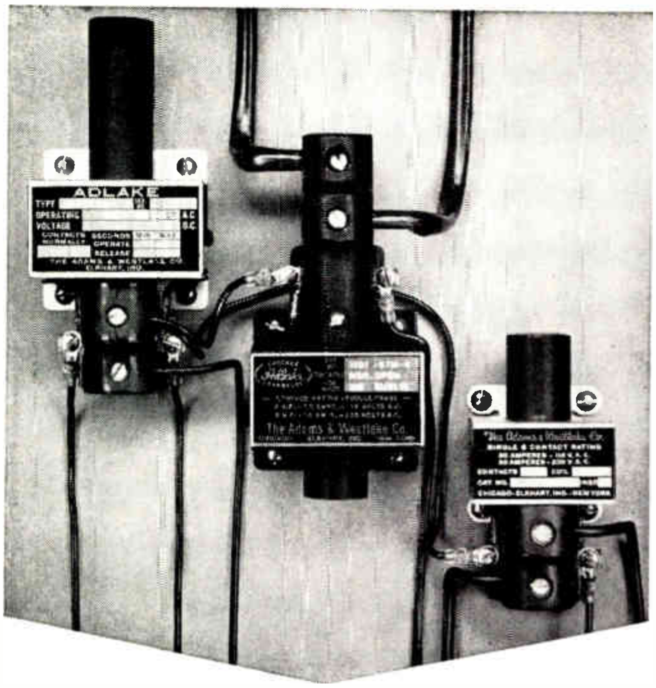


64-17

See more at WESCON Booths 2301-2303

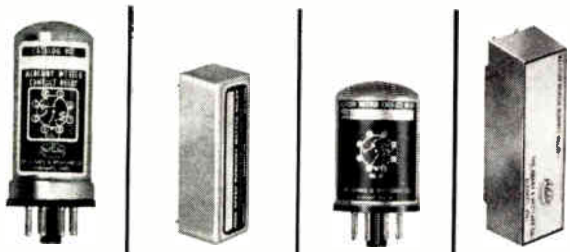
Circle 59 on Inquiry Card

World Radio History



APPLY THESE RELAYS DIRECT

Who needs panels and connectors? Adlake molded (epoxy) head relays fasten directly to the point of application. You save on materials. Because they install faster, production costs are lower. Other advantages include: excellent insulating ability, dimensional stability, proof against flame — and additional Adlake reliability. Available as time delay and quick-acting load relays. **Send for a free catalog.**



Type MW-1600 Mercury Wetted

Type MWSB-16000 Mercury Wetted

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Adlake makes more kinds of mercury relays than anybody.

Adlake® RELAYS

The Adams & Westlake Company, Dept. R-8808, Elkhart, Ind.
Phone Area 219, COngress 4-1141

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Parametric amplifier is tunable over the band by a single dc voltage control (instantaneous bandwidth is about 150mc).

The antenna-mounted portion of this system contains an integrated parametric amplifier/cryogenic refrigerator combination, an automatically stabilized pump source, and a post-receiver consisting of a double-conversion superheterodyne system. This entire unit weighs 70 lbs. and fits in a weather-proof enclosure 21 x 26 x 8 in. The parametric amplifier provides a gain of 30db and an instantaneous bandwidth of 150MC that can be dc-bias tuned over the 7.25-7.75GC band. It operates continuously from 30°K to 340°K without retuning. Thus, the systems remains operational during refrigerator cool-down or in case of refrigerator failure (with the refrigerator off, the overall receiver noise temperature is 260°K). The closed-cycle refrigerator operates at 30°K. This air-cooled unit weighs 30 lbs.

The remote-control portion of this system fits in a standard relay rack panel which is 12 in. high and weighs 30 lbs. It provides meter indication of system voltages, refrigerator temperature, pump level, etc. It also contains the single tuning knob that controls the center frequency of the receiver pass band. The system was built by TRG, subs. of Control Data Corp., Route 110, Melville, N.Y.

HONORARY DEGREE FROM DREXEL

Virgil A. Graham, (left) associate director of the EIA Engineering Department, congratulates Leon Podolsky on receiving an honorary doctorship in science from Drexel Institute in Philadelphia. Mr. Podolsky is chairman of EIA Components Parts Panel and he is also an official and member of the engineering staff of Sprague Electric Co.

World Radio History

MICROELECTRONIC DEVELOPMENTS . . .

First prototypes on seven complex MOS integrated circuits have been produced by General Micro-electronics Inc. for Astrodata Inc., producer of data systems, timing, telemetry instruments and systems. Nature of the circuits and intended use has not been disclosed.

A new line of milliwatt resistor-transistor logic (RTL) integrated circuits, the MC908C series, has been announced by Motorola Semiconductor Products Inc. Operating power requirement of the RTL series is 2.5mw per node. Motorola reports that they can operate from −55°C to +125°C. The MC908G series consists of seven low-power, resistor-transistor logic circuits with a typical propagation delay of 40nsec. per stage.

An integrated Circuit Seminar will be held in the Cambridge Charter House, Cambridge, Mass., Monday, Sept. 13 through Friday, Sept. 17, 1965, sponsored by Integrated Circuit Engineering Corp., Applications, design, reliability and economics of microelectronics will be covered, including silicon molithics, hybrids, compatible hybrids, multichips, flip chips, and thin films. (Box 4388, Philadelphia, Pa. 19118).

New from Whittaker Corp.'s Abacus Div. is an integrated circuit BCD/-Decimal converter or Binary to Octal converter. The IN-12 is an expansion of the Abacus "I" series and contains 12 monolithic integrated circuit NAND gates and gate expanders. Outputs of the converter are at standard logic levels and can drive 12 NAND gates, 10 flip-flops and a 200pf stray capacitance at 4.5MC.

IBM scientists reported advances in integrated circuit techniques. Among these were control over resistor values to plus or minus 4% by precise control of diffused sheet resistance. Techniques for isolation of devices in monolithic circuits included one which gives sharp impurity profile and provides low collector resistance for high-speed units by growing the epitaxy after oxidation and polycrystalline Si growth. Also reported was a process which chemically etches a hole in P-material followed by an epitaxial regrowth technique. Another technique involves use of P-N junction isolation at the bottom of an isolated unit, and oxide isolation on the side walls.

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slip easily over miniature lamps to add color or change color. Made of silicone rubber, they are unbreakable, reuseable, and lightweight. Eliminate inventories of colored lamps; use clear lamps plus colored SILIKROME filters. Consistent uniformity and stability of color even at high temperatures. Impervious to contaminents. No special mounting fittings required.

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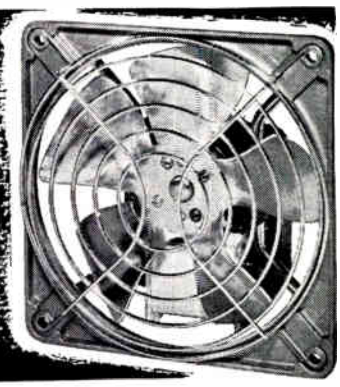

Cyclohm MODEL 8040

DELIVERS 105 CFM. *MOUNTS ON 4⅛" SQUARE*

- Greater output, yet costs less than smaller-capacity competitive units ($10.75 in 1-10 lots, much lower in larger quantities).
- Powered by the Howard Unit Bearing Motor (over four million successful installations).
- *Guaranteed for 5 years to require no maintenance or re-lubrication.*

Write for Bulletin 8040, describing the complete line of Howard Guaranteed-Performance Air Movement Assemblies.

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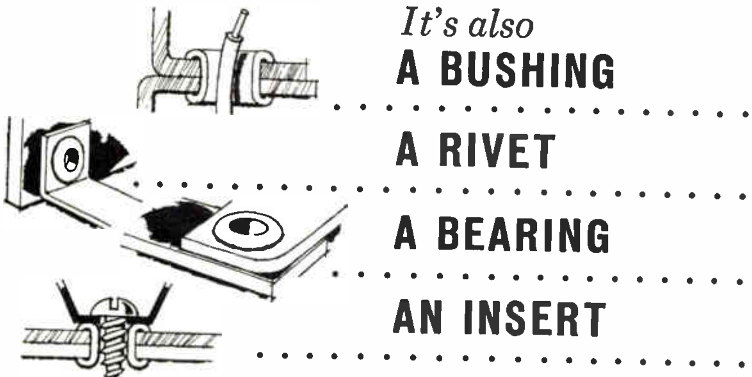
World Radio History

WESTERN UNION, CANADA LINK MICROWAVE NETWORKS

Two transcontinental microwave networks, providing more than 14,500 miles of advanced microwave facilities across the United States and Canada, are now jointed by a 3-station, 112-mile link between Buffalo and Toronto.

Joining of the two radio beam systems paves the way for expansion by Western Union and Canadian National-Canadian Pacific Telecommunications into new and broader areas of communications, using microwave facilities of the 3 companies. Both radio beam systems are capable of handling all forms of advanced communications, including high speed data, facsimile, voice, telegraph and Telex for the general public, business, government and the military.

The Western Union radio beam systems placed in service last November, extends 7500 miles from Boston, New York and Washington to San Francisco and Los Angeles and serves major population centers and defense installations in 23 states.



AND A MONEYSAVER!

You're probably familiar with the advantages of USM Electronic Eyelets for PW board applications. But have you discovered USM *INDUSTRIAL* Standardized Eyelets and their ability to handle all sorts of mechanical jobs in the Electronics Industry . . . and do them faster and better with cost savings up to 50%?

If you haven't investigated USM *INDUSTRIAL* Eyelets, you may be missing important opportunities for smoothing your production flow, reducing your assembly costs, and increasing your profits. It's easy to get the facts. Just send us a note on your letterhead, outlining your operations. You will receive information on a new *INDUSTRIAL* kit of eyelets and hand setting tools. It's ideal for prototype work. If you wish we'll have one of our representatives call and discuss your requirements in detail.

USM Eyelets

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United Shoe Machinery Corporation

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TV HOMEWORK

No cowboys and Indians here. Ten-year-old Wayne Burner tries hand at operating new General Electric Datanet—760 Keyboard Display Terminal. Device will display data stored in GE-235 computer systems. Device also allows changing and updating of data in the computer from the unit's keyboard.

'EARTH SCIENCES' UNIT SEEN IN PROPOSED AGENCY UNION

Development of a comprehensive "earth sciences" agency is foreseen with a proposed U. S. Environmental Science Services Administration (ESSA). This new agency would result from the merger of the Weather Bureau and Coast and Geodetic Survey, both of the Commerce Department. If Congress approves the merger, then the Central Propagation Laboratory of the National Bureau of Standards also would be transferred to ESSA.

Some observers foresee this agency as possiby paralleling NASA in President Johnson's "Great Society." ESSA's activities could include space programs of the Weather Bureau, plus atmospheric sciences, weather modification, earthquakes, air and water pollution, and possibly, oceanography.

MEDICAL COMPUTER

A digital computer that speeds up biomedical research is now in use at the University of Washington's School of Medicine in Seattle. Used by the school's Dept. of Physiology and Biophysics, the Raytheon 440 computer is part of a real-time biomedical data acquisition and processing system. The 440, according to Dr. Allen Scher, professor of physiology and biophysics, will help develop special programming languages and computer commands for general use in biomedical data acquisition, editing and computation.

World Radio History

Best long distance visual display now competitively priced

$19.00 EACH IN QUANTITY 2" HIGH NUMERALS

Bright, long-life National Readout Tube* displays provide best readability over longer viewing distances. National Readout Tubes can be designed into lightweight, compact displays. More for your money too. National's standards for high quality are retained, while quantity prices save you big money over all other visual displays on the market. Request full technical data and prices today!

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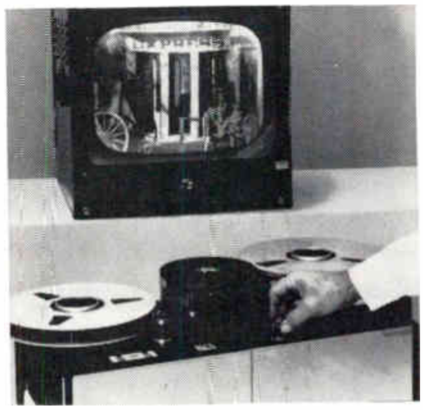
VARI-PLAYBACK TV TAPER



Precision Instrument PI-4V TV recorder features StopScan and VariScan, single controls which allow playback at stop-motion, or slow motion at any speed up to original recorded speed. First 23 of the 75-lb devices have gone to the Air Force for instructor training.

NASA BUYS 'LARGEST' HYBRID COMPUTING SYSTEM

NASA has purchased the "largest hybrid computing system ever developed," reports Electronic Associates Inc. The $1.7 million system will be used to simulate critical docking maneuvers for project Apollo.

The new computing "giant" is an EAI Hybrid System, consisting of two EAI 8800 (Analog/Hybrid) and one 8400 (Digital) Scientific Computing Systems. The complete system is scheduled for installation at the NASA Computation and Analysis Division in Houston, Tex., by March 1966.

AM NEEDED ON TUNERS

Sherril Taylor, vice president for radio of the National Association of Broadcasters, urges hi-fi and stereo equipment makers to include AM radio on all-solid-state tuners. He said that this would make their products more marketable. Mr. Taylor said that "to create new markets and new customers" a product must be made more appealing. AM radio can provide an "added incentive" for market expansion."

INSTRUMENTS FOR APOLLO

Display instruments using the newest light source will be developed by Sylvania Electric Products, Inc., to help Apollo astronauts to a safe landing on the moon. The electroluminescent (EL) instruments will consist of five numerical digits displayed on a 2 x 4-inch flat surface. The numbers will indicate changes in the speed at which the moon craft is traveling.

WHAT'S NEW in OPERATIONAL AMPLIFIERS at BURR-BROWN?

PLENTY!

1. **NEW FET MODULE SERIES**
New FET amplifiers offering wide bandwidth, low noise, low input capacitance, extremely high and extremely stable input resistance . . . in 1.8" x 1.2" x 0.6" and 1.0" x 1.0" x 0.7" packages.
2. **NEW FET CHOPPER-STABILIZED UNIT**
Model 1608A provides improved low drift performance for applications requiring maximum stability.
3. **NEW POWER AMPLIFIER**
A second-generation all-silicon power booster, Model 1634A designed to increase operational amplifier output current capability.
4. **NEW TRANSDUCER AMPLIFIER**
A new higher-output differential DC amplifier specifically designed for transducer applications.
5. **NEW FUNCTIONAL MODULES**
Sample and hold, multiplier/divider, log converters and other new functional modules in rack mounting packages . . . up to 16 modules per 3½" x 19" rack space.

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CDS-5 (To-5)

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CDS-7

top performance

CDS-9

POWERMASTER PHOTOCELLS

Outstanding construction and design of Pioneer Photocells assure long-life and top performance. New heavy base (.080) allows compression glass to metal seal on leads, eliminates danger of air leakage and cell deterioration.

Available in one inch, half inch and To-5 sizes over a wide sensitivity range.

Consult us on special applications of photo sensitive layers.

Photocells pictured are actual size.

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DOUBLE SUN POWER

Reflected sun from V-ridge concentrators matches glitter of spinning prop powered by solar energy. Jack Tallent, Boeing Company aerospace engineer, holds small section of concentrating solar cell unit of several V-ridge concentrators, which are thin aluminum panels with solar cells in valleys and highly reflective aluminum on 60°-slopes to bounce extra sunlight onto cells. This unit, being developed for spacecraft, generates 2 watts.

TAPE RECORDER POWERED BY CELL, BUILT-IN CHARGER

A new cordless tape recorder with a built-in power cell and recharger has been announced by the V-M Corp., Benton Harbor, Mich.

The book-size recorder is the first to incorporate a completely self-contained nickel cadmium power cell and recharger, according to V-M. The 5 lb. instrument will record or playback up to four hours anywhere, indoors or out, on a single charge.

The six-transistor recorder can be recharged hundreds of times at an ordinary ac outlet. It will also run on ac, recharging itself at the same time. The Charger can even be operated and recharged on the current from an auto cigarette lighter socket.

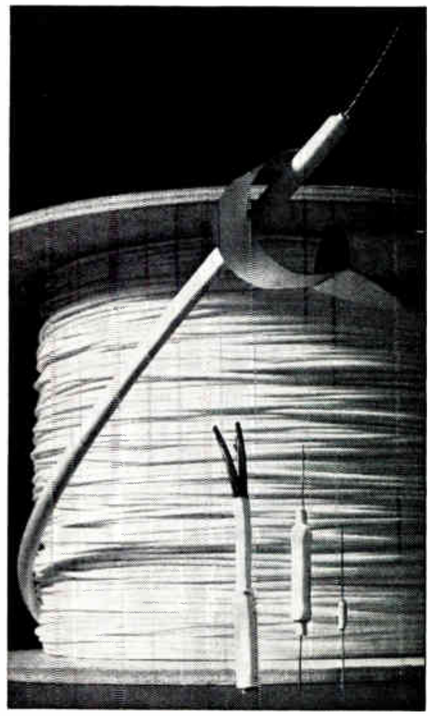
EIA REPORTS 1965 YEARBOOK FOR SALE AT HOME OFFICE

The Electronic Industries Association's Yearbook—"the most complete and authoritative reference to the economic state of all product segments of the electronic industries"—is on sale at EIA's headquarters in Washington, D. C.

Prepared by staff economists and statisticians of the EIA Marketing Services Department, the publication reviews in detail the condition of all major electronics markets during 1964 and the 40-year statistical history of the electronic industry.

INSULTITE

heat-shrinkable tubing



first of the INSULRAD family of irradiated polyolefins from E.C.C.

Now there's an important new source of heat-shrinkable tubing–INSULTITE from Electronized Chemicals Corporation.

INSULTITE meets competitive heat-shrinkable tubing requirements spec for spec—*outperforms* other shrinkables in volume resistivity, longitudinal change, water absorption, and resistance to solvents.

INSULTITE is the answer wherever skin-tight packaging or encapsulating covers are needed. Apply heat: INSULTITE molds itself around smooth or irregular shapes to form a tight protective jacket.

INSULTITE is available in standard colors and sizes and is supplied in four-foot or specified lengths.... all competitively priced and available now. For more information on this new product, write, wire or call Electronized Chemicals Corporation, Burlington, Massachusetts. Telephone 617-272-2850.

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DESK-SIZED, ALL SOLID-STATE ACCOUNTING SYSTEM SERIES

National Cash Register Co. has unveiled a new addition to its 395 family of solid-state accounting systems.

Called the 395-300, the new desk-size business system is said to provide the decision-making performance and speed of a small computer while keeping the economy of a conventional mechanical accounting machine.

Like the rest of the 395 family, the new series uses computer addresses and instructions, and has a magnetic disc memory. It provides 20 or 40 totals, giving users of the 395 system a choice of 20, 40, 80, or 120 electronic totals among the machines available. Each total is stored as a 14-digit word and can be accessed at the rate of 29 times a second.

ZENITH READY TO PRODUCE DECODERS FOR PAY-TV

Following FCC approval of a 3-year extension of the Hartford, Conn., subscription TV test, Zenith Radio Corp. disclosed that it is preparing to produce the Phonevision™ Decoders required to meet the expansion plans announced for the operation by RKO General.

Joseph S. Wright, Zenith president, said that his company will begin quantity production of the additional home set decoders to be installed on new subscribers' sets to unscramble the over-the-air subscription TV programs and provide convenient billing records.

Shipment of the units, which incorporate further technical improvements are slated for early August.

NEW SYSTEM PROCESSES CHROMATOGRAPH DATA

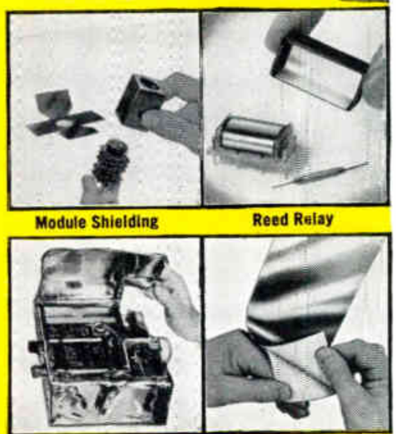
The new Infotronics CRS-40 is an "advanced performance magnetic tape data collection and processing system for analytical chemistry." Where several chromatographs are in operation, the CRS-40 system provides important efficiencies and economies through the use of a single integrated and printout function for the total data output of all the chromatographs, according to experts at Infotronics Corp.

The system incorporates two major sub-systems: one or more portable magnetic tape recorders (CRS-40R); a central tape playback-process system (CRS-40P). Data can be collected from tape recorders at analyzers in several locations.

JUST CUT TO PATTERN

Netic & Co-Netic Magnetic Shields

HAND FORM IN SECONDS



Module Shielding

Reed Relay

Wein Bridge Oscillator

Peelback Adhesive Foil

A great convenience to design engineers, packaging engineers, R/D, etc. A fast inexpensive empirical tool to determine and shield the necessary components of systems. Use multiple layers if needed. Thicknesses from .002". Also widely used in automated or manual production line techniques.

Netic attenuates high intensity fields, Co-Netic low intensity fields. Permanently Pre-Annealed. Not affected by bending, vibration or shock. Minimum retentivity. Increases systems reliability.

MAGNETIC SHIELD DIVISION

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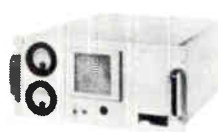
UNITRON INCORPORATED

28 VDC to 60 CPS

STATIC INVERTERS

SINE WAVE

PS 65-178B
250 VA



PS 63-81A
1.0 KVA

PS 64-154
3.6 KVA

Unitron's all solid state static inverters can offer reliable standard 115 volts 60 cps sine wave power for your airborne and air-transportable systems. These units feature proven performance • high efficiency • long maintenance free operation • voltage regulation • short circuit and overload protection • low distortion • RFI protection. These units are designed to meet all applicable military specifications. Excellent application is found in requirements for 60 cps recorders, teletypewriters, crypto machines, laboratory equipment, cameras, etc.

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Try These Two New Additions To Your

JUST RELEASED

INTRODUCTION TO EDP

TEACH YOURSELF...

- The role of computers in business organizations.
- The computer as a problem-solving tool.
- Elements in computer programming.
- Symbolic and machine language concepts.
- The computer's central processor.
- System flowcharts—input and output format.
- Hardware and software concepts.

READING & EVALUATING FINANCIAL REPORTS

LEARN HOW TO...

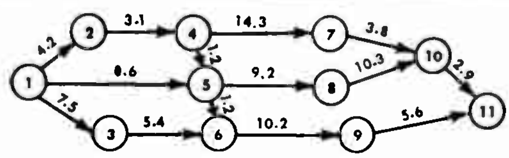
- Read and understand income statements and balance sheets
- Identify critical items and trends
- Evaluate the strength of your company
- Compare stocks for investment.
- Conduct professional ratio-analyses.

TEST YOUR SKILLS IN THESE ELECTRONICS GROWTH AREAS

Engineers and technicians at General Electric, North American Aviation, ITT, General Dynamics, Raytheon, Philco, Douglas Aircraft, Continental Device, Automatic Electric, and other leading companies have selected 7 initial subjects in these areas for their own personal development.

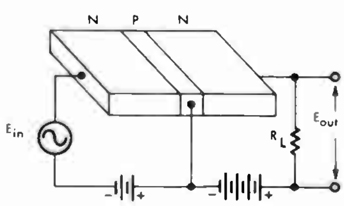
Test **your** knowledge of these fundamental subjects. Here are some sample questions from comprehensive examinations being used in the electronics industry to measure performance in these areas. Try them yourself.

PERT



12. Examine the network you have just constructed.
    - (a) Identify the critical path by giving the sequence of events along the path: ______________.
    - (b) Give the T_E which you calculated for the ending event of the network ________ weeks
    - (c) It is now reported that activity 6-9 cannot be completed in less than 11.8 weeks. Will it still be possible to meet T_L? ☐ yes ☐ no
    - (d) If the changes mentioned in (c) above would make it impossible to plan completion of the project by the time the allotted span has run out, what can he do to replan so that he does meet the schedule?

INTRODUCTION TO TRANSISTORS

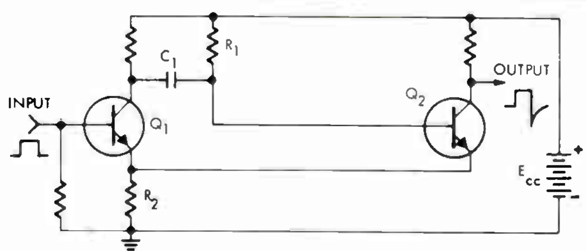


29.

- (a) The NPN transistor circuit illustrated above operates as a(n) ______________.
- (b) With reference to the circuit shown above, MATCH the items below on the left with those on the right by placing one letter in each blank:

A. base-collector junction	1.___high impedance
B. emitter-base junction	2.___input impedance
	3.___low impedance
	4.___output impedance

BASIC TRANSISTOR CIRCUITS



27.

- (a) The schematic diagram above shows an emitter-coupled one-shot ______________.
- (b) In the stable state Q_1 is ☐ on ☐ off and Q_2 is ☐ on ☐ off.
- (c) The positive pulse turns on Q_1 which in turn: ☐ cuts off Q_2 ☐ turns on Q_2.
- (d) When C_1 discharges, Q_2 is: ☐ cut off ☐ turned on.
- (e) When Q_2 conducts, drawing current through R_2, Q_1 becomes ______________ biased.

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World Radio History

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For example, when engineering members of the American Materials Handling Society took the PERT program at home in their spare time, they averaged 12.2 hours to complete the program and scored 90.1% on the final exam. Here is their individual performance data:

Job Title	Fore-man	Ops. Mgr.	Proj. Eng.	Supervisor		Pers. Mgr.	Chief Eng.	Traffic Mgr.
Education	H.S.	B.S.	M.S.	H.S.	H.S.	B.A.	B.S.	B.S.
Time (hrs.)	11.3	10.5	9.4	13.3	19.0	13.8	11.3	9.5
Age (yrs.)	36	22	44	48	52	47	47	50
Score (%)	94	97	97	94	92	87	80	79

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BASIC SYSTEMS INCORPORATED 880 THIRD AVENUE/NEW YORK, N.Y.

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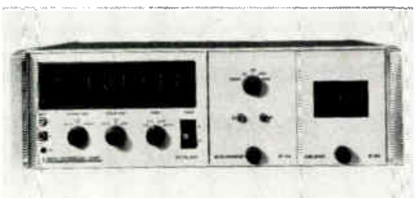
At WESCON

DIGITAL MULTIMETER

The DVX-315 integrating digital multimeter measures ac and dc voltages, resistances, ratio, and freq. to 1MC. It computes true engineering units, zero offset corrections, scale factor corrections, hi-lo comparisons, and go or no-go's. Linearity is ±0.001%. Common-mode rejection (ac) is 140db. Data Technology. BOOTH 4519.

Circle 298 on Inquiry Card



COAXIAL ATTENUATORS

These coaxial attenuators use high-precision metalized resistive elements to obtain a VSWR of <1.25:1 to 2.5GC. All values of attenuation from 1, 2, 3 and up to 60db are available. I-TEL, Inc., BOOTH 1119.

Circle 299 on Inquiry Card

ROTARY SWITCH

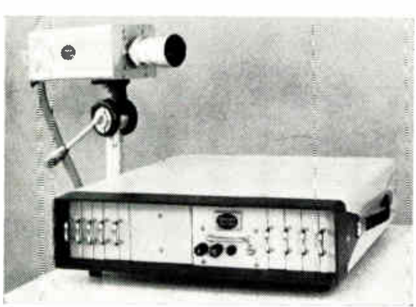
The electro reed-type rotary switch provides high-reliability and long-life switching for video, audio, r-f switching, and data processing uses. It is rated at 15v-a for ac and 10w., dc. Life expectancy is 2 million operations. Electro Switch Corp. BOOTH 1204.

Circle 300 on Inquiry Card

CLOSED-CIRCUIT TV

Series V1000 system uses a 30MC video bandwidth to attain resolution of 800 lines in both vertical and horizontal directions. System enables broad scenes to be viewed whole and in considerable detail by a single fixed camera. For example, an entire 8½ x 11 in. typewritten page can be presented in a single readable image. Granger Assoc. BOOTHS 1802-03.

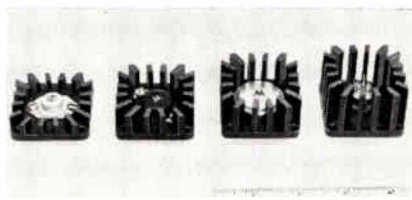
Circle 301 on Inquiry Card



HEAT SINKS

Series 680 heat sinks provide optimum natural convection cooling/unit volume of space occupied above the circuit board. The effective and unusual fin design permits free circulation of air from any direction which permits mounting of the heat sink in any position. It accepts all popular transistors. Wakefield Engineering. BOOTH 614.

Circle 302 on Inquiry Card



KEYED BUSHING

This keyed bushing provides low cost insulation for standard BNC male connectors. Keyed to both panel and connector, the bushing cannot be accidentally rotated. No panel punches are needed. Milton Ross Co. BOOTH 1508.

Circle 303 on Inquiry Card

RESONANT REED DECODER

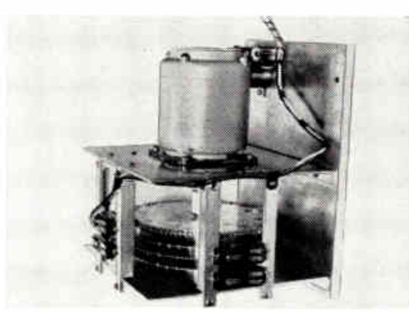
The MD5C 5-channel resonant reed decoder performs 5 separate remote switching functions. The multi-channel narrow band audio freq. has 2, 3, 4 or 5 channels; freq. range: 200 to 600 CPS. Bramco Controls Div., Ledex. BOOTHS 2205-06.

Circle 304 on Inquiry Card

STEPPING PROGRAMMER

Model 189 is well suited to complex sequencing or programming uses. This electro-mechanical timer controls up to 99 circuits and offers 100 discreet cam positions. Its switches are tripped in a preset sequence by easily removable program pins. Switch contacts are rated at 15a. @ 120vac. Eagle Signal Div., E. W. Bliss. BOOTH 1021.

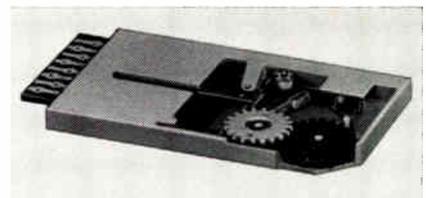
Circle 305 on Inquiry Card



COUNT/CONTROL SYSTEM

The Uniprint module fulfills the need for design in count/control systems where a printed readout is necessary. Counting speed is 50/sec. Printed figure size is 0.14 x 0.09 x 0.15 in. line thickness. Max. impact force is 0.05 lbs; impact time is 10msec. Count life is 100 million counts; minimum print life is 10 million prints. Durant Mfg. Co. BOOTHS 1910-11.

Circle 306 on Inquiry Card



MICROCIRCUITRY COIL

The new Doroidal Coil P/N 3641 is a microminiature coil available in 36 overlapping inductance ranges from 0.12μh-100μh. It measures 0.2 x 0.25 in. and provides freqs. attainable by toroids. Cambridge Thermionic Corp. BOOTH 2404.

Circle 307 on Inquiry Card

VARIABLE ATTENUATOR

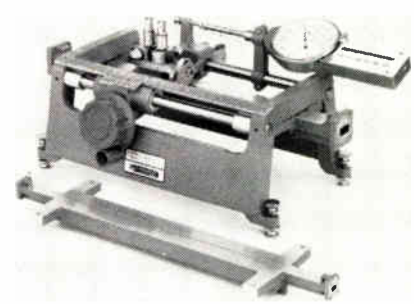
With the Model 3952-90 full attenuation is reached in less than 1 turn, and may be easily read from a directly calibrated dial in attenuation db. Freq. range is 1-2GC; min. atten. range is 90db dynamic; and max. ins. loss is 5.0db. Arra Inc. BOOTH 1819.

Circle 308 on Inquiry Card

PHASE METERS

Model P301B covers 12.4GC to 40GC. It is used for standards labs where precise measurement capability is needed over a large band of freqs. The range 12.4GC to 40GC is covered with 3 interchangeable waveguide slotted sections 2 of which, the P-band covering 12.4GC to 18GC. and the R-band covering 26GC to 40GC, are shown. Wiltron Co. BOOTH 4213-14.

Circle 309 on Inquiry Card



World Radio History

PERMANENT MAGNETS: Cast Alnico, Sintered Alnico and Ceramic Magnets (Arnox). MAGNETIC CORES: Silectron-C Cores and Distributed Gap Cores. Tape Wound Cores of Deltmax, Supermalloy, Permalloy, Supermendur and Silectron. POWDER CORES: MO-Permalloy Powder Cores, Iron Powder Cores and MSS Iron Powder Cores. TRANSFORMER LAMINATIONS AND HARDWARE: Nickel-Iron, Silicon-Steel Laminations, Transformer Cans and Hardware, Tube Shields. SPECIAL MAGNETIC MATERIALS: Vicalloy, Permendur and Vibralloy.

And they are all precision engineered. The Arnold engineering facilities are among the world's largest and most complete, devoted exclusively to helping solve your magnetic device problems.

In addition, Arnold is a prime source for precision metal rolling . . . ferrous and non-ferrous strip, close tolerances and ultra-thin gauges . . .

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Circle 73 on Inquiry Card

World Radio History

ELECTRONIC INDUSTRIES

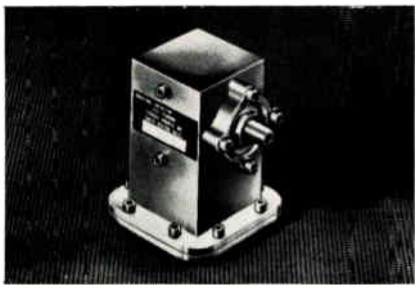
NEW PRODUCTS

At WESCON . . .

VIBRATING CAPACITOR

This vibrating capacitor varies its capacitance in a sinusoidal manner for the purpose of modulating a dc signal. It measures currents as low as 10^{-16}a. Drift is 0.1mv max./24 hrs., noncumulative. Stevens-Arnold, Inc. BOOTH 2816.

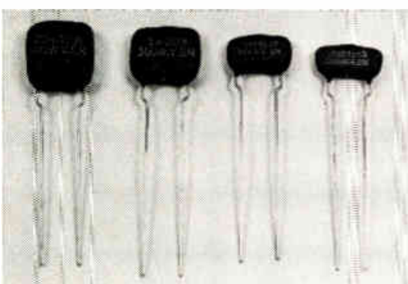
Circle 289 on Inquiry Card



DIPPED CAPACITORS

The El-Menco flattened Mylar dipped capacitors are available in voltage ratings of 50, 75, 100, 200, and 400vdc for operation at 85°C. Because of their flattened construction, higher component densities are obtainable. Electro Motive. BOOTHS 1611-12.

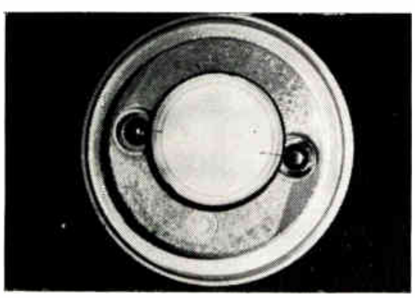
Circle 290 on Inquiry Card



PHOTODIODES

The SGD-444 has a sensitivity of 0.5μa/μw typical at 0.9 microns (70% quantum efficiency). An improved guard ring construction limits leakage level to 0.2μa typical at 90v. The unit has a wide spectral range, fast speed of response, and a wide dynamic range of linearity. Edgerton, Germeshausen & Grier, Inc. BOOTHS 1311-12.

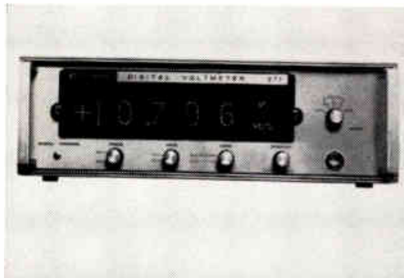
Circle 291 on Inquiry Card



DIGITAL VOLTMETER

The DV-271 uses reed relays and has a built-in ratiometer. The 4-digit unit measures dcv @ 0.01% accuracy and dc ratio at 0.005% accuracy. Readout speed is 2 readings/sec. Cubic Corp. BOOTHS 4201-02.

Circle 292 on Inquiry Card



FREQUENCY COUNTER

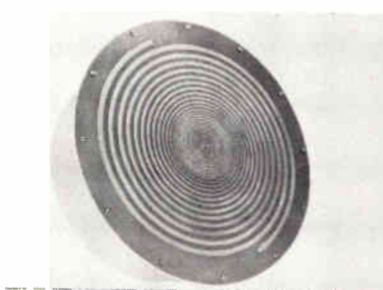
The Model 951 provides ease, speed, economy, and total elimination of operator error in making high resolution freq. measurements from 10 CPS to 6GC. No calculations are required. Input sensitivity is typically -13dbm (50mv RMS). Eldorado Electronics. BOOTHS 4106-07.

Circle 293 on Inquiry Card

SPIRAL ANTENNA

This cavity-backed spiral antenna has bandwidth capability of 10:1. The feature is said to make the spiral antennas superior to the conical helix, conical spiral, cavity backed log periodic, and other freq. independent antennas over comparable bands. Min. gain is 5db, and VSWR is 2:1 max. American Electronic Labs. BOOTH 1715.

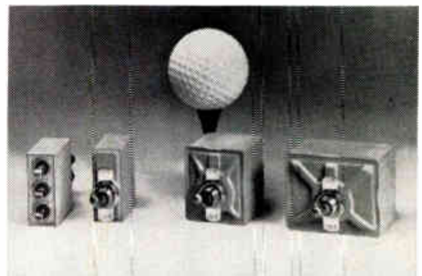
Circle 294 on Inquiry Card



CIRCUIT BREAKER

Series SM military-type subminiature circuit breakers have special-function internal circuits for combined protection and control. Available in 1, 2, and 3-pole models with voltage ratings through 240v. Heinemann Electric. BOOTHS 2516-17.

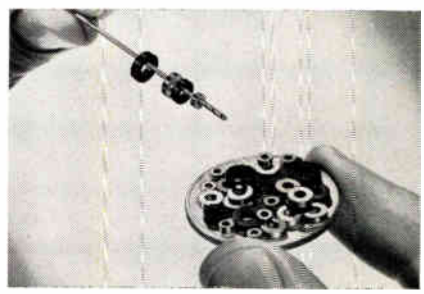
Circle 295 on Inquiry Card



IRON POWDER TOROIDS

A line of 29 subminiature iron powder toroid cores in 12 sizes are being introduced by The Arnold Engineering Co. Permeability ranges from 8 to 25; inductance values range from 9.37 to 78μh/100 turns of wire. Inductance tolerance is ±8%. BOOTHS 2601-3.

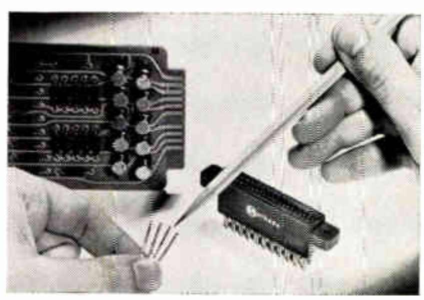
Circle 296 on Inquiry Card



RECEPTACLE CONNECTOR

The 170-100 series is a double-sided, 22-position card receptacle connector. Cantilever-beam designed contacts with precious metal ball contact points are used to hold close tolerances on PC board insertion forces. It accepts 0.058 to 0.071 in. thick PC boards and supplies 100 grams at minimum deflection conditions. Methode Electronics. BOOTH 1622.

Circle 297 on Inquiry Card



World Radio History

THE RIGHT ANSWERS MAY MEAN A NEW LIFT TO YOUR CAREER

1 **What makes McDonnell so special as a prime contractor?** A history of excellence in every one of its product areas: missiles, spacecraft, aircraft, electronic equipment, automation services.

2 **Now that Gemini and Phantom II are well into production what about new engineering and scientific assignments?** McDonnell has many more active aerospace programs in house that promise long-term stability and professional growth.

3 **How stable has McDonnell been in the past?** McDonnell has never had a major decline in its engineering and scientific areas, during its entire 26-year history. The company has grown rapidly in everyone of its product areas. McDonnell is presently working on a billion-dollar backlog.

4 **Is this strictly production work? What about research and development?** Any company that can design and build a Gemini or a Phantom must have its hard core of systems engineers, analysts, physicists, metallurgists, aerodynamicists, thermodynamicists, propulsion experts plus other specialists. Research in every area and original equipment design and experimentation are vital and integral parts of McDonnell.

5 **Is there still room for personal growth?** There's no ceiling on individual potential. New assignments demand the best talents available. If you are looking for growing room ... in a stable company ... that has a national reputation for product excellence ... *Join the McDonnell Team.*

You'll benefit from group insurance (McDonnell pays 90%); retirement income (McDonnell pays ⅔); patent compensation; 8 paid holidays; educational assistance (up to full sponsorship and reduced work weeks); professional recognition; beautiful communities and natural vacationlands.

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Aircraft Structural Design Engineers • Electronic Systems Engineers • Structural Test Engineers • Propulsion, Aerodynamics Engineers • Operations Analysis Engineers • Guidance & Control Mechanics Engineers • Thermodynamics Engineers • Industrial Engineers • Stress Analysts • Loads, Weights Engineers • Plant Design Engineers • Facilities Engineers • Specifications Engineers • Engineering Psychologists • Flight Test Engineers • Aerospace Ground Equipment Designers • Chemical Engineers • Systems Analysts • Scientific Programmers • Electronic Equipment Engineers

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World Radio History

If you think you can find a better low-cost controller for any common variable...

You're right... here's the Compack!

AC, DC, or temperature—as long as there's a current or voltage signal, API's new Compack will both indicate and control it.

Simple, convenient and reliable, the Compack is designed for both OEM and in-plant applications in all types of industries. And its price is as small as its size.

These additional features are important too:

- Continuously indicates signal.
- Inherently fail-safe and unaffected by ambient light.
- Taut-band meter movement supplied where suitable—more sensitive, precise, repeatable and rugged.
- Panel cutout less than 3" diameter—measures only 5¼" behind panel.
- Electrical cold junction compensation for pyrometers.
- Set points anywhere on scale.
- Single or double set point models.
- 3 sizes of black phenolic meter cases—3¼", 4½", 5½".

Ask for Specs and Prices in Bulletin 44

Visit Wescon Booth No. 4121-22

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Circle 75 on Inquiry Card

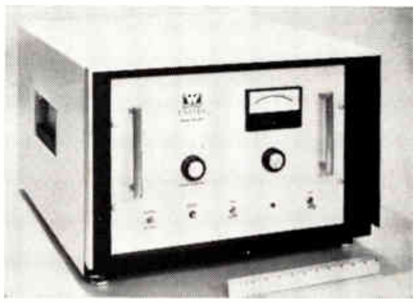
NEW PRODUCTS

At WESCON

WELDING POWER SUPPLY

The Model 1-123-01 provides a continuous repetition rate of 400 welds/min. @ 130w.-sec. Capable of handling all weldable materials, this new unit is designed for welding electrical and mechanical parts such as micro-switches, transistor headers, gages, etc. Weldmatic Div./Unitek. BOOTHS 625-26.

Circle 310 on Inquiry Card



LOW COST DVM

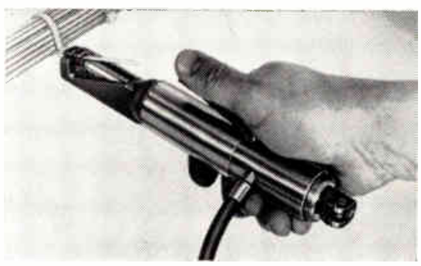
The 5-digit Model 5015 is a low cost (below $2000) digital voltmeter. Ranges are ±9.9999/99.999/999.99v. Common-mode rejection is 100db @ 60 CPS. Accuracy, ±0.01% of reading ±0.001% full scale. Either input can be floated 1kv above chassis. Non-Linear Systems. BOOTHS 4301-02.

Circle 311 on Inquiry Card

CABLING TOOL

The ATS-2B pneumatic cabling tool tightens, tensions, cuts and ejects cut off portion of the all nylon Sta-Stap® cable ties, clamps and identification markers. It allows selection of strap tension level. Panduit Corp. BOOTH 142.

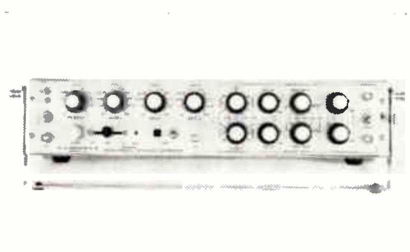
Circle 345 on Inquiry Card



PULSE GENERATOR

The PG-32 adds flexibility to any pulse generator operating for 0.1 CPS to 20MC. It contains 2 channels: one for positive current or voltage, and one for negative. Pulse width 50nsec. to 1sec. Intercontinental Instruments. BOOTHS 4407-08.

Circle 312 on Inquiry Card



HIGH-POWER TWT

The VA 626G has a CW output of 100w. and gain of 30db over the octave freq. band of 4 to 8GC. The 5 lb. air cooled unit is ideal for data transmission, RFI test sets, troposcatter transmitters, noise generators, and special broadband uses. It also drives crossed-field amplifiers. Varian Assoc. BOOTHS 2309-17.

Circle 346 on Inquiry Card

PHASE METER

Type 524A2 digital phase meter features phase angle in degrees directly represented in 4-digits, and reading that is independent of signal amplitude ratio. No freq. adjustment is needed from 20 CPS to 500 KC. Accuracy is ±0.1° (±1 digit) for symmetrical waveforms of any shape. Ad-Yu. BOOTH 4014.

Circle 313 on Inquiry Card

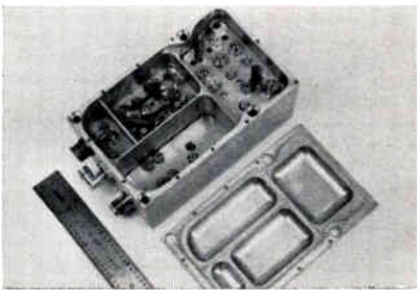
NEW PRODUCTS

At WESCON

POWER AMPLIFIER

Model 5700-AP2 increases power output of 1.5-4w. VHF transmitters to at least 22w. The all solid-state unit has a freq. range from 215-250MC. Gain is 11db. Energy Systems. BOOTH 1805.

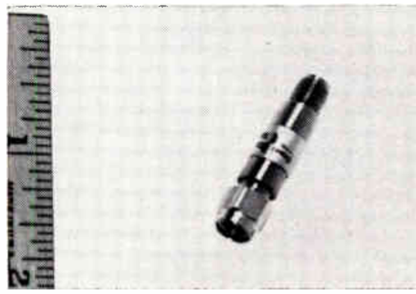
Circle 314 on Inquiry Card



FIXED ATTENUATOR

Model 20500 fixed attenuator covers a dc to 4.0GC freq. range. It is available in 3, 6 or 10db attenuation values with an attenuation tolerance of ±.5db. Omni-Spectra, Inc. BOOTH 1820.

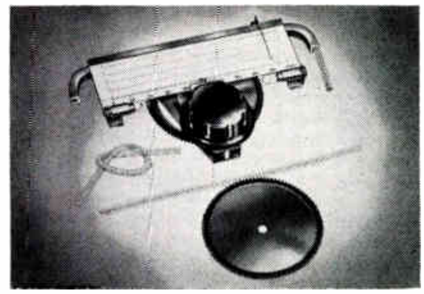
Circle 316 on Inquiry Card



ILLUMINATED DIAL

The No. 10037 dial assembly eliminates string-driven pointers, all indicator stutter or wabble. The pointer is driven by a non-slip gear. James Miller Mfg. Co. BOOTH 2608.

Circle 318 on Inquiry Card



SCOPE DOLLY

This versatile dolly handles standard and oversize oscilloscopes and other test equipment. It features a spacious non-skid deck inclined at 22° to easily accommodate virtually all laboratory and workshop instruments. Dimensions are 19¼ x 29½ x 36½ in. Waber Electronics. BOOTH 1123.

Circle 315 on Inquiry Card

PLUG-IN RELAYS

This magnetic plug-in relay is for general-purpose control. Available in 1, 2, or 3 PDT, the 5a. unit features small size, low-cost, and electrical life of 10 million operations. Enclosed in a plastic see-thru cover, relays have sturdy pin plugs for use with standard 8 or 11-pin octal bases. Ward Leonard. BOOTH 1405.

Circle 317 on Inquiry Card

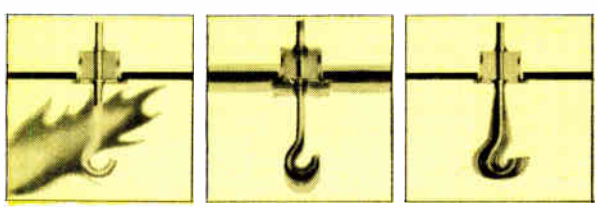
STUD WELDER

The Mark 4 can weld fasteners to thick or thin metal without burn-through or distortion to the reverse side. It operates on the stored energy principle, and requires no flux, ferrules, special wiring or metal preparation. Studs are welded flush without fillet or protrusion. Omark Industries. BOOTHS 115-116.

Circle 319 on Inquiry Card

You might know DAGE would do it!

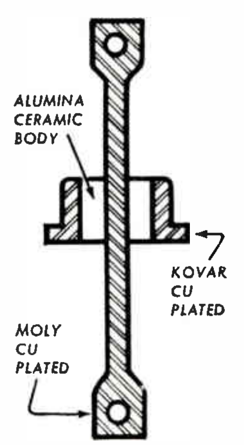
— solve heat, shock, vibration problems with CERAMETERM® ceramic-to-metal terminals



HEAT
Searing heat up to 1500° F can't crack CERAMETERM

SHOCK
20,000 PSI impact can't crack CERAMETERM

VIBRATION
CERAMETERM won't fail, won't leak under severest vibration environments



Above: *Standard Single Pin Feed Thru.* Straight, pierced or hooked pin; also hollow tube pin. Many other CERAMETERM types available.

DAGE

DAGE whips another big problem for you! CERAMETERM® (ceramic-to-metal) terminals give you *complete reliability* wherever extreme heat, shock and vibration exceed the capacity of glass-to-metal seals. Call or write *today* for details and prices.

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Circle 77 on Inquiry Card

World Radio History

NEW PRODUCTS

AT WESCON

EDDY CURRENT TESTING

The MRA 1090 magnetic reaction analyzer is an eddy current instrument for non-destructive materials testing. It operates from 20cps to 100kc. F. W. Bell. BOOTH 4411.

Circle 320 on Inquiry Card

PRINTER

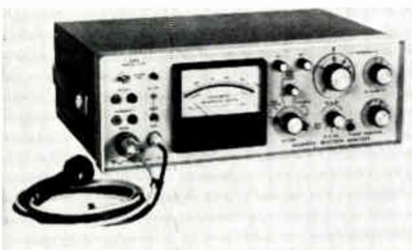
The Model 7000 Printer accepts digital data from an external source and prints a permanent record. The printer accepts various input data and logic levels. Clary Corp. BOOTH 4409.

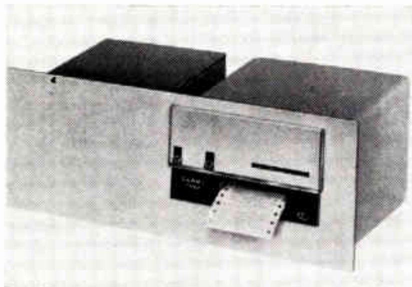
Circle 322 on Inquiry Card

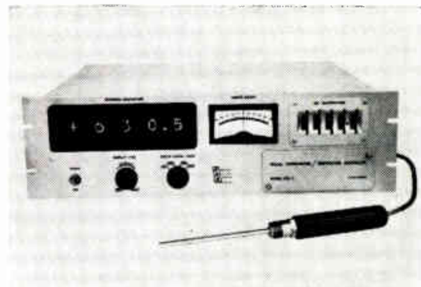
POTENTIOMETRIC SYSTEM

Model PPMS-1 is a precision potentiometric measuring system which makes 1 ppm measurements. Constant and variable outputs are floating. Princeton Applied Research Corp. BOOTHS 4523-24.

Circle 324 on Inquiry Card







DIODE SWITCH

Model K-6186 broadband diode switch covers 1 to 8gc. Handling 1kw peak r-f power or 1w. CW, the component has a 1db max. insertion loss across the band and provides 30db min. isolation. The max. switching time is 75nsec. Melabs. BOOTH 1813.

Circle 321 on Inquiry Card

ELECTRON BEAM GUN

With 6kw beam output, the VeB-6 electron beam gun produces deposition rates up to 3000 Å/sec. with such source materials as iron. The compact 2 in. dia. x 3 in. gun is self-accelerated and uses electrostatic focusing. Veeco Instruments. BOOTHS 721-23.

Circle 323 on Inquiry Card

TV CAMERA

The Sync-Lok TV camera has a positive 2:1 interlace, synchronizing generator. The sync-generator mounted under the cover of the camera insures that 2 alternate fields of each scanning frame exactly interlace. Packard-Bell. BOOTHS 3816-17.

Circle 325 on Inquiry Card

(BOOTH 2717 WESCON)

GLOBE

For prototype motors/blowers not on anyone's shelf, call Globe 513 222-3741

When you need prototypes you need them fast—and you may want one or several units.

We know this. That's why the Globe Small Order Department has its own manufacturing facility separate from our extensive production operations. Standard components are assembled for quick delivery of your custom designs.

You name your requirements — d.c. or a.c., speed and torque, available voltage, cfm, back pressure, size, environment, any special performance characteristics. We'll design with you or for you—build it off the back of an envelope if necessary—see that you get what you ordered and stay with you through the modification stages until your project is honed to everyone's satisfaction.

Globe Industries, Inc., 2275 Stanley Avenue, Dayton, Ohio 45404, U.S.A., Tel: 513 222-3741.

World Radio History

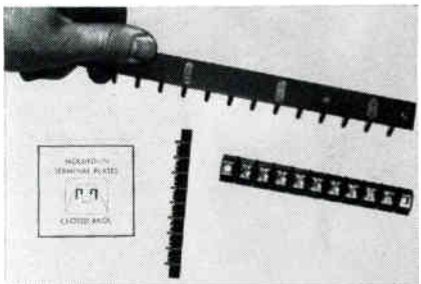
NEW PRODUCTS

AT WESCON

TERMINAL BLOCKS

This line of closed-back blocks is ideal for restricted space uses requiring economical single-screw blocks. Block lengths run to 15 in. with up to 31 terminal sections. ETC Inc. BOOTHS 1115-16.

Circle 326 on Inquiry Card



PULSE GENERATOR

The Type 1398-A pulse generator is a self-contained, general-purpose source. It features rise and fall times under 5nsec. PRF range is 2.5 CPS to 1.2MC. General Radio. BOOTHS 3801-04.

Circle 328 on Inquiry Card

COAX DUMMY LOADS

Three new series of coaxial dummy loads will be exhibited by Microlab/FXR, Livingston, N.J. The new units operate in the 0.2 to 10GC region. Power ratings up to 15kw average. BOOTHS 3510-11.

Circle 330 on Inquiry Card

RECORDER TEST SET

Model 1565/66 provides a simplified approach to servicing pen and chart systems of X-Y, rectangular, and polar recorders. It combines ac and dc voltmeter, ac and dc output signals with a 0-150db attenuator, and dynamic synchro test system. Scientific-Atlanta. BOOTH 4120.

Circle 327 on Inquiry Card

COAXIAL SWITCHES

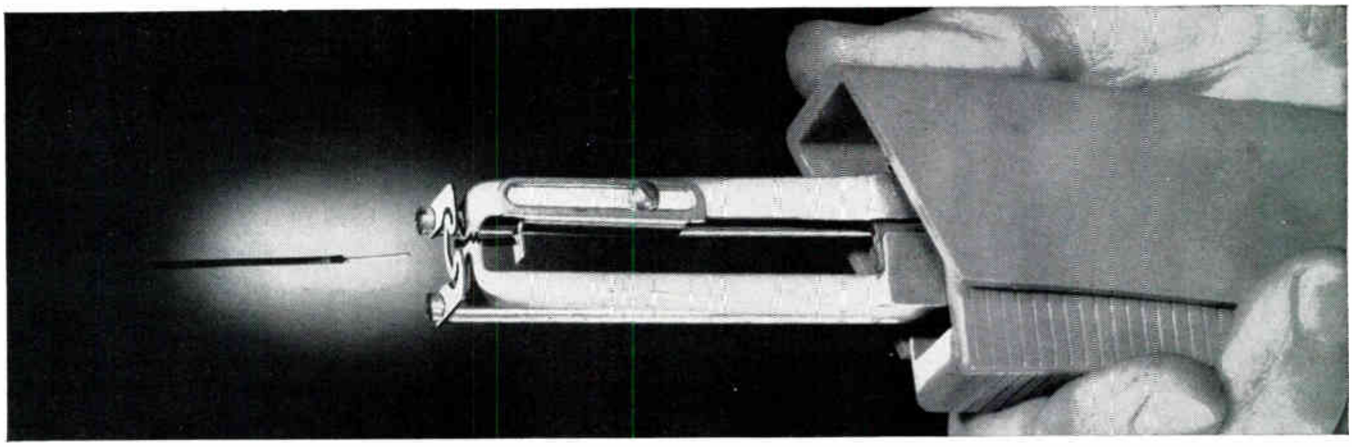
Model TC-3 is a 3-position unit that provides the switching facility needed to display 3 separate traces on an oscilloscope. It features low insertion loss and low VSWR. Isolation/switch: 30db (min.) dc to 1GC and 28db (min.) 1GC to 1.2GC. Jerrold Electronics. BOOTHS 3510-11.

Circle 329 on Inquiry Card

COAX ADAPTER

Model 112AC56-1 waveguide-to-coax adapter is constructed of stainless steel. It covers freq. range 7.05-10.0GC and has a VSWR of 1.25 max. Connectors include a male-type N coaxial and a UG51/U cover flange. Microwave Development Lab. BOOTH 1821.

Circle 331 on Inquiry Card



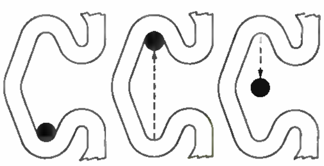
UNIQUE ONE SQUEEZE THERMAL WIRE STRIPPER

The new Ideal Swing-Grip® thermal wire stripper uses a unique mechanical action to strip in a single, continuous squeeze. Swinging grippers move the wire into contact with the thermal element so no twisting of the tool is necessary. The same grippers hold the insulation slug during removal, completely eliminating any contact with the conductor strands. Single element assures uniform heat.

"Beading" is reduced by the thin section of the element blade. "Drag-out" or "stringing" of insulation is eliminated since the heated element is not used to pull the slug.

The tool is light weight and designed to remain cool during production operations. Head size has been held to a minimum for easy access in close quarters. Three simple adjustments and a variety of element shapes permit precision stripping of Teflon and other thermoplastic insulations on a range of wires from 30 to 12 AWG. Write us for specifications.

Curved heating element contacts wire first on one side . . . then on other side, severing insulation all around wire. Removing wire from tool pulls off insulation held by the grippers.



IDEAL

IDEAL INDUSTRIES, INC.

5127-H Becker Place, Sycamore, Illinois

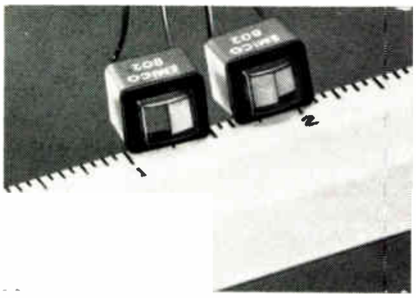
In Canada: IDI ELECTRIC (Canada) LTD. AJAX • Ontario

Circle 79 on Inquiry Card

World Radio History

CIRCUIT INDICATOR

For dc equipment. Used to monitor on-off conditions down to 1v.

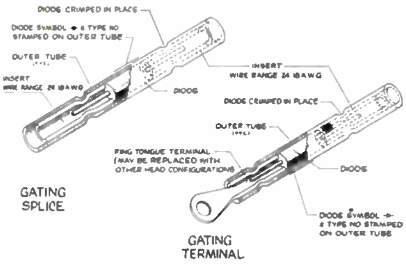


Model 802 is 0.4062 x 0.4687 x 0.405 in. It monitors on-off conditions, and can be used on applications down to 1v., where pilot light will not operate. It is packaged in a clear plastic case and has a 2-color, center-divided scale half covered by the meter flag. The power required to move the flag is less than 2mw, and overload capacity is 15 times the 1.5ma current rating. A change in electrical condition exposes the red half of the scale, indicating that the change has taken place. Electro-Mechanical Instrument Co., Perkasie, Pa.

Circle 252 on Inquiry Card

DIODE GATING TERMINAL

Physically incorporates a diode as part of a solderless wire terminal.

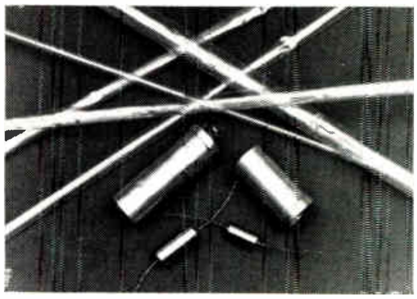


This unit houses any type of switching diode or low current rectifier diode (limited to 1a. for the present). Gating terminals (or splices) are available with certain popular diodes, or may be packaged using customer's diode in various terminal-head configurations. Typical uses include patch cord gates, inter-chassis or inter-card cabling in place of matrix assemblies, reverse current blocking devices, and point-to-point wiring. Hollingworth Solderless Terminal Co., 4320 NW 10th Ave., Ft. Lauderdale, Fla.

Circle 253 on Inquiry Card

SHRINKABLE TUBING

Shrinks to half of its original dia. within seconds upon application of heat.



The IX-6004 is an extremely thin walled, fast shrinking tubing. Temps. from 225° to 425°F are suitable for shrinking it. Combining high dielectric protection and physical toughness, IX-6004 is formed of a polyester film with a thermally welded, nonadhesive seam. The thermally welded seam eliminates the problems associated with conventional adhesive bonded seams, including degradation both at operating temps. and when used with solvents and cleaning solutions. 3M Co., 2501 Hudson Rd., St. Paul, Minn.

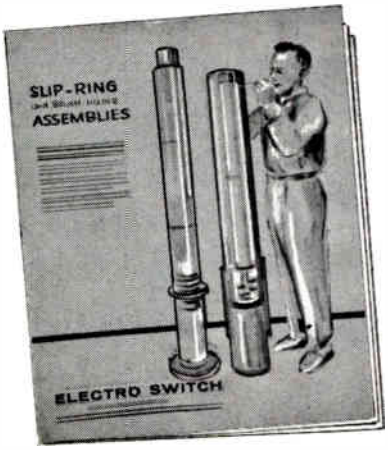
Circle 254 on Inquiry Card

SLIP RINGS

and slip-ring assemblies

designed and built to your performance specifications

- Single-circuit or multi-circuit
- Low-current or high-current
- Drum-type or pancake
- Internal or external rings



This new bulletin gives details of representative Electro Switch slip-ring designs and includes a convenient check-list to use in specifying slip rings and assemblies.

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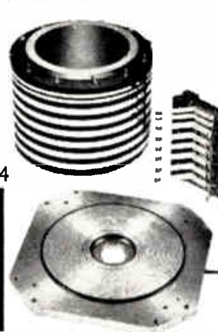
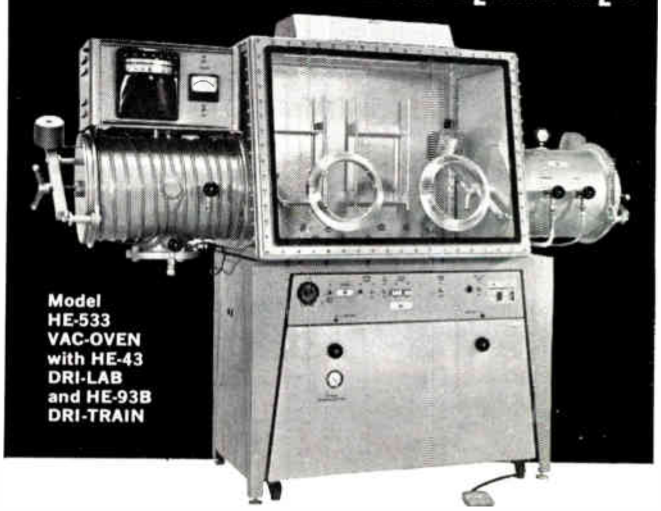


ELECTRO SWITCH

ELECTRO SWITCH CORP.
167 King Ave., Weymouth (Boston), Mass. 02188
Telephone 335-5200, Area 617

Circle 80 on Inquiry Card

ONE PART PER MILLION O_2 and H_2O



■ Especially suited for degassing and drying electronic components in vacuum oven ■ Components sealed in DRI-LAB under ultra-dry inert atmosphere conditions produced by DRI-TRAIN recirculating gas purification system ■ Many other curing, pre-heating and aging applications ■ Temperature range of oven to 600°C controlled to ±1° ■ Provisions for 6" diffusion pumping system for high-vacuum operations ■ Front panel can be adapted with sealed microscope for microsoldering, microwelding, etc.

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VAC **VACUUM/ ATMOSPHERES CORPORATION**

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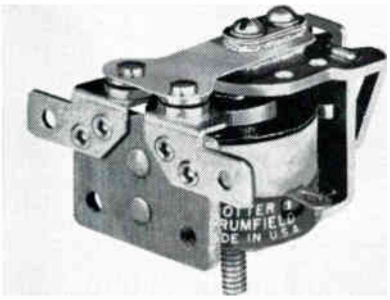
Circle 81 on Inquiry Card

World Radio History

NEW PRODUCTS

HEAVY DUTY RELAY

Capable of switching 20a. Coil voltages to 110vdc and 230vac can be furnished.

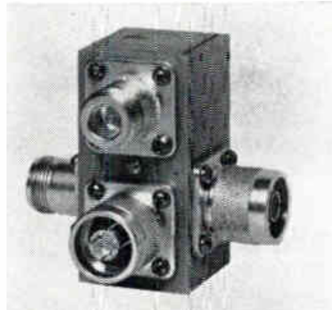


The KR3-H series relay has heavy copper-alloy movable contact arms with twin ¼ in. dia. silver-cadmium-oxide contacts. They are rated at 20a. at 115vac 60 cycles resistive, or 28vdc; 1 HP 115/230v. 60 cycles. Its contact arrangement is 1 Form X (SPST-NO-DB). Its small size and rugged construction makes it particularly desirable for use in automation controls, communications circuits and many other uses where limited space is a factor. Potter & Brumfield, Princeton, Ind.

Circle 255 on Inquiry Card

REFLECTOMETER

Reveals serious faults in coaxial cables. Bandwidth is 0.5 - 220MC.

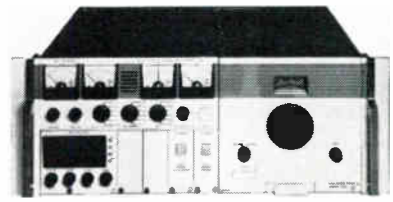


Cable faults which cause objectionable ghosts and reflection noise in TV reception are reliably detected, before cable installation, by the Model 701 Reflectometer. A bridge device, it may be used to distinguish between critical and relatively unimportant reflections caused by minor variations in impedance uniformity in the cable. Impedance is 75Ω; balance is greater than 35db. Spencer-Kennedy Laboratories, Inc., 1320 Soldiers Field Rd., Boston, Mass.

Circle 256 on Inquiry Card

TELEMETRY RECEIVER

Covers 100 - 6000MC; is all solid-state including r-f head.



This receiver has a built-in r-f preselector (7MC at VHF) which reduces spurious response and intermodulation. It permits low input VSWR (less than 3:1). The unit has a noise figure of 6db throughout VHF band, and a new technique improves large signal quieting. All spurious is down 60db. Plug-in linear phase i-f filters are available, with remote selection capability. Buffer stages prevent AGC detuning. Data-Control Systems, Inc., E. Liberty St., Danbury, Conn.

Circle 257 on Inquiry Card

VERSATILITY

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(EVEN COLORS!)

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Circle 83 on Inquiry Card

World Radio History

WIREWOUND TRIMMER

For industrial and military uses. Resistance ranges: 100Ω to 2.5 megohms.

Series 330PC ½ x 13/32 in. trimmer has a carbon-ceramic element. The trimmer far exceeds performance specs. of Mil-R-94B. Power rating is ⅜w. @ 70°C derated to zero load @ 150°C. Voltage rating, terminals to case, high pot test, 1 min. is 750vac with 500vdc operating max. Voltage rating across end terminals is 350vdc not to exceed rated load. Stability under humidity is ±8% max. Chicago Telephone of California, Inc., subs. of CTS Corp., 1010 Sycamore Ave., So. Pasadena, Calif.

Circle 258 on Inquiry Card

WIREWOUND RESISTORS

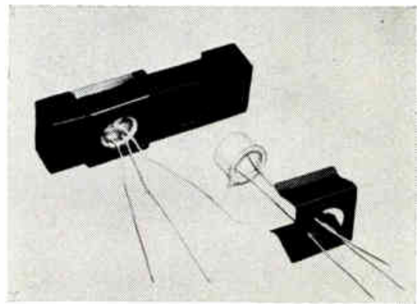
Have low inductance and low capacitance. Rise times are as low as 20nsec.

RT resistors can be supplied with rise times of 20nsec. (from 10% to 90% of peak pulse amplitude with a 100KC pulse input) and as low as 400nsec. (0 to 100% peak pulse amplitude), depending on resistance values and physical configurations. Low inductance is created by a special winding technique. Specially designed bobbins contribute to the lower capacitance. Standard axial lead types offer wattages ranging from 0.15 to 2w. Kelvin, 5919 Noble Ave., Van Nuys, Calif.

Circle 259 on Inquiry Card

HEAT SINK

For transistors. Conducts heat from the base of the transistor.

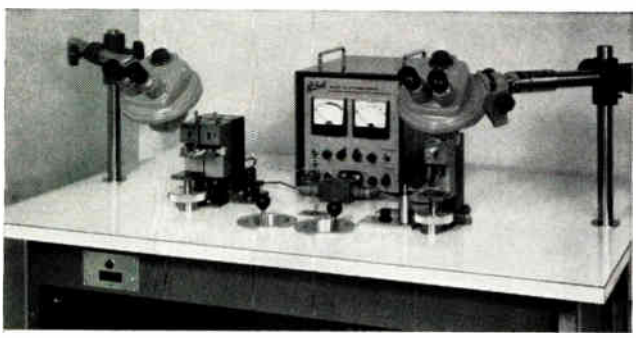


Aluminum transistor heat dissipators, numbers 10054-1 and 2, are for TO-5 transistor case sizes. The -1 unit is non-insulated, has a body finish of black anodized aluminum, and clips of Ebonal "C". The -2 unit is an insulated unit with a hard anodized black aluminum body and clips of Delcoat "B". The breakdown voltage is 350v. minimum dc on the -2 unit. The transistor is clipped into place, with no screws or bolts. Atlee Corp., 2 Lowell Ave., Winchester, Mass.

Circle 260 on Inquiry Card

Weld, Solder and Bond

with this Versatile Machine!



Weltek's new Model 750 can be set up in minutes to do microminiature welding, controlled soldering or "nail head" bonding. With this one piece of equipment you can solder or weld flat packs to p.c. boards, do module welding, point-to-point microsoldering or bond a wire to a transistor chip! The possibilities are unlimited. The 750 can do *all* of your miniature joining work . . . in the lab or in production. And it is reasonably priced.

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Circle 85 on Inquiry Card

World Radio History

NEW PRODUCTS

PICOAMPERE SOURCE

Outputs from 10^{-14} to 1.1×10^{-4} ampere dc, positive or negative.

The Model 261 Picoampere Source allows users to quickly and accurately check their picoammeters from 10^{-14} to 10^{-4}a. The procedure consists of using a coaxial cable to connect the source to the picoammeter and dialing the desired output. It operates from 105-125 or 210-250v. Output isolation from low to ground is greater than $10^{9}\Omega$ shunted by $0.001\mu f$. Its current output is dialable in 0.01-steps from 10^{-15} to 1.1×10^{-4}a. Keithley Instruments, Inc., 12415 Euclid Ave., Cleveland, Ohio.

Circle 261 on Inquiry Card

DECADE SCALER

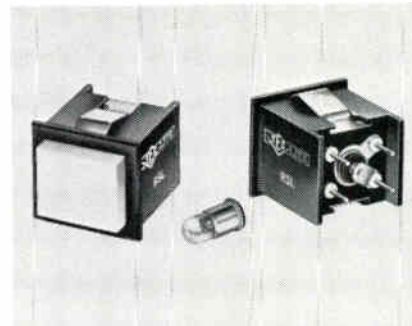
Extends to 100MC, the freq. range of any freq.-measuring instrument.

With the Type 1156-A Decade Scaler any 10MC counter becomes a 100MC counter with a single connection. Input sensitivity and output levels of the scaler are high enough to permit its use with almost any counter on the market. A 5-position input attenuator provides sensitivities of 0.1, 0.2, 0.5, and 1v., peak-to-peak, at 50Ω, and 1v, peak-to-peak, at 500Ω. Output is a 20ma sq. wave, at 1/10 the input freq. that delivers 1v. into a 50Ω load. General Radio Co., West Concord, Mass.

Circle 262 on Inquiry Card

INDICATOR SWITCH

Offers 3 different options with 14 different lens colors.



The Tec-Lite Rectangular Switch Lite, RSL Series, provide a choice of 14 different lens colors. Lenses can be hot stamped with legends in 4 different type sizes. Three available options include: Model 1, SPST normally open switch and indicator; Model 2, 2 normally open switches, DPST, and no indicator; and Model 3, an indicator only. The switch is rated 100ma at 120vac, non-inductive. Transistor Electronics Corp., Box 6191, Minneapolis, Minn.

Circle 263 on Inquiry Card

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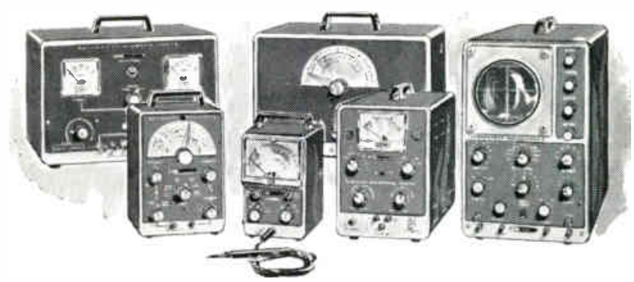

5" Lab Oscilloscope
Kit IO-12, 24 lbs...$ 76.95
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Assembled IGW-102 $54.95

Condenser Checker
Kit IT-11, 7 lbs......$29.95
Assembled ITW-11..$49.95

VTVM
Kit IM-11, 5 lbs......$24.95
Assembled IMW-11.$39.95

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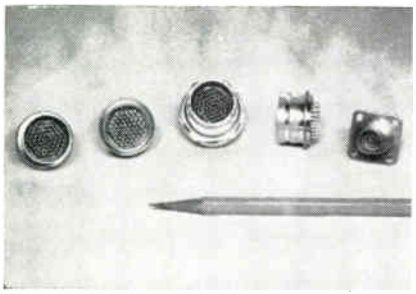
Circle 87 on Inquiry Card

NEW PRODUCTS

HERMETIC CONNECTORS

Have a leak rate of less than 0.001 micron cu ft./hr.

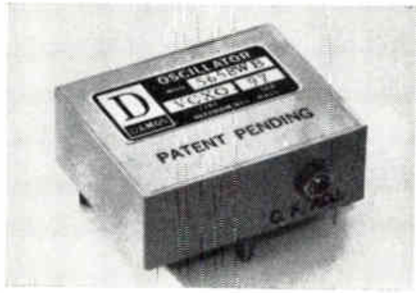


The subminiature DSM's meet and exceed the electrical and environmental performance requirements of the latest applicable Mil specs. They are available in 5 shell sizes: 3, 7, 12, 19, and 27, containing 7, 19, 37, 61, and 91 #22 contacts respectively. They have a wide range of clocking positions, and are available in sq. flange, single hole, and solder mount type mounting configurations. Pin contacts rated at 2a. Deutsch Co., Electronic Components Div., Municipal Airport, Banning, Calif.

Circle 264 on Inquiry Card

CRYSTAL OSCILLATORS

Available on short lead time with any specified center freq. from 10 to 20MC.

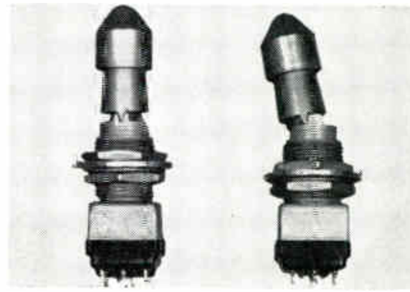


The Series 5658WB Voltage-Controlled Crystal Oscillators are all solid-state quartz stable units whose freqs. can be varied linearly by an external modulating signal. They may be inserted into systems as simple components with no auxiliary compensating circuitry. Any specified center freq. is externally adjustable ±1KC; freq. deviation: ±20KC: sensitivity: +10KC/v. minimum; linearity: ±1% from best straight line. Damon Engineering, Inc., 240 Highland Ave., Needham Heights, Mass.

Circle 265 on Inquiry Card

MILITARY SWITCHES

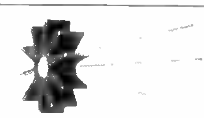
Resistive ratings include 4 amps @ 28vdc: 3 amps @ 115vac.



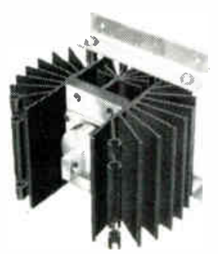
These miniature military switches feature a variety of lever lock configurations. They are available in 2- and 3-position circuit arrangements, for maintained or momentary operation, in SP-DP. The line meets all general requirements of Mil-S-8834 (Type 1). Inductive ratings are 1a. @ 28vdc and 115vac. Minimum rating for dry circuit use is 25μa @ 5mv. Other standard features include positive make-break operation and gold-plated contacts. Cutler-Hammer, 436 N. 12th St., Milwaukee, Wisc.

Circle 266 on Inquiry Card

COOLING SEMICONDUCTORS?



STANDARD HEAT SINKS . . .



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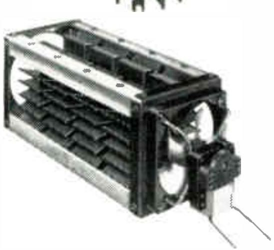

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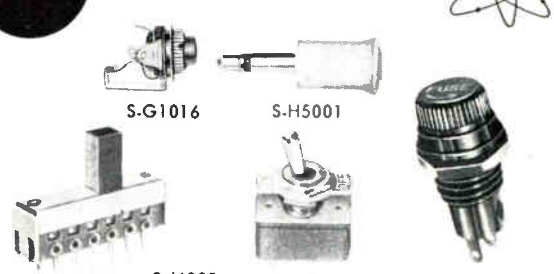

SMK is one of the largest manufacturers in Japan of high quality electronic components with over 40 years of repute in both domestic and overseas markets.
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Circle 89 on Inquiry Card

World Radio History

MINIATURE POTENTIOMETER

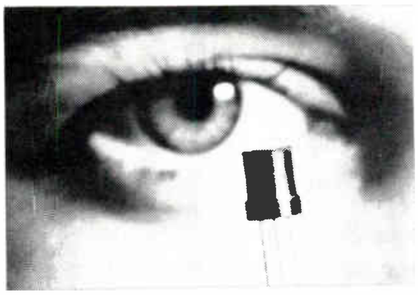
Resistance range is 100Ω—50KΩ. Has 7 in. resistance element.

The Model 3070 has a 7 in. resistance element in a 1 in. long package. It uses the same helical principle as precision potentiometers. The unit uses resistance wire having about double the normal cross-section area for any given resistance value. This greatly increases element life and overall reliability. A slip-action clutch design at the end of wiper travel prevents internal mechanical damage from forced adjustment. Resistance tolerance is ±5%. Bourns, Inc., 1200 Columbia Ave., Riverside, Calif.

Circle 267 on Inquiry Card

SILICON TRANSISTORS

Storage time to 14nsec.; gain bandwidth product is 300MC.

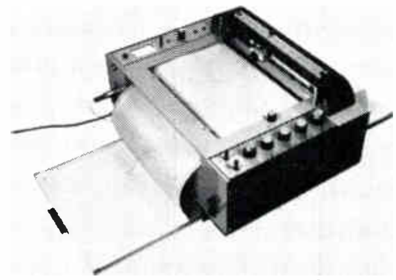


Three epoxy-encapsulated planar epitaxial passivated npn silicon transistors have been developed for medium-to-high-speed switching. The 2N3605 has a typical storage time of 14nsec. and a gain-bandwidth product (f_t) of 300MC. The 2N3606 and 2N3607 have storage times of 20nsec. The new devices can replace high-price metal-can transistors, and in may cases are direct plug-in replacements. Collector-to-emitter rating for all 3 types is 14v. General Electric Co., Schenectady, N. Y.

Circle 268 on Inquiry Card

PLOTTING RECORDER

Plots small excursions at rates in excess of 1200 points / min.



Model 6550 Recorder is said to read out the memory of multi-channel analyzers, average transient computers and digital oscilloscopes at an average rate 4 to 5 times as fast as was formerly possible with null-detecting X-Y recorders. Records with frequent large excursions are plotted out at an average rate of 16 channels/sec. An incremental advance chart paper drive automatically advances the chart 0.025, 0.050, 0.075 or 0.100 in./channel. Houston Omnigraphic Corp., 4950 Terminal Ave., Bellaire, Tex.

Circle 269 on Inquiry Card

WORLD'S FIRST
MINIATURE 4PDT TOGGLE
UNITIZED BODY

Available with color coded caps

- One-piece "unitized body" reduces parts, weight, size to a minimum for ultra-miniature space requirements
- Supplied with miniature bat handles or plastic color-coded caps. Solid silver contacts and terminals.
- Insulation over 100 megs. Breakdown over 1000V. Over 80,000 on/off cycles.
- 4 PDT $4.85. Ask for O.E.M. quantity price schedule on complete line of ALCOSWITCH.

BODY SIZE ½" x ½" x 13/16"

ALCOSWITCH

SEND FOR FREE CATALOG — LAWRENCE, MASS. DEPT T-57

Circle 90 on Inquiry Card

CERAMIC TERMINAL STRIPS

UPGRADE YOUR EQUIPMENT QUALITY

Features a permanent bond between metal and ceramic, not just an adhesion. Fired copper-plate on ceramic is silverplated and tinned which facilitates soldering and re-soldering of components and leads. Superior to temperature afflicted plastic. Withstands excessive heat.

ASK FOR ALCOSTRIPS

ALCOSWITCH

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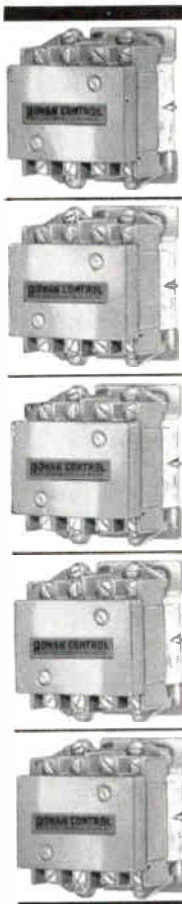
Circle 91 on Inquiry Card



ROWAN

Rowan's Relays and Contactors offer maximum versatility, compactness, and outstanding electrical and mechanical life resulting in high reliability. For example, just one of Rowan's basic units provides 1 to 5 poles, 10 to 50 amperes, AC or DC, is horsepower rated and is available in more than 80 contact configurations.

Write for literature on trouble-free Rowan products.

THE ROWAN CONTROLLER COMPANY
P.O. Box 306, Westminster, Maryland

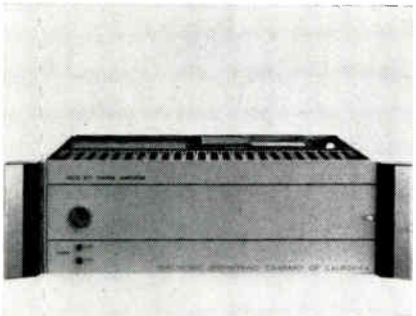
Circle 92 on Inquiry Card

World Radio History

NEW PRODUCTS

TIMING AMPLIFIER

Offers virtually any combination of outputs and inputs.

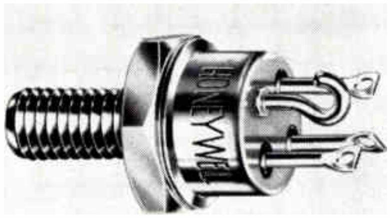


The EECO 871 accepts time codes in serial form or pulse trains, and amplifies the signal to a level and power suitable for various recorders, neon lamps, or for driving long lines. Amplifier card sockets are universally wired with power inputs and outputs so that virtually any combination of outputs and inputs can be arranged. Time codes and pulse train inputs may be 1, 2 or more separate inputs in modulated carrier form, dc level shift, and both. Electronic Engineering Co., 1601 E. Chestnut Ave., Santa Ana, Calif.

Circle 270 on Inquiry Card

POWER TRANSISTORS

Collectors isolated for wider design of transistor circuits.

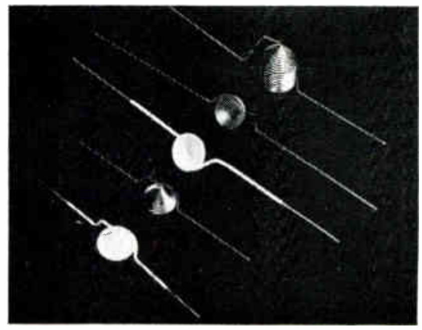


This family of nine 5a. silicon power transistors has isolated collectors. Each of the new 30w. triple-diffused planar devices (2N3744-52) uses a beryllium oxide wafer inserted to make a sandwich-style pedestal that electrically isolates the silicon chip from the package. The isolated collector allows design of either common-base or common-emitter circuits without the need for mica washers and insulating bushings. Max. power can be used. Honeywell Semiconductor Products Div., 1177 Blue Heron Blvd., Riviera Beach, Fla.

Circle 271 on Inquiry Card

THIN FILM EVAPORATORS

Saves tungsten filaments and produces high-quality thin-films.



These baskets produce the rapidity of evaporation necessary for high quality, high reflective silver film required in solid-state optical maser development. Similarly, they are used in obtaining thin films of nickel and nichrome. The alumina forms complete contact between each coil of the element, thus preventing drop-out of molten silver. By prefiring in a vacuum to remove minor impurities, subsequent rapid evaporation produces films which are improved in quality and purity. CM Mfg. Co., Bloomfield, N. J.

Circle 272 on Inquiry Card

Now, DPDT, 3PDT and 4PDT relay with universal tube-type socket exclusively from Milwaukee Relays. A truly 10 amp 600 volt, 2, 3 or 4-pole double throw relay using a low cost, high quality tube-type plug and socket. Developed jointly by Amphenol-Borg Electronics and Milwaukee Relays, this new plug-n-socket relay gives you:

1. 5, 10 and 15 amp contact rating. Plug and socket supplied as combination.
2. Socket accepts solder connection or 3/16" fast on.
3. Meets UL spacing requirements thru 10 amp 1/4" over surface, 1/8" thru air, 1/32" thru material.
4. Rugged design — heavy duty locator key, sure gripping pins relay won't jiggle loose from shock or vibration.

Order now! Model 205, 5 and 10 amps. Model 225, 15 amps. Write, wire or phone.

MR

Milwaukee Relays, Inc.
A Deltrol Corp. Affiliate
602 Pioneer Road, Cedarburg, Wis. 53012
Telephone (414) 377-4010

Circle 93 on Inquiry Card

NOW 2 VIBROTEST® MEGOHMMETERS

Measure resistance to 10 million megohms

versatile·accurate·reliable

24" total scale length... 1 to 10,000,000 megohms in 6 decades

measures resistance on printed circuits, transistor and miniaturized circuit components, cables, motors, etc.

measures leakage resistance of capacitors

measures grounded and ungrounded sections of three-terminal resistors

advanced features

- constant test voltage over full range
- no overload damage
- positive line voltage control
- maximum guarding flexibility
- latest tube-miniaturization techniques

2-35.7 ***Get all facts... write for Bulletin 2-1.4***

AR **ASSOCIATED RESEARCH, INC**
3787 W. BELMONT AVE., CHICAGO, ILLINOIS 60618

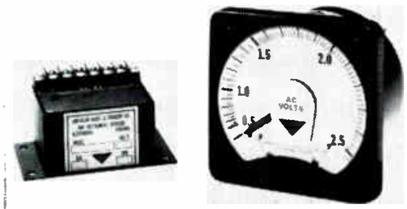
Circle 94 on Inquiry Card

World Radio History

NEW PRODUCTS

RMS VOLTMETER

Operates within 1% accuracy over freqs. from 40 CPS *to 10*KC.

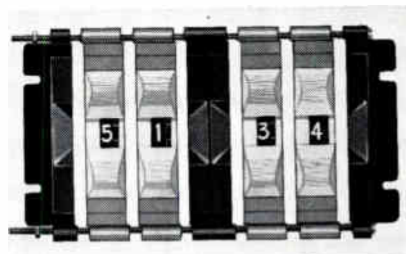


This single-freq. voltmeter provides true RMS indications. Accuracy is unaffected by harmonic content or waveshape, and the voltage sensors are temp. compensated. The voltage sensing element is a balanced differential thermocouple that provides fast response and exceptional sensitivity. The sq. law sensor output results in an expansion of the scale at the high end, thereby providing increased resolution for values in the normal operating region. AMF Instrument Div., American Machine & Foundry Co., P. O. Box 929, Alexandria, Va.

Circle 273 on Inquiry Card

THUMBWHEEL SWITCH

Bi-directional, has positive pushbutton action, and is modular in design.



These precision thumbwheel switches are ideal for computers, data recorders, and precision test equipment. Bi-directional, the switch rotor and readout wheel move one position each time the rocker is depressed. Direction of rotation is determined by which end of the rocker thumbwheel is depressed. The switches are fabricated to modular dimensions so that they are easily mounted in a variety of arrangements. There is virtually no limit to the number of switches which can be grouped together. Oak Mfg. Co., Crystal Lake, Ill.

Circle 274 on Inquiry Card

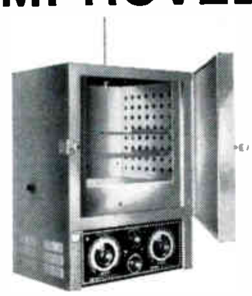
PULSE GENERATOR

Useful in design and testing of high clock-rate computers.

Model 216A Pulse Generator delivers continuous pulses or internally regulated pulse bursts with rise time under 2½nsec., at repetition rates up to 100MC. With rapid rise time and ability to deliver 10v. into 50Ω, it exhibits nearly ideal pulse shape. The output circuit constitutes a true 50Ω source. Reflections which would otherwise interfere with accurate measurements are thus eliminated. The instrument generates pulse bursts either on external trigger command or at selected successive intervals. Hewlett-Packard Co., 1501 Page Mill Rd., Palo Alto, Calif.

Circle 275 on Inquiry Card

IMPROVED!



NEVER SO MUCH OVEN FOR UNDER **$300**

BLUE M STABIL-THERM®

ELECTRIC UTILITY OVENS

FULL U.L. APPROVAL . . . EXCLUSIVE "MEMORY" RING TEMPERATURE CALIBRATING DIAL—make one of the most popular (and economical) ovens ever designed even more dependable!

- **"Memory" Ring Dial** makes pin-point calibration of temperatures fast, easy, sure . . . "remembers" calibration factors for 100% reproducibility. Lock prevents accidental setting change.
- U.L. Approval assures safety.

Wattage automatically controlled for quick, stable working temperatures. Range: +38°C. to +260° C. (+500°F.). Two sizes: 1 or 2.4 cu. ft. All stainless or with enameled steel exteriors. Rugged for years of continuous service in the laboratory or for production.

PRICES, COMPLETE: **$297.50 TO $429.00.**

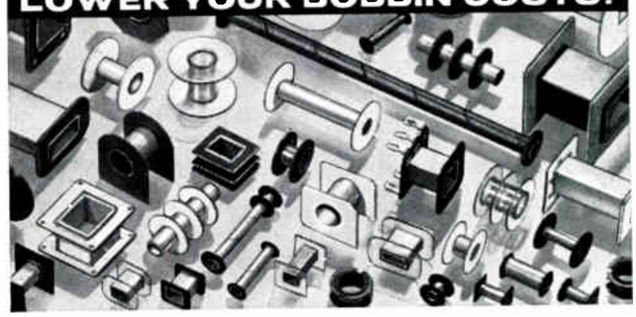
SEND FOR FULL INFORMATION

BLUE M *Electric Company*

Corporate Headquarters: BLUE ISLAND, ILLINOIS 60406

Circle 95 on Inquiry Card

HOW PRECISION CAN LOWER YOUR BOBBIN COSTS!



From Prototype Through Production

For engineering and prototype quantities: Our fabrication facilities enable us to supply virtually any type bobbin desired. Over 4,000 tools accumulated over 25 years permit the production of small quantities at no tooling cost or, in some cases, a small revision charge. Materials can be furnished to meet practically any electrical and temperature requirement.

For production quantities when mold costs can be absorbed: The transition can be made economically to molded parts. Our fully automatic single cavity system provides parts at low mold cost and piece prices comparable to multi-cavity operation. Bobbins can be furnished in all thermo-plastics, including glass filled and asbestos filled materials for elevated temperatures.

Request bulletins. Send or phone specifications for quote.

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BUCKEYE BOBBIN DIVISION

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Circle 96 on Inquiry Card

World Radio History

Indicator Lights, Anyone?

102SR

106S

105S

SIZE?

the smallest

DESIGN?

the most advanced concept in the field

855S

301

856S

QUALITY? RELIABILITY?

of course

Available through authorized distributors or write direct to

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"The Touch of Brilliance in Panel Design"

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Circle 97 on Inquiry Card

NEW PRODUCTS

BINDING POST

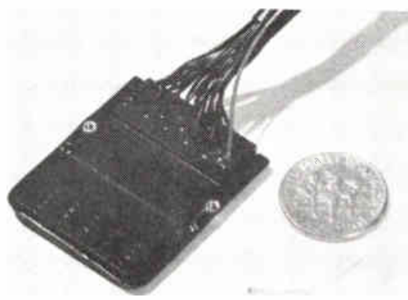
For use with sealed equipment requiring external connections.

This insulated water tight binding post meets Mil P55149/8. This new binding post is of extremely rugged construction. It is particularly useful in applications where high vibration and shock stresses are encountered. Two silicone rubber "O" rings provide a positive seal when the post is mounted. Terminal leads are connected by merely depressing the spring-loaded cap and inserting the tip of the lead between 2 stainless steel grippers. Hugh H. Eby Co., 4710 Germantown Ave., Phila., Pa.

Circle 276 on Inquiry Card

LIGHT SOURCE

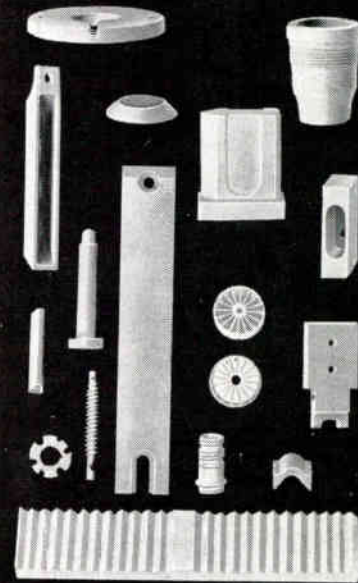
For uses where small size and low operating current are important.



This subminiature, gallium phosphide junction device emits red light when passing current in the forward direction. The new type of light source, based on radiative recombination at the PN junction, is suitable for a variety of instrument and indicator uses. These lamps are approx. 0.030 in. in dia. and provide electroluminescent radiation at 7000 Å. Switch-on time of the lamp is typically 15nsec., and the operating temp. range is from $-20°C$ to $+70°C$. Seven lamps are presently available giving minimum light intensities ranging from 1.5 to 20 x 10^{-5} candles when driven by 50ma pulses of 1msec. duration. Ferranti Electric, Inc., E. Bethpage Rd., Plainview, N. Y.

Circle 277 on Inquiry Card

DESIGNER NEEDS SOLVED...



DIAMONITE®
HIGH ALUMINA
CERAMICS

Diamonite—extremely versatile. Forms a myriad of shapes requiring ■ electrical insulation ■ low dielectric loss ■ high heat resistance ■ thermal conductivity ■ hardness ■ wear resistance ■ chemical inertness or ■ high mechanical strength. ■ It readily metalizes for brazed assemblies or vacuum seals.

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PRODUCTS MFG. CO. SHREVE, OHIO 44676
Div. of U.S. Ceramic Tile Co.

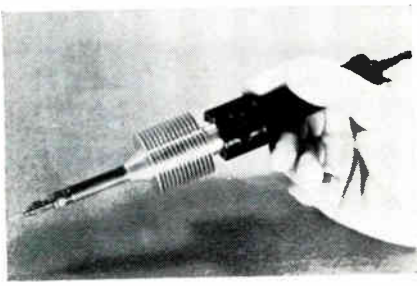
Circle 99 on Inquiry Card

World Radio History

NEW PRODUCTS

FLAMELESS TORCH

Pencil-type, hot air torch produces temps. to 750° F.

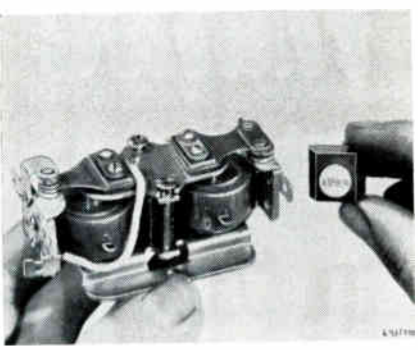


This torch handpiece is 9 in. long and weighs 4 oz. It has a changeable tip enabling the user to vary hot air flow and temp. for selective heating uses. Air is supplied from a small remote pump with adjustable air output up to 7 cu. ft./hr. The high air temp. attainable makes it an ideal production tool for plastic working, heat curing, and drying, and soft soldering in special cases, and shrinking thermal-fit tubing around lead wires and components. Its tip is narrow enough to even probe into chassis wiring for repair work. It operates on a 115v./60 cycle. Henes Mfg. Co., 4301 E. Madison St., Phoenix, Ariz.

Circle 278 on Inquiry Card

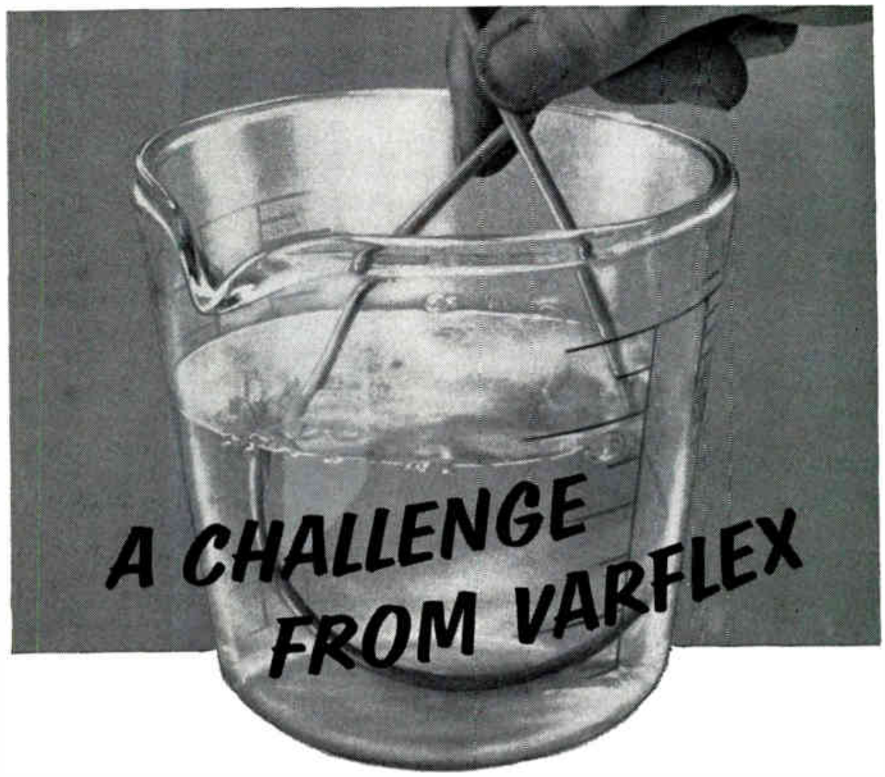
LATCHING RELAY

General purpose relay uses a magnet instead of interlocking metal levers.



The 100ML and 101ML relays use a magnet for both trip and release. By eliminating interlocking metal levers, a major cause of failure is eliminated. In operation a 1-piece armature on the magnet rocks up and down with a seesaw movement. In normal operation the armature is attracted to the coil side energized. It also operates in the opposed mode at about ½ the voltage or ¼ the power. With a double iron circuit the magnetic stability is excellent. Several times the line voltage can be applied without affecting magnet strength even though coils are connected simultaneously and opposed to the magnet. Thornton-Reichert, Inc., 828 N. Broadway, Milwaukee, Wisc.

Circle 279 on Inquiry Card



GIVE **Varglas ACRYLIC** (CLASS B SLEEVING) ***the "Acid Test"...***

... or any tests you can think of for organic solvents, oils and water. Even to alkalies it exhibits surprisingly strong resistance.

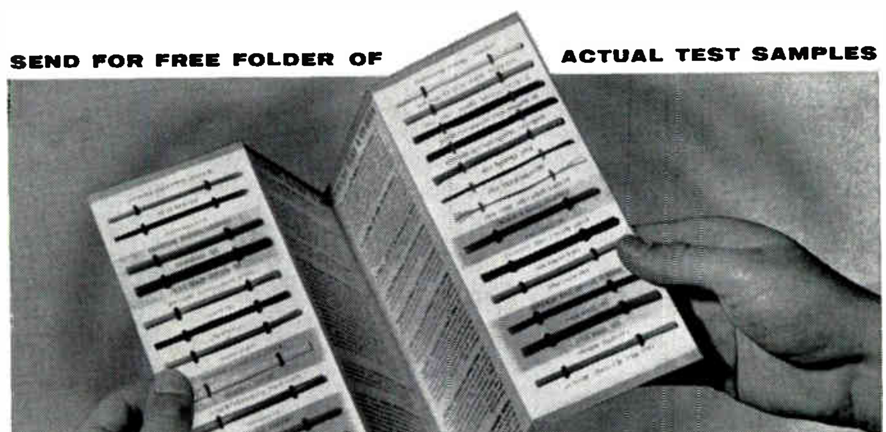
Put the heat on it. Subject it to temperatures up to 150°C. over a long period. Go even further: expose it to 225°C. for 15 minutes. There will be no softening, flowing, blistering, or loss of dielectric strength. Like all Varflex products, Varglas Acrylic is made to exceed Government, IEEE and NEMA standards by far.

Made of modified acrylic resin on Fiberglas braid, this sleeving is compatible with polyester, acrylic, epoxy, phenolic, and formvar enamels. It can be ordered in a full range of sizes and coding colors.

You'll find our service on the same high level as our products: immediate off-the-shelf shipment or on special production, one week.

VARFLEX CORPORATION, 308 N. Jay Street, Rome, N. Y.

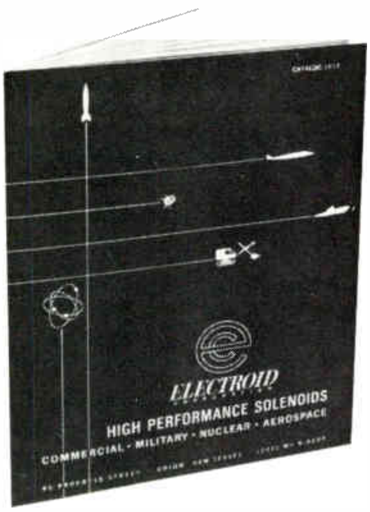
SEND FOR FREE FOLDER OF ACTUAL TEST SAMPLES



Circle 100 on Inquiry Card

World Radio History

This is the most revolutionary solenoid catalog ever written !



If you specify high performance DC solenoids, it will be well worth your while to write for it immediately. For the first time, a solenoid catalog allows you to pinpoint the unit that matches your design requirements... by utilizing a master selector and a system of multiplier factors. Fast, easy, accurate. Write for yours today. ELECTROID Corporation, 56 Progress St., Union, N. J., (201) MU 6-8290.

ELECTROID CORPORATION

55

Circle 101 on Inquiry Card

NEW PRODUCTS

TWO GUN OSCILLOSCOPE

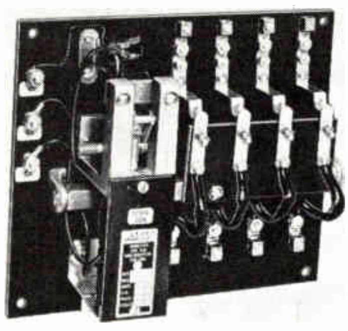
Permits viewing 2 separate signals simultaneously without time sharing.

Model 5MC2P allows simultaneous viewing without beam switching. Other features include a 3½ in. flat-faced CRT with choice of phosphors for short, medium or long image persistance; sweep range from 1μsec./cm to 1 sec./cm; a calibrated sweep magnifier; and horizontal positioning beyond 10 dia. Bandwidth is dc to 5MC (3db), and sensitivity is 100v./cm to 100mv/cm with high sensitivity of 1mv/cm on 1 beam at reduced bandwidth. A built-in precision signal generator allows rapid calibration at the front panel. Binary Electronics of Calif., 1429 N. State College Blvd., Anaheim, Calif.

Circle 280 on Inquiry Card

MULTIPOLE RELAYS

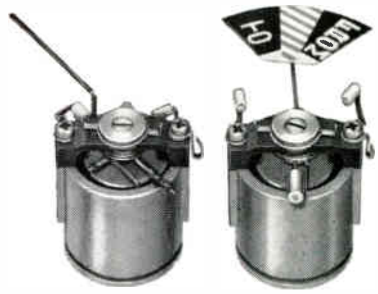
Available either mechanically held or electrically held.



Two new relays are available which provide single or double throw multipole control of electrical circuits, and are rated 25a./pole. Both types are equipped with heavy-duty silver contacts, and are available in a variety of N.O. and N.C. pole arrangements to a max. of 18 N.O. poles. The mechanically held design is used wherever the relay must be unaffected by voltage or line failure, or where the minor ac hum of electrically held units cannot be allowed. Where minor ac coil hum can be permitted, the electrically held design is ideal. Zenith Electric Co., 152 W. Walton St., Chicago, Ill.

Circle 281 on Inquiry Card

High torque, Self-shielded



AI-2 (actual size)

moving coil mechanism

Versatile mechanisms for critical indicating and control systems have "On-off", "+, –". "Go-no go", null, left-right, or scale indicators. High torque, self-shielded core magnet design permits grouping of functions in small panel space. Moving coil weighs 100 mg less and provides at least 10% more torque than best previously available mechanism of this type. Wide choice of sensitivities; synchro or standard mounting.

AMMON

AMMON INSTRUMENTS, INC.
345 Kelley Street, Manchester, N. H. 03105

Circle 102 on Inquiry Card

NEW DIGITAL TIMER

FOR ALL-PURPOSE LABORATORY and INDUSTRIAL

TIMING

DIRECT READING—TIMING AT A GLANCE

DIGITAL CLOCK

#160-12H.......... 12 HOUR
#161-24H.......... 24 HOUR

Independent front panel time reset controls. Digits resettable individually. Front panel mount . . desk or bench use. ⅝" digits—12 hour. 5/16" digits—24 hour. Completely enclosed anodized metal dust-proof case. H 4½", W 6", D 3¼". Wt. 3½ lbs. 120V 60CPS. Also available in all voltages.

Complete Line: Delay, Interval and Cycle Timers, Digital Computers
CATALOG ON REQUEST

PENNWOOD NUMECHRON CO.
TYMETER ELECTRONICS
7249 FRANKSTOWN AVE., PITTSBURGH, PA. 15208

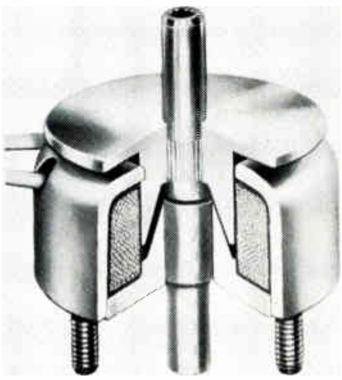
Circle 103 on Inquiry Card

World Radio History

NEW PRODUCTS

PUSH/PULL SOLENOID

For extremely rapid response and high force to size.

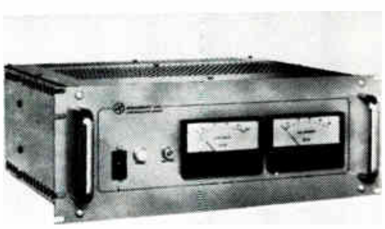


This solenoid responds in less than 10msec. at intermittent duty, and is available with conical or flat-face plungers. It is precalculated to deliver optimum performance. It uses a precision-wound coil for max. copper in minimum space. Operating voltage are 28vdc and 115vac rectified, continuous and intermittent duty. Ledex Inc., 123 Webster St., Dayton, Ohio.

Circle 335 on Inquiry Card

VOLTAGE REGULATORS

The 500va to 5kva units can establish precise ac voltages for all rated loads.

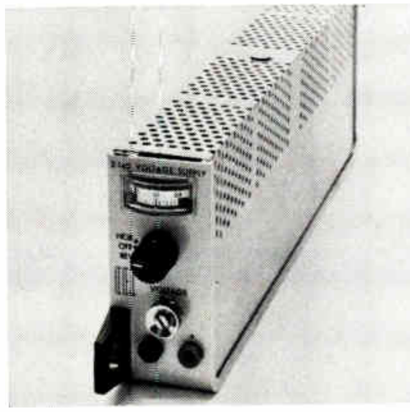


These LVRs are capable of supplying the transients of current associated with motor starting, lamp loads, etc. without limitation. They can be used in 3 phase wye or delta configurations for balanced or unbalanced loads. Reliability is high because all semiconductors are isolated from power - handling circuits to avoid components failure by voltage or current transients. The actual load current and supply voltage are handled by magnetic currents. Input voltage range is 103 to 127v. with output of 115v.; output range is 100 to 120v. Regulation is ±0.1 RMS. Response to line and load charges is 30 to 75msec. Input freq. is 57-80 CPS. Microdot Magnetics, Inc., 5960 Bowcroft St., Los Angeles, Calif.

Circle 336 on Inquiry Card

VOLTAGE SUPPLY

Output of 1 to 24v. and current to 200ma. Up to 1.6a. output in parallel mode.

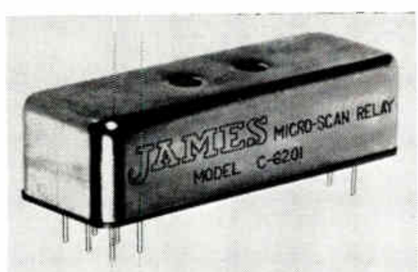


The type 3-140 voltage supply is a single-channel strain-gage unit. It is desinged for use by the aerospace, atomic power, and commercial manufacturing industries. The supply is used with strain-gage transducers and other commonly used devices requiring a dc excitation voltage. Consolidated Electrodynamics Corp., subs. of Bell & Howell Co., 360 Sierra Madre Villa, Pasadena, Calif.

Circle 337 on Inquiry Card

SINGLE-THROW RELAY

Designed for multiplexing dry circuit signals from transducers.



Series 6200 is available in 6 models including DPST and 3 PST, with Form A contact configurations in 6, 12, or 20v. drive. They are used in high-speed, low-noise applications such as data acquisition, instrumentation, direct digital control, process control equipment, and other data identification uses in the μv range. One pole of the 3-pole design is built with heavy duty contacts for switching the signal pair shield. This provides common mode rejection up to 200v. Electrostatic noise is less than 4 x $10^{-5}\mu v/\Omega$, with thermal offset less than $0.5\mu v$. Operate and release times are each $750\mu sec.$ max. Repetition rate is up to 250 pulses/sec., bounce free. James Electronics, 4050 N. Rockwell Ave., Chicago, Ill.

Circle 338 on Inquiry Card

BETTER SOLDERING

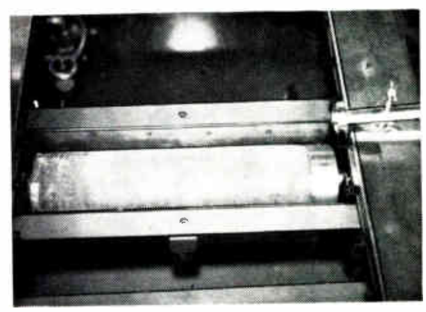
***by* London Chemical Company**

SPRAY FLUXING

LONCO RESIN FLUXES are particularly well adapted to spray application. For short runs hand spraying, with templates restricting flux to bottom of boards, can be used. Adequate ventilation is a positive requirement.

For longer runs, automatic spraying equipment is used and here LONCO RESIN FLUXES, with excellent surface tension reducing characteristics, ensure positive wetting and excellent soldering with minimum flux residue.

TYPICAL SPRAY FLUXING EQUIPMENT



Typical Spray Fluxing Unit (Dee Electric Co., Chicago 13, Illinois) incorporates a revolving mesh drum with air tube mounted close under top of drum. As drum revolves in flux air blows flux from mesh drum to circuit board. Excellent flux wetting is achieved.

Write for Application Data Sheet No. 117 covering SPRAY FLUXING TECHNIQUES.

LONCO EMULSIFIERS LONCO CHEMICAL SPECIALTIES

LONDON CHEMICAL COMPANY, Inc.

1533 N. 31st Ave.
MELROSE PARK, ILL.

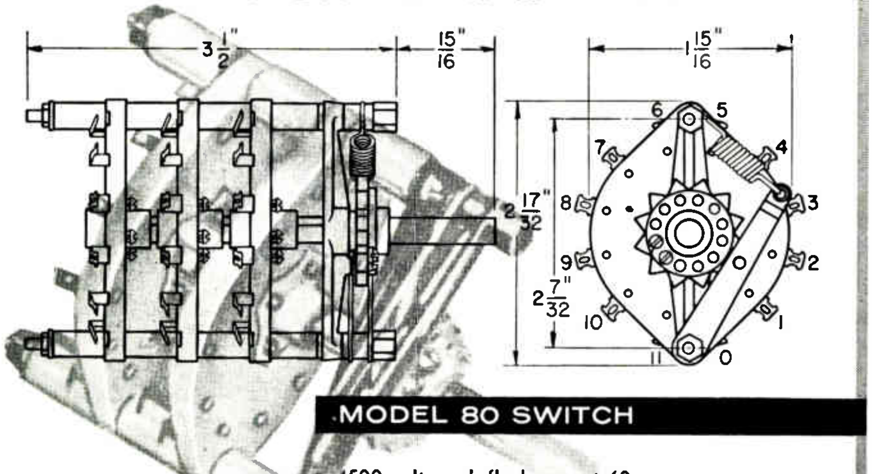
MEMBER IPC

Chemicals for Electronic Production

Circle 104 on Inquiry Card

World Radio History

Switch to the Best



MODEL 80 SWITCH

- 4500 volt peak flashover at 60 cps
- 10 ampere current carrying capacity
- Current carrying members heavily silver plated
- Kel-F rotors • Steatite spacers and stators
- Black anodized die cast aluminum support bracket
- Nylon detent wheel • Stainless steel detent arm
- Oil impregnated bronze sleeve bearing

RSC FOUNDED 1933

RADIO SWITCH CORPORATION

MARLBORO, NEW JERSEY • Telephone: HOpkins 2-6100

Circle 105 on Inquiry Card

ULTRA-COMPACT 4 CRYSTAL FILTERS for 4.0 to 7.5 MEG. RANGE*

Sharpens band pass of IF's in AM receivers.
Good shape factor and low insertion loss.
Only 5/8" square x 1 11/32" high.
Temperature range: −30°C to +65°C.
*Other filters from 1 kc to 100 meg. available.

50
40
30
DB
20
10
0

-15 -10 -5 0 +5 +10 +15
KC

JK PRODUCTS

CTS KNIGHTS, INC.

(Formerly the James Knights Company)

SANDWICH, ILLINOIS

a subsidiary of **CTS** Corporation, Elkhart, Indiana

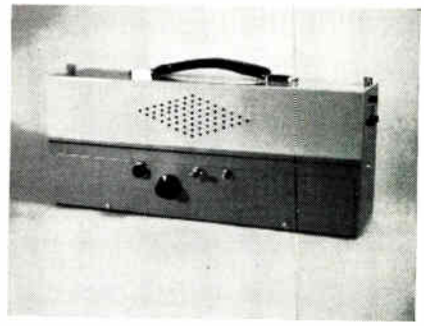
CTS KNIGHTS

Circle 106 on Inquiry Card

NEW PRODUCTS

PORTABLE LASER

Dc-excited gas laser with power output of 1.0 to 1.5ma.

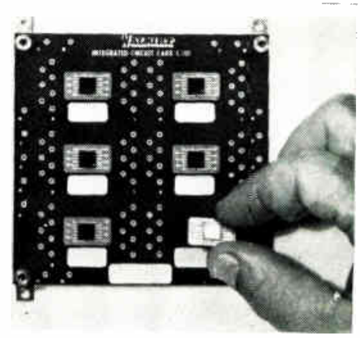


Model 715-1 helium-neon dc-excited gas laser is a portable, self-contained unit weighing less than 15 lbs. It is 15½ x 6¾ x 4 in. It can be plugged into any 115vac line and may be mounted in any orientation. The output wavelength is 6328Å. Power output is 1.0 to 1.5mw multimode, and up to 0.3mw single mode. Beam divergence is 6 milliradians angular, uncollimated, for the confocal configuration, and 3 milliradians, collimated. Beam dia. at the exit mirror is 2 mm. Maser Optics, Inc., 89 Brighton Ave., Boston, Mass.

Circle 284 on Inquiry Card

FLAT-PACK BREADBOARD

Allows rapid assembly of I.C. flat-packs into final system configuration.



This system consists of individual carriers for I.C.'s and a PC mother board which allows up to 6 I.C. carriers to be plugged in, or soldered, to the mother board. Several mother boards can be attached to each other so that final array is just like a production system, with practically no sacrifice in system size. Wiring hook-ups are made to forked terminals on opposite side of the I.C.'s to prevent damage during assembly wiring. By using all available plug-in features, individual I.C.'s and mother boards can be used over and over again in other systems. Walkirt, 10321 S. La Cienega Blvd., Los Angeles, Calif.

Circle 285 on Inquiry Card

World Radio History

NEW PRODUCTS

DRY REED SWITCH

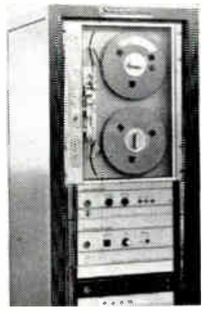
Has fast closure time and low bounce. Ideal for explosive atmospheres.

Series G is a compact dry reed switch with a behind-panel length of 0.975 in. The new switch is available with up to 4 PST or 2 PDT, with each pole isolated. It has a max. contact rating of 0.5a or 12w. @ 125vac. Dielectric of its hermetically sealed, oxygen-free contact area, it is ideal for dry circuits in corrosive or explosive atmospheres. George Risk Industries, Inc., 672 15th Ave., Columbus, Nebr.

Circle 339 on Inquiry Card

DATA RECORDER

Records up to 100 analog inputs of 50mv to 5v. full scale data.



The solid-state 755 records on magnetic tape in IBM-compatible format at 500 tape characters/sec. The input impedance is over 100 megohms. The 755 can be supplied with a single input channel or with an analog multiplexer for any number of input channels. Up to 100 input channels are standard. More can be supplied if needed. Electronic Engineering Co. of Calif., 1601 E. Chestnut Ave., Santa Ana, Calif.

Circle 341 on Inquiry Card

ACCELEROMETER

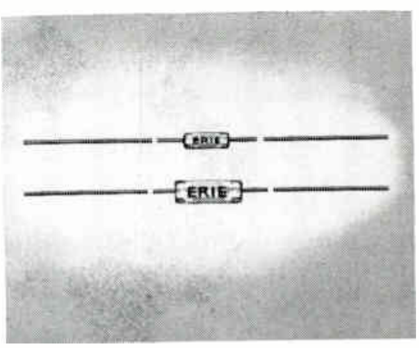
Particularly well suited for mounting in confined spaces.

Model 2222 piezoelectric accelerometer is 0.25 in. hex x 0.20 in. high. Its light weight, 0.5 gram, permits measurement of the motion of circuit boards, components, airframe skin and other lightweight structures with negligible loading effects from its own mass. This transducer is adhesive mounted and it is optimized for operation with both charge and voltage amplifiers. Endevco Corp., 801 S. Arroyo Pkwy., Pasadena, Calif.

Circle 343 on Inquiry Card

GLASS CAPACITORS

True glass hermetic seal protects against environmental conditions.

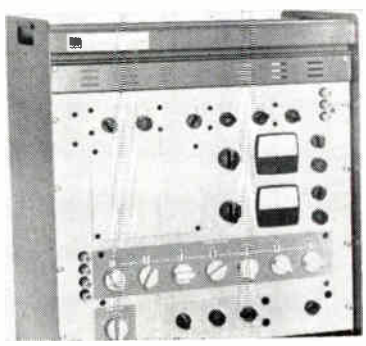


These 2 Monobloc glass encased capacitors are available in capacitance ranges to 0.068mf. The smallest of the 2 measures 0.100 in. in dia. x 0.260 in. in length in a capacitance range to 10K pf. The 0.68mf capacitor measures 0.130 in. in dia. x 0.390 in. in length. Insulation resistance after 20 days of moisture cycling/Mil std. 202, method 106A is 20K megohms. In manufacture, very thin films of ceramic are bonded into solid structures, yielding high capacitance-to-volume ratio. The resulting construction is said to provide rugged capacitors for critical uses. Samples available upon request to Erie Technological Products, Inc., Erie, Pa.

Circle 340 on Inquiry Card

MEASURING SYSTEM

Seven decade dials provide 1μv resolution on the lowest range.

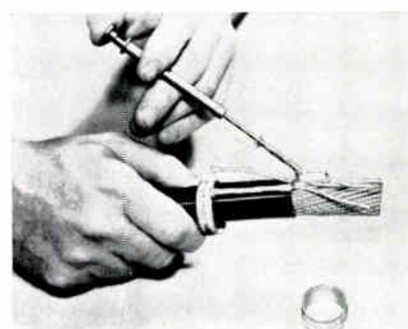


The Model 1045A voltage measuring system provides direct-reading measurement of dc voltage from 1.111.1110v. full scale to 11.111110v full scale on 3 ranges. The system combines a direct-reading potentiometer, a direct-reading standard cell comparator, a guarded volt-box and 2 independent null detectors. A self-calibrating feature permits a conservative accuracy rating of ±5 ppm +1μv of reading for most settings. Calibration adjustments can be made in a matter of minutes and with no external calibration equipment. Electro Scientific Industries, Inc., 13900 N.W. Science Park Dr., Portland, Ore.

Circle 342 on Inquiry Card

EXTRACTOR TOOL

Quickly separates the conductor from the braid, leaving the braid intact.



The Lead Extractor is a tool for extracting the conductor in shielded cable preparatory to installing a connector or terminal. It is available in 5 sizes which accommodate shield dia. of 0.055 in. through 0.248 in. Use of the new tool requires no special training. After the insulation is stripped off and the braid flared, the conductor tube is slipped over the insulated wire until the desired breakout point is reached. At this point the wire is bent down and the plunger at the end of the tube is pushed. The lead will be extracted from the braid at the desired point. The Thomas & Betts Co., 36 Butler St., Elizabeth 1, N.J.

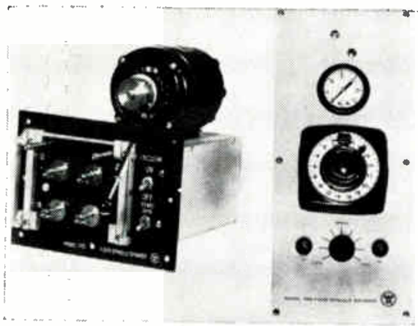
Circle 344 on Inquiry Card

World Radio History

NEW PRODUCTS

SPINNING DEVICE

For applying a thin, uniform coating to 4 semiconductor wafers simultaneously.

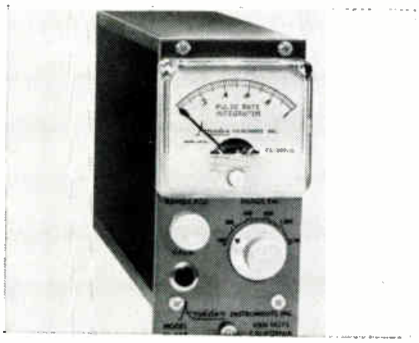


This 4-spindle spinner is capable of spinning 4 wafers of up to 1½ in. dia. simultaneously at speeds to 6900 rpm. It can be used to apply any of the usual etching chemical coatings. The 4 spindles are loaded from a combination carrier and baking tray, which makes it unnecessary to disturb the wafers throughout the spinning and baking operations. Once the coating has been applied and the spin cycle is initiated, the smooth, rapid acceleration of the spindles spreads the coating uniformly by centrifugal force. Westinghouse Scientific Equipment Dept., P. O. Box 868, Pittsburgh, Pa.

Circle 332 on Inquiry Card

FREQ.-TO-DC CONVERTER

Furnishes low impedance dc output proportioned to freq. or pulse input.

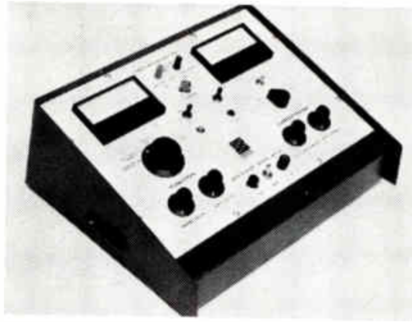


Model P1-400 Freq.-to-DC Converter furnishes a low impedance dc output voltage and current precisely proportional to the freq. or input pulse rate. It also gives a visual meter indication of input freq. and a pulse output for operating counters and recorders. The unit can be used with low level sources such as flowmeters and tachometers. Continuous adjustment is provided by a range selector switch and a range adjusting pot to obtain full scale output for any freq. input from 100 CPS to 3200 CPS. The output is accurate to 0.1%. Anadex Instruments Inc., 7833 Haskell Ave., Van Nuys, Calif.

Circle 333 on Inquiry Card

SCR TESTER

Designed to measure device performance at forward currents up to 100a.

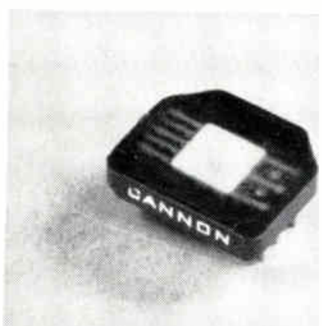


Built for use in engineering labs, incoming inspection, and quality control organizations, the Model MP-122 combines simplicity of operation with a high degree of accuracy. It allows rapid device characterization with capabilities for failure analysis, unit-to-unit parameter matching, and vendor sample evaluation. It measures forward and reverse blocking voltage and leakage current, gate firing current and voltage, holding current and forward voltage, gate turn off gain, dv/dt, di/dt, and UJT characteristics of standoff ratio and valley voltage. Sensory Systems, Inc., P. O. Box 2071, Costa Mesa, Calif.

Circle 286 on Inquiry Card

MODULE CARRIER

Permits flat pack modules to be plugged into PC boards.



The Bug Plug™ module carrier is for integrated circuits with microminiature contacts. They can be plugged directly into PC boards. Repair difficulties are greatly reduced since a defective unit can be simply unplugged and replaced. Leads from integrated circuits are attached to the contacts of a module by percussive/arc or resistance welding. After the leads are secured, the unit is encapsulated for protection. The modules are capable of withstanding shock up to 50g's and vibration up to 2KC without resonance or of continuity. ITT Cannon Electric, 3208 Humboldt St., Los Angeles, Calif.

Circle 334 on Inquiry Card

CONTACT CONNECTORS

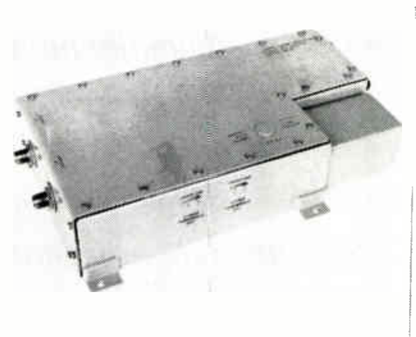
Meets the wire wrapping standards of data processing equipment.

This line of hermaphroditic contact connectors have 0.045 in. sq. tail wire-wrap terminations. The terminations are extremely rigid and will not bend out of position when subjected to normal production handling procedures. The offset contact used has a 0.045 in sq. tail termination as required for programmed wire wrapping. The contact itself can be supplied in bulk for insertion in customer's mother board. A special seating section facilitates retention in the mother board when contacts are used individually. Cinch Mfg. Co., 1026 So. Homan Ave., Chicago, Ill.

Circle 287 on Inquiry Card

TUNNEL DIODE AMPLIFIER

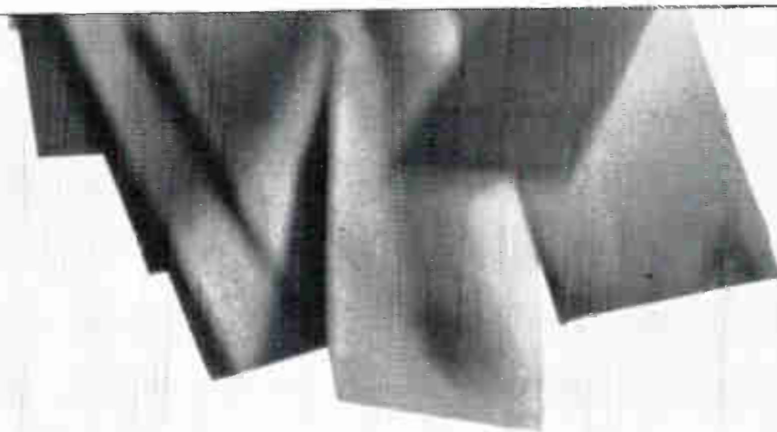
Maintains a flat gain of 17 ±1db with a 4.9db max. Noise figure from 5.4GC to 5.9GC.



The D65C4 tunnel diode amplifier assembly has self-contained failure logic circuitry, diode bias supply, 5-port switching circulator, and redundant battery. It uses the system coolant to maintain a constant internal temp., permitting operation over the 0° - 65°C amb. range. In the event of diode failure, min./max. bias current sensors automatically switch the 5-port circulator to bypass the amplifier. Another automatic feature is switching to the internal bias battery upon failure of the external bias supply. Sperry Microwave Electronics Co., P.O. Box 1828, Clearwater, Fla.

Circle 288 on Inquiry Card

World Radio History



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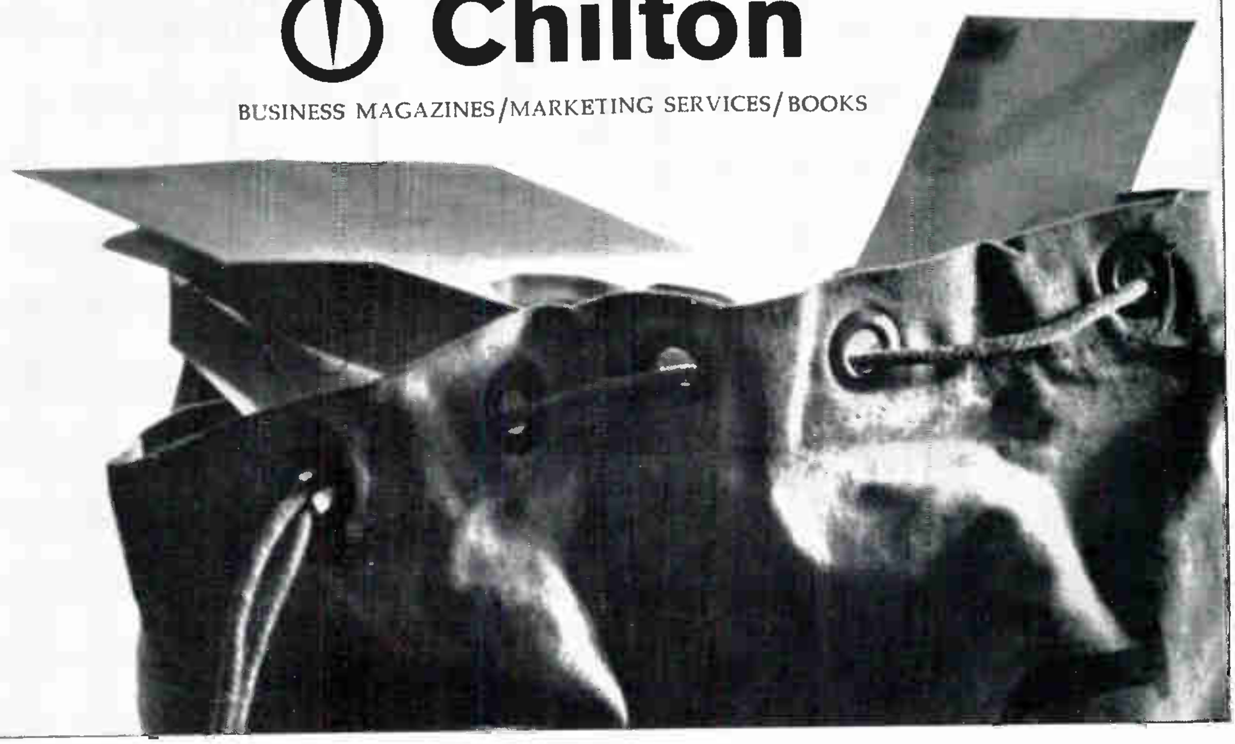


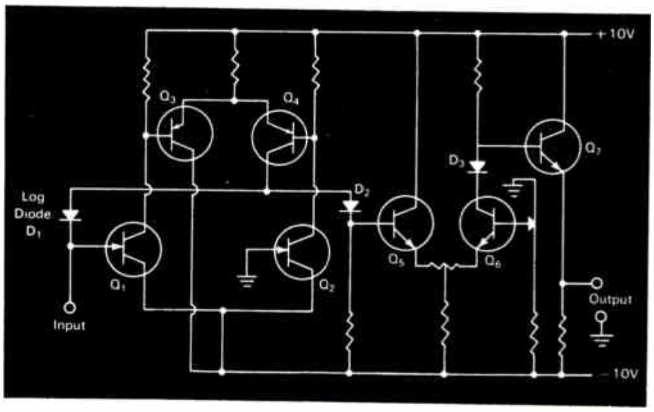
World Radio History

Logarithmic Amplifier Uses FET

SOME INSTRUMENTATION AND RECORDING applications require a logarithmic response to an input signal having a range of current variation from 10^{-12} to 10^{-4}a. Temperature compensation also is required.

A solid-state amplifier that uses field-effect transistors and planar junction diodes is a solution. The basic circuit is a temperature-stabilized amplifier composed of 3 differential amplifier stages, an emitter-follower output stage, and a planar-junction logarithmic diode.

The required response to large range of input current variation is achieved by using 2 n-channel field-effect transistors, Q_1 and Q_2 for the first differential amplifier stage. Because of the very high input impedance of these transistors, they are also sensitive to very small current.



The transistors, Q_1 and Q_2 drive the second differential amplifier stage, Q_3 and Q_4. The output of Q_3 is applied to the final differential amplifier stage, Q_5 and Q_6, and to the planar-junction logarithmic diode, D_1. By inserting D_1 in the feedback path to the first differential amplifier stage, the logarithmic output of the circuit is achieved.

The output of Q_8 is applied to Q_7, which is operated as an emitter-follower. This provides a high output impedance for the amplifier. The differential amplifier structure of the circuit provides temperature compensation.

For optimum overall characteristics, the components should be matched. The final output voltage, E_o, taken between the emitter of Q_7 and ground, will be $E_o = K_1 \log(5 \times 10^{11} I_{in} + 1) + K_2$.

For further information contact: Technology Utilization Officer, Jet Propulsion Lab., 4800 Oak Grove Dr., Pasadena, Calif., 91103. Ref: B65-10145.

Reducing Distortion of FM Modulator

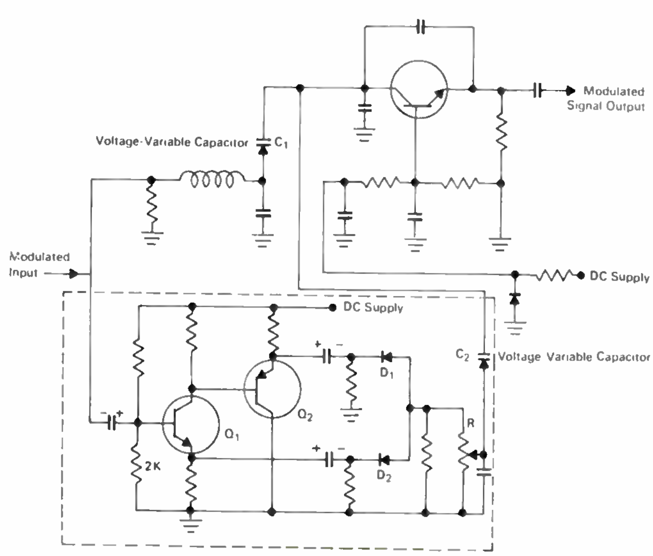
SECOND HARMONIC and intermodulation distortion of a voltage-variable capacitor used to modulate an oscillator had to be reduced. A correction circuit designed to improve the linearity of the voltage-variable capacitor used to modulate a free-running oscillator was tried.

The diagram shows the use of the voltage-variable capacitor C_1, with the correction circuit enclosed in dashed lines. The modulating signal input is phase-inverted and amplified (by Q_1-Q_2) and applied to the full-wave-rectifier diodes D_1 and D_2 to generate the second harmonic without introducing any of the fundamental frequency into the correction circuit. Operation takes place in the square-law portion of the rectifier-diode characteristic, so that D_1 and D_2 also perform a squaring function.

The output from the rectifier-squaring network is applied to the potentiometer, R, which then provides a correction signal to the voltage-variable capacitor C_2 across the tuned circuit of the oscillator. The correction signal must have the proper polarity to reduce total tank-circuit capacitance on both the positive and the negative peak swings of the modulating signal input. A gain control at the rectifier output provides for adjustment of the correction-signal level.

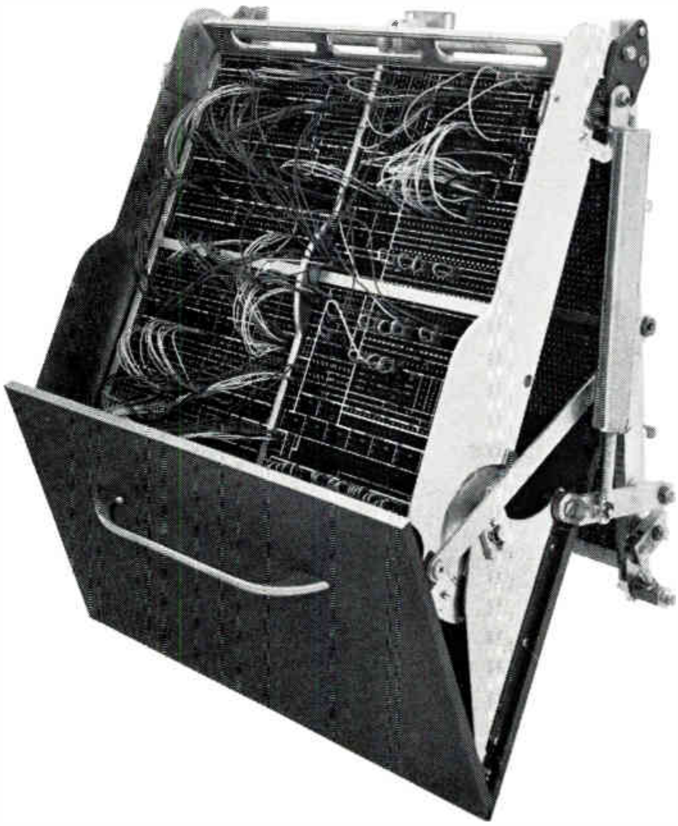
Although this circuit was designed to improve the linearity of modulation of a free-running oscillator, where modulation is done by use of a voltage-variable capacitor, it may also be applied to either the master oscillator in a radio transmitter or a subcarrier oscillator in a telemetry system. However, this improvement is applicable only to a-f modulation, and will not correct for slowly varying dc inputs in some telemetry systems.

For further information contact: Technology Utilization Officer, Goddard Space Flight Ctr., Greenbelt, Md., 20771. Ref: B65-10152.



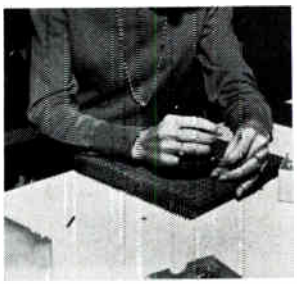
World Radio History

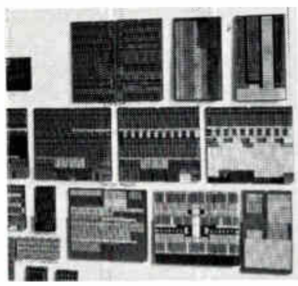
Mac Panel
Plugboard Programming Systems

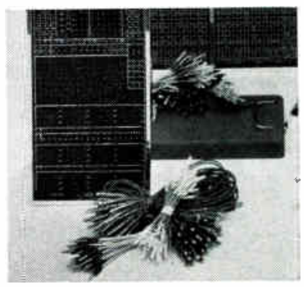


Mac Panel total engineering assures you of precisely made systems that meet the most critical requirements.


System design and engineering


Precise handwork


General or special legend silk-screening


All types of plugwires

Total engineering at MAC Panel means that from initial design through delivery, each Plugboard Programming System receives personal attention by skilled engineers. This attention to detail guarantees that the system specifications meet all of your requirements for circuits, space limitations, environmental conditions, signal levels, frequency range, and reliability. From the precise handwork necessary for contact spring placement to the silk-screening of general purpose or multi-color special legends, you are assured of receiving only top quality, precision products. ☐ MAC Panel offers eleven standard sizes of Plugboard Programming Systems and a wide variety of standard Plugwires. We can also provide custom designed systems and wires for special applications. Find out how MAC Panel can give you a reliable, low-cost method of flexible program control in your equipment. See your MAC Panel representative or write today.

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ACTUAL SIZE

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GROWING CRYSTALS (Concluded) . . . *from page 82*

There are a number of variations of this method used for growing specific crystals. Growing boules and crystals by the plasma method is one that combines the basic Verneuil technique with r-f induction heating and high temperature induction coupled plasma. Other variations include use of image furnaces that use heat from the sun or from carbon arcs focused by mirrors.

Gas Phase Method

A large number of techniques use the gas phase method for growing crystals, and especially for the epitaxial growth of silicon for transistors. In growth by sublimation, a solid substance is converted directly into gas and back again to a solid. High vacuum often aids this process and heating or cooling the seed crystal or growth area is often needed.

A second gas technique uses a chemical reaction to prepare the growth material right in the growth region. A volatile silicon substance and a carbon compound such as toluene are vaporized in separate gas streams and brought together in a heated zone where the reaction yields silicon carbide. This process is very important in epitaxial growth of silicon, where the reaction of silicon tetrachloride with hydrogen deposits a layer of silicon onto a heated silicon crystal.

All in all, these techniques permit man to produce in hours and days the materials that occupied natural processes for whole geological ages; the man-made varieties are often in much purer form. Synthetic crystals are used instead of the natural when natural material is inadequate in purity, size, or availability.

The way we approach the growth of a new material must be based on knowledge of the properties of the material, including melting point, vapor pressure, existence of phase changes, decomposition with temperature, solubility, reaction with solvents, purity requirements, and so on. This knowledge must be matched with parameters of the various growth techniques.

NEW EIA ENGINEERING HEAD

David R. Hull (left) is new director of EIA Engineering Department and two-term past president. Center is Dr. Harper W. North, EIA president, and vice president R&D, TRW Inc. Frederick Lack (right) is retiring director who headed department since 1949. Announcement was made at EIA's 1965 annual convention in Chicago.

Circle 56 on Inquiry Card

World Radio History

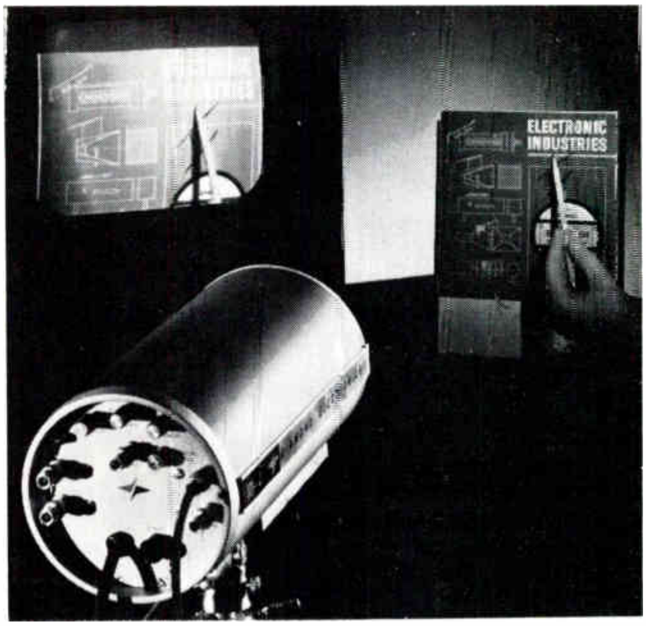
VOLTAGE CONTROL AIDS COMPUTER ACCURACY

ERRATIC COMPUTATIONS CAUSED BY LINE-VOLTAGE DROPS have long been a problem in computers. This appears to be solved by a ⅜ in. dia. microelectronic circuit which provides optimum error-free performance by rigid control of voltages.

The circuit, designated NCS-675A, precisely regulates, or adjusts the voltages at individual points of use throughout the computer. They replace bulky and complex conventional systems which control the voltages from a central power source. By regulating the voltage directly at point of use, the circuit provides a more stable voltage—which is essential to error-free operation of the calculating circuits. The microcircuit also permits greater flexibility of computer design, since each unit operates independently. Thus a temporary overload at any point in the computer system will not affect other points.

The NCS-675A, a product of General Instrument Corp., Hicksville, N. Y., is designed for use with 5v. integrated circuits. It contains 2 high performance silicon epitaxial transistors, a compensated zener diode reference element and a 3-resistor network, all packaged in a TO-5 can. The voltage regulator is used with an external power transistor to allow handling up to 5a. of current.

While providing smaller and more efficient voltage control (to ±0.2v.) and thus more reliable computer calculations, the new microcircuit also can make for lower cost of commercial computers.



NEW TV CAMERA

To show us the sharpness of the image projected by their new closed circuit TV camera, Diamond Electronics used as a subject this Nov. 1964 issue of ELECTRONIC INDUSTRIES. Diamond engineers report that the new camera, St-2, is the first industrial-commercial use of molecular integrated circuits (micrologic components).

NEW Coaxial Pulse Connectors 15 KV RMS

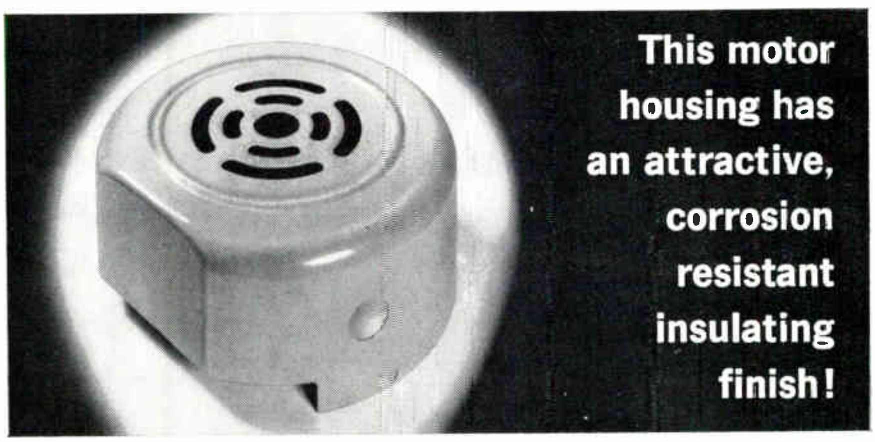
This new feed-thru and associated 15kv AC cable connectors are designed for corona-free performance with no derating even at altitudes of 15 miles. Engineered to keep noise transients/radiation and dielectric degradation to minimum levels.

Typical characteristics of this series are: Corona-free level 20kv RMS; Hi-Pot test, 40kv DC; current capacity, 20a average; temperature range — 65°F to 250°F; 50 ohms nominal impedance.

Write or call Ken Weast, Sales Manager or Louis Galambos, Engineering Director for details.

ROWE Industries, Inc.
CABLE DIVISION
1702 AIRPORT HIGHWAY • TOLEDO, OHIO 43609
TWX 419-379-0186

Circle 76 on Inquiry Card



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Typical rotor and stator insulated with Vibro-Flo Epoxy Coatings

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World Radio History

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VOID-FREE CORE SOLDER

CEN-TRI-CORE® CAN REDUCE YOUR COSTS AND INCREASE YOUR RELIABILITY . . .

- Consistently reproducible results.
- No rejects due to lack of flux.
- Eliminates operator adjustments due to flux percentage variations.
- Every inch of solder is usable — up to 33⅓% more joints per pound of solder used.
- Special core construction gives proper sequence of melting —flux flows in front of molten solder due to thinner solder wall.

CEN-TRI-CORE'S UNIQUE CONSTRUCTION

ASSURES GREATER CONSISTENCY

REDUCES SOLDERING TIME BY ⅓

(center wire is rosin coated prior to extrusion of outer sleeve)

- Provides for instant release of fast acting, quality controlled fluxes.
- Available in 8 precisely controlled flux percentages — each held to a tolerance of ±.2% by weight.
- Exceeds Federal Spec. QQ-S-571d — made from higher purity materials and held to closer tolerances.
- Supplied with fully activated, mildly activated and pure water white rosin cores.

Write or call for Bulletin A-103A, a generous free sample of Cen-Tri-Core, and information on Leak-pruf® acid-filled and organic flux-filled core solders.

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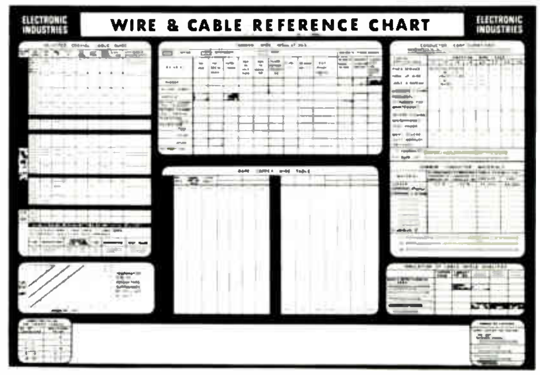

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WIRE & CABLE Reference Chart

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Prepared by the editors of Electronic Industries, the information on this chart has never been presented in this manner before.

In the September issue— LOOK FOR IT!

ELECTRONIC INDUSTRIES

The STATE-OF-THE-ART Magazine for Electronic Engineers

World Radio History

ELECTRONIC INDUSTRIES

SPECIFICATIONS OF POWER RELAYS

(Continued from page 58)

POWER RELAYS	TYPE NO. OF SERIES	AC CONTACTOR	DC CONTACTOR	GENERAL PURPOSE	HIGH VOLTAGE CONTACTOR	HIGH CURRENT CONTACTOR	LOW VOLTAGE CONTACTOR	MERCURY CONTACT	MOTOR FIELD	INDUSTRIAL	OVERLOAD	PLUNGER TYPE	REVERSING CONTACTOR	TIME DELAY	UNDER VOLTAGE	PHASE PROTECTION	PLUGGING RELAY	NO. OF POLES	CONTACT FORM	NOM. CONTACT VOLTAGE (V)	NOM. CONTACT CURRENT (A)	NOM. COIL VOLTAGE (V)	NOM. COIL POWER (W)	NOM. COIL VA	MINIATURE	ENCASED	HERMETIC SEAL	MIL SPEC
Couch Ordnance, Inc. 3 Arlington St. N. Quincy 71, Mass.	2B		X	X														2	C	30	10	to 250	2	2	X	X	X	X
Cramer Div. Giannini Controls Corp. Old Saybrook, Conn.	412E			X						X				X				2	A	120	15	120	7.0	10.5		X		
	450A			X						X				X				2	A	120	15	120	7.0	10.5		X		
	310E			X						X				X				1	A	120	20	120	2.7	4.75		X		
Crane Electronics Co. 1401 Firestone Santa Barbara, Goleta, Calif.											X			X	X										X	X	X	X
Cutler Hammer, Inc. 315 N. 12th St. Milwaukee, Wisc. 53201	PR	X															X			600								
	RP	X													X	X						to 550						
	LR	X				X													SPDT	to 600	1.5K							
	—	X																1-4			1.2K					X		
	—	X											X					1-4								X		
	—		X															1-2			.8K	to 550				X		
	ST/SW	X	X	(thermal)							X								NC/NO									
	SR	X	X								X							2										
	6042	X	X	X														1-3	ST/DT		to 300	28/120				X	X	X
	MX	X								X								1	DT		16					X		
	AA	X	X							X								1	NO/NC	230	15							
	BG	X								X								2-8	NO/NC		15							
Durakool, Inc. 1010 N. Main St. Elkhart, Ind.	BF/C	X						X		X								2/3	NO	to 460	60/35	115						
	BB/C	X						X		X								2/3	NC	to 460	60/35	115						
	CF/C	X						X		X								2/3	NO	to 460	100/75	115						
	CB/C	X						X		X								2/3	NC	to 460	100/75	115						
Eagle Signal Div. E. W. Bliss Co. 736 Federal St. Davenport, Ia. 52803	25PD	X	X	X														1	STDB	115	25	to 250		3.6				
	25PA	X	X	X														1	STDB	230	25	to 250		3.6				
	25PS	X	X	X															SPDT	230	25	to 250		3.6				
Ebert Electronics Corp. 130 Jericho Tpk. Floral Park, N. Y.	MR	X	X		X	X	X	X	X	X		X						1,2	NO/NC	115	20	230					X	
	EM 1,2,4	X	X		X	X	X	X	X	X		X						1,2	NO/NC	115	35	230					X	
	HD 1,2,4	X	X		X	X	X	X	X	X		X						1,2	NO/NC	115	60	230					X	
	EM 7	X	X		X	X	X	X	X	X		X						3	NC	115	35	230					X	
	HD 7	X	X		X	X	X	X	X	X		X						3	NC	115	60	230					X	
	—			(thermal)								X		X				1,2,3	ST	115	to 60						X	
	100	X	X		X	X	X	X	X	X									NO/NC	115	100	to 440					X	
E-T-A Products Co. of America 6284 Cicero Ave. Chicago 46, Ill.	46-500-P										X									250	to 10					X		
	SK0019													X				1	NO NC	110	10	to 230	2.5			X		
	SK0023	X									X							3		500	to 5					X		
Filtors, Inc. 65 Daly Rd. E. Northport, L. I.	BRF			X														2	C			26.5	2.3		X	X	X	X
General Electric Co. Industry Control Dept. 1501 Roanoke Blvd. Salem, Va.	IC2812/12	X	X				X	(Nema sizes 6,7,8,9)										2,3,5				to 600						
	IC2814	X	X		X													3,5	NO NC	to 5K	400							
	IC2827	X	X								X									to 550	5							
	IC2824										X								NO NC	to 550	10							
	IC2820								X		X		X			X				110	15					X		
	IC2800	X	X	X														1,2			to 100							
	IC2800	X	X															1,2			to 2.5K							

(Continued on next page)

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ELECTRONIC INDUSTRIES

POWER RELAYS (Continued)

POWER RELAYS	TYPE NO. OF SERIES	AC CONTACTOR	DC CONTACTOR	GENERAL PURPOSE	HIGH VOLTAGE CONTACTOR	HIGH CURRENT CONTACTOR	LOW VOLTAGE CONTACTOR	MERCURY CONTACT	MOTOR FIELD	INDUSTRIAL	OVERLOAD	PLUNGER TYPE	REVERSING CONTACTOR	TIME DELAY	UNDER VOLTAGE	PHASE PROTECTION	PLUGGING RELAY	NO. OF POLES	CONTACT FORM	NOM. CONTACT VOLTAGE (V)	NOM. CONTACT CURRENT (A)	NOM. COIL VOLTAGE (V)	NOM. COIL POWER (W)	NOM. COIL VA	MINIATURE	ENCASED	HERMETIC SEAL	MIL SPEC
General Electric Co. (Continued)	IC2800													X					NO NC		to 300							
	PAA	X	X								X	X			X				NO NC	to 600	to 10							
	PAC	X	X								X	X		X	X				NO NC	to 600	to 35			to20				
	PAV	X	X								X	X			X				NO NC	to 600	to 10							
	PBA	X	X								X	X			X				NO NC	to 600	to 10							
	PBC	X									X	X			X				NO NC	to 600	to 10			to 5				
	PCV	X									X	X			X				NO NC	to 460	to 10							
Globe Electrical Mfg. Co. 1729 W. 134th St. Gardena, Calif.	(DC Solenoid)																			115	20	to 120				X	X	
Guardian Electric Mfg. Co. 1550 W. Carroll Ave. Chicago, Ill. 60607	2300	X		X														2	DT	115	15	to 230						
	2305		X	X														2	DT		15	to 220						
	2100	X		X														2	DT	230	25	to 230						
	2110		X	X														2	DT		25	to 220						
	220	X																1	ST NO	230	20	to 230						
	225		X															1	ST NO		20	to 110						
Guide Industries, Inc. 11855 Wicks St.	S-1127		X			X												4	ST NO	115 28	50	28		.7A		X	X	X
	S-1126		X			X												2	DT	110 28	15	28				X	X	X
H. B. Instrument Co. American & Bristol Sts. Philadelphia, Pa. 19140	7140	X						X				X						1	N O	110	30	110 60					X	
	7150	X						X				X						1	N O	220	20	220 60					X	
	7190		X					X				X						1	N O	115DC	7DC	115DC					X	
	7250	X						X				X						1	N C	110	30	110 60					X	
	7360-H		X					X				X						1	N C	115DC	7DC	115DC				X	X	
	7020-DP	X						X				X						2	N O N O	110	30	110 60					X	
	7250-DP	X						X				X						2	N C N C	110	30	110 60					X	
	C-7491	X						X				X						1	N O	110	30	110 60				X	X	
Heinemann Electric Co. Trenton, N. J. 08602	C										X			X				1,2	NO NC	120	3	to 600				X	X	
Hi-G, Inc. Spring St. & Rt. 75 Windsor Locks, Conn.	1400	X	(Phase Senso· far 3 ϕ power)													X		1	DT	30	2	ta 208	5		X	X	X	
	T		X			X												2	DT	30	10	ta 115	1		X	X	X	X
Honeywell, Inc. 2747 Fourth Ave. S. Minneapolis, Minn. 55408	R482	X		X															DPDT	120	15	240	5			X		
	R447	X				X													DPDT		16	240						
Hurletron, Inc. Whittier, Calif.	9031	X	X	X														1	DT		10	28 115		.06A	X	X		X
	9032	X	X	X														2	DT		10	28 115		.12A	X	X		X
	9033	X	X	X														3	DT		10	28 115		.18A	X	X		X
	9034	X	X	X														4	DT		10							
ITT General Controls, Inc. 801 Allen Ave. Glendale, Calif. 91201	R6	X	X															2-3	NO DB	480	25	to 240		23				
	R9	X	X															2-3	NO DB	480	30	to 240		23				
	R5	X	X															2-3	NO DB	480	30	to 240		23				
	R10	X	X															2-3	NO DB	480	40	to 240		55				
	R8	X	X															2-3	NO DB	480	50	to 240		55				
	TD4		X											X				1	SPDT	24 240	25	24						
	TD6													X				1	SPST NO	246 240	75	24						

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The following survey of technical specifications on power relays has been compiled by ELECTRONIC INDUSTRIES directly from information supplied by the individual manufacturers. The aim has been not so much to itemize each specific relay, but rather to guide the design engineer to the appropriate manufacturer and the series of relays which is most likely to fill his needs.

A STATE-OF-THE-ART REPORT

POWER RELAYS	TYPE NO. OF SERIES	AC CONTACTOR	DC CONTACTOR	GENERAL PURPOSE	HIGH VOLTAGE CONTACTOR	HIGH CURRENT CONTACTOR	LOW VOLTAGE CONTACTOR	MERCURY CONTACT	MOTOR FIELD	INDUSTRIAL	OVERLOAD	PLUNGER TYPE	REVERSING CONTACTOR	TIME DELAY	UNDER VOLTAGE	PHASE PROTECTION	PLUGGING RELAY	NO. OF POLES	CONTACT FORM	NOM. CONTACT VOLTAGE (V)	NOM. CONTACT CURRENT (A)	NOM. COIL VOLTAGE (V)	NOM. COIL POWER (W)	NOM. COIL VA	MINIATURE	ENCASED	HERMETIC SEAL	MIL SPEC
Joidinger Mfg. Co. 1921 W. Hubbord St. Chicogo, Ill.	AR	X	X	X						X	X				X			1-5	C	115	12	to 300	.8	3		X	X	
	PR	X	X	X						X	X				X			1-2	C	115	10	to 300	1.5	5				
	MD	X	X	X						X	X				X			1-2	C	115	25	to 150	1.5	5				
Jennings Radio Mfg. Corp. 970 McLoughlin Ave. Son Jose, Colif. 95108	RF10A	X	X	X	X	X						(Vocuum Reloy)						1	C	20KV	60A	26.5DC						
	4200	X	X	X	X	X					X	(Vocuum Reloy)						1	A or B	5-50KV	50-400A	115-230AC						
	4300	X	X	X	X	X					X	(Vocuum Reloy)						1	A or B	5-50KV	50-400A	6-230AC & DC						
	4400	X	X	X	X	X					X	(Vocuum Reloy)						1	C	5-50KV	50-200A	6-230AC & DC						
	4600	X	X	X	X	X					X	(Vocuum Reloy)						1	A or B	5-50KV	50-600A	24-100DC						
	4900	X	X	X	X	X					X	(Vocuum Reloy)						1	A or B	5-50KV	50-600A	115-230AC						
	4700										X	(High Voltoge Overcurrent Sensor)						2	C	28C 115AC	15A	6-115DC 115AC						
	600V Contoctor	X		X		X	X		X	X		(3φ Vocuum Reloy)						3	A	600V	300A	26DC 115-230AC						
	5KV Contoctor	X		X	X	X			X	X		(3φ Vocuum Reloy)						3	A	5KV	300A	26DC 115-230AC						
	RP230-DS2252	X						(RF Vocuum Reloy)										1	A or B	20KV	35A 32MC	26DC 115-230AC						
Leach Corp. Reloy Div. 5915 Avalon Blvd. Los Angeles, Colif.	9091 9191	X	X	X														1	STDB	115 220	30 20	to 230		8.5				
	9094 9194	X	X	X														2	STNO	230	20	to 230		8.5				
	6104 6107	X	X	X														to 4	ST	115	30	to 440		13.5				
	9100	X		X														3	STDB	230	30	to 230		17				
	9274	X	X	X														4	DT	115	15	28 115				X	X	X
	1157	X	X	X														2	DT	115	12.5	to 220		6				
	2028 2128	X	X	X														4	DT	115	12.5	to 220		6				
Line Electric Co. Div. Industriol Timer Corp. 200 River St. Oronge, N. J.	LRP LRD	X	X	X													X	to 3	DT	115	15					X		
	LR LG	X	X	X						X								to 3	DT	115	15	to 220	3			X		
	ST	X	X	X						X								2	DT	115	25	6-440						
	STM	X	X	X						X								2	ST	115	25	to 230						
	MKO	X	X	X						X								to 3	DT	115	10	to 230	1.5		X			
	MKH	X	X	X						X							X	to 3	DT	115	10	to 230	1.5		X	X		
	MKTRO	X	X	X						X							X	to 3	DT	115	10	to 230	1.5		X	X		
	HKH	X	X	X						X							X	to 3	DT	115	10	to 230	1.5		X	X	X	
	HKTRO	X	X	X						X							X	to 3	DT	115	10	to 230	1.5		X	X	X	
	MK	X	X	X						X								to 3	DT	115	5	to 230	1.5		X			
	MKP	X	X	X						X							X	to 3	DT	115	5	to 230	1.5		X	X		
	MKTR	X	X	X						X							X	to 3	DT	115	5	to 230	1.5		X	X		
	HKP	X	X	X						X							X	to 3	DT	115	5	to 230	1.5		X	X	X	
	HKTR	X	X	X						X							X	to 3	DT	115	5	to 230	1.5		X	X	X	
Mochinery Electrificotion, Inc. Northboro, Moss. 01532	MEK-03AA	X	X	X						X								4	NO NC	300	15	115	50					
	MEK-03AB	X	X	X						X								8	NO NC	300	15	115	50					
	MEK-03AC	X	X	X						X		(plug-in)						7	NO NC	300	15	115	50			X		
	MEK-45AA	X		X						X				X	On Deloy			2 2	1NO 1NC	115	10	115		8		X		
	MEK-45AB	X		X						X				X	Off Deloy			2	1NO 1NC	115	10	115		8		X		
	MEK-45TP	X	X	X						X				X	Pneu-motic			2	1NO 1NC	120	15	120		10		X		
Mack Electric Devices, Inc. Wyncote, Po. 19095	A80	X	X					X		X		X		X				1,2,3	NO	115	35	to 440	5	6		X	X	
	B80	X	X					X		X		X		X				1,2,3	NC	115	35	to 440	5	6		X	X	
	A105	X	X					X		X		X		X				1,2,3	NO	115	60	to 440	5	6		X	X	
	B105	X	X					X		X		X		X				1,2,3	NC	115	60	to 440	5	6		X	X	

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POWER RELAYS (Continued)

POWER RELAYS	TYPE NO. OF SERIES	AC CONTACTOR	DC CONTACTOR	GENERAL PURPOSE	HIGH VOLTAGE CONTACTOR	HIGH CURRENT CONTACTOR	LOW VOLTAGE CONTACTOR	MERCURY CONTACT	MOTOR FIELD	INDUSTRIAL	OVERLOAD	PLUNGER TYPE	REVERSING CONTACTOR	TIME DELAY	UNDER VOLTAGE	PHASE PROTECTION	PLUGGING RELAY	NO. OF POLES	CONTACT FORM	NOM. CONTACT VOLTAGE (V)	NOM. CONTACT CURRENT (A)	NOM. COIL VOLTAGE (V)	NOM. COIL POWER (W)	NOM. COIL VA	MINIATURE	ENCASED	HERMETIC SEAL	MIL SPEC
Magnecraft Electric Co. 5575 N. Lynch Ave. Chicago, Ill. 60630	88D	X	X	X														1	STDB	115	50	to 230				X	X	
	88R	X	X	X														2	DT	115	15	to 115				X	X	
	11D		X	X														1	STDB	115	50	to 110			X	X	X	
Master Specialties Co. 15020 S. Figueroa St. Gardena, Calif. 90247	2000	X														X		1	ST	115	3	115 277	10				X	
	2000	X														X		2	DT	115	10	115 277	10				X	
	3000		X											X				2	DT	28	2 10		5				X	
Milwaukee Relays, Inc. 606 E. Pioneer Rd. Cedarburg, Wisc.	120	X	X	X						X								1	DT	115	15	6-230	1.5	3.2		X		
	120	X	X	X						X								1	NO DM	115	20	6-230				X		
	130	X	X	X						X								1	DT	115	25	6-230	2	4.5		X		
	130	X	X	X						X								1	NO DM	115	35	6-230						
	220	X	X	X						X								1,2,4	DT	115	15	6-230	2	6				
	900	X	X	X						X								1,2	A-D X,Y	115	25	to 440	2	9.5				
	905	X	X	X						X							X	2	DT	115	25	6-230	2	9.5		X		
	120ML	X	X	X						X	(latching)							2	DT	115	20	6-230	2	3		X		
	130ML	X	X	X						X	(latching							2	DT	115	35	6-230	2	3		X		
	225	X	X	X						X							X	4	DT	115	15	6-230	2	6		X		
Massman-Elliot Corp. 202 S. Larkin Ave. Joliet, Ill.	5240	X	X	X														1	NO DB	115	25	to 250		2.3				
	5250	X	X	X														1	NO DB	230	25	to 250		2.3				
Ohmite Mfg. Co. 3601 Howard St. Skokie, Ill. 60076	CR	X	X	X						X								1	SP ST	115	15	to 440AC to 230DC	5.6 2.75					
	CRC	X	X	X						X								1	SP ST	115	15	to 440AC to 230DC	5.6 2.75			X		
	CRH	X	X	X						X								1	SP ST	115	15	to 440AC to 230DC	5.6 2.75				X	
	DO	X	X	X						X								3-4	3PDT 4PDT	115	10	to 440AC to 230DC	6 3					
	DOHP	X	X	X						X								3-4	3PDT 4PDT	115	10	to 440AC to 230DC	6 3				X	
	DOEP	X	X	X						X								3-4	3PDT 4PDT	115	10	to 440AC to 230DC	6 3			X		
	DOS	X	X	X						X								2	DPDT	115	15	to 440AC to 230DC	3 2.5					
	DOSTP	X	X	X						X								2	DPDT	115	15	to 440AC to 230DC	3 2.5			X		
	DOSHP	X	X	X						X								2	DPDT	115	15	to 440AC to 230DC	3 2.5				X	
	DOSY		X	X						X	(plate circuit)							2	DPDT	115	15	to 115DC	1					
	DOSYEP		X	X						X	(plate circuit)							2	DPDT	115	15	to 115DC	1			X		
	DOSYHP		X	X						X	(plate circuit)							2	DPDT	115	15	to 115DC	1				X	
	DOY		X	X						X	(plate circuit)							3-4	3PDT 4PDT	115	10	to 115DC	1.5					
	DOYEP		X	X						X	(plate circuit)							3-4	3PDT 4PDT	115	10	to 115DC	1.5			X		
	DOYHP		X	X						X	(plate circuit)							3-4	3PDT 4PDT	115	10	to 115DC	1.5				X	
	GPR	X	X	X						X	(thyratron plate)							1-4	to 4PDT	115	5 & 10	to 230AC to 110DC	1.6 1.4	2				
	GPRTS	X	X	X						X	(thyratron plate)							1-4	to 4PDT	115	5 & 10	to 230AC to 110DC	1.6 1.4	2		X		
	GPRHP	X	X	X						X								1-4	to 4PDT	115	5 & 10	to 230AC to 110DC	1.6 1.4	2			X	
	QC	X	X				X			X								1	DB SPST	115	25	to 440AC to 230DC	5.6 2.75		X			
	TKL		X	X						X								2-4	2 or 4DT	115	1	to 115DC	1.25					
	TKLEP		X	X						X								2-4	2 or 4DT	115	1	to 115DC	1.25			X		
(Continued on next page)	TKLHP		X	X						X								2-4	2 or 4DT	115	1	to 115DC	1.25				X	

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POWER RELAYS (Continued)

ELECTRONIC INDUSTRIES

POWER RELAYS	TYPE NO. OF SERIES	AC CONTACTOR	DC CONTACTOR	GENERAL PURPOSE	HIGH VOLTAGE CONTACTOR	HIGH CURRENT CONTACTOR	LOW VOLTAGE CONTACTOR	MERCURY CONTACT	MOTOR FIELD	INDUSTRIAL	OVERLOAD	PLUNGER TYPE	REVERSING CONTACTOR	TIME DELAY	UNDER VOLTAGE	PHASE PROTECTION	PLUGGING RELAY	NO. OF POLES	CONTACT FORM	NOM. CONTACT VOLTAGE (V)	NOM. CONTACT CURRENT (A)	NOM. COIL VOLTAGE (V)	NOM. COIL POWER (W)	NOM. COIL VA	MINIATURE	ENCASED	HERMETIC SEAL	MIL SPEC
Ohmite Mfg. Co. (Continued)	TO		X	X						X								2-6	2-4 or or 6DT	115	3 or 5	to 220DC	0.1	per pole				
	TS		X	X						X								2-4	DPDT 4PDT	115	10	to 115DC	.25	per pole				X
	TSHP		X	X						X								2-4	DPDT 4PDT	115	10	to 115DC	.25	per pole			X	X
	TT		X	X						X								2-4	DPDT 4PDT	115	5	to 115DC	.15	per pole				X
	TTHP		X	X						X								2-4	DPDT 4PDT	115	5	to 115DC	.15	per pole			X	X
Pacific Relays, Inc. 13915 Soticoy St. Van Nuys, Calif.	—			X											X			4	4C	28DC 115AC	10AMP	28DC	1w		X	X	X	X
Phaostron Instrument & Electronic Co. 151 Pasadena Ave. S. Pasadena, Calif.	PR 9500 PR 9401		X						X									7		175	to 50	30						
Phillips Advance Control Corp.	PG	X	X	X														1,2	C,Z		30							
Joliet, Ill.	PC	X	X	X														1	DP	115	15							
	PV	X	X	X														1	ST/DT		30	to 450						
	33B	X	X															3-5	A,B,C			24						
	67			X														8	C		3,5		.05					
Joseph Pollak Corp. 81 Freeport St. Boston 22, Mass.	RL1200	X				X												1,2	C	120	30			10	X			
Potter & Brumfield	AK	X	X	X														2	DPDT	115	10	110/230	2	6.4		X		
Princeton, Ind.	PR	X	X	X														2	DPDT	115/230	25	6-440	2	9.8		X		
	PM	X	X	X														4	DT	115/230	25	to 440	4.4	14		X		
	MB		X															1	XYZ	28DC	60	6-110	2.7		X	X	X	
	MR	X	X	X														3	DT	115	8	6-220	1.6	3.3		X		
	AB	X	X	X														2	DPDT	115	10	6-230	2	6.4		X		
	KR3-H	X	X	X						X								1	X	115	20	to 230	1.2	2	X	X		
Price Electric Corp.	7			X														2	C	28	10	28			X		X	X
323 Church St.	5409			X														2	C	28	10	28	1.6		X			X
Frederick, Md.	5424			X														4	C	28	10	28	2.6		X			X
	5424 HS			X														2	C	28	10	28	2.6		X		X	X
	5609			X														2	C	28	10	28	1.6		X			X
	5624			X														4	C	28	10	28	1.6		X			X
	5651			X														6	C	28	10	28	3.0		X			X
	5609 HS			X														2	C	28	10	28	1.6		X		X	X
	5624 HS			X														4	C	28	10	28	1.6		X		X	X
	5651 HS			X														6	C	28	10	28	3.0		X		X	X
	5709			X														2	C	28	10	28	1.7		X			X
	5724			X														4	C	28	10	28	2.6		X			X
	5724 HS			X														4	C	28	10	28	2.6		X		X	X
	2106			X														2	C	28	15	115		4.5				X
	2106 HS			X														2	C	28	15	115		4.5			X	X
	2106			X														1	Z	28	30	115		4.5				X
	2106 HS			X														1	Z	28	30	115		4.5			X	
	2109			X														3	C	28	15	115		7.0				X
	2109 HS			X														3	C	28	15	115		7.0			X	X
	2109			X														2	1Z/1C	28	30/15	115		7.0				X
	2109 HS			X														2	1Z/1C	28	30/15	115		7.0			X	X

(Continued on next page)

World Radio History

ELECTRONIC INDUSTRIES

POWER RELAYS (Continued)

POWER RELAYS	TYPE NO. OF SERIES	AC CONTACTOR	DC CONTACTOR	GENERAL PURPOSE	HIGH VOLTAGE CONTACTOR	HIGH CURRENT CONTACTOR	LOW VOLTAGE CONTACTOR	MERCURY CONTACT	MOTOR FIELD	INDUSTRIAL	OVERLOAD	PLUNGER TYPE	REVERSING CONTACTOR	TIME DELAY	UNDER VOLTAGE	PHASE PROTECTION	PLUGGING RELAY	NO. OF POLES	CONTACT FORM	NOM. CONTACT VOLTAGE (V)	NOM. CONTACT CURRENT (A)	NOM. COIL VOLTAGE (V)	NOM. COIL POWER (W)	NOM. COIL VA	MINIATURE	ENCASED	HERMETIC SEAL	MIL SPEC
Struthers-Dunn, Inc. Lambs Rd. Pitman, N. J.	415XBX	X	X	X						X								2	DPDT	220	15	to 220	3	6	X			
	8 and 84	X	X	X						X								to 5	DT	to 600	30	to 550	8	15				
	B 22	X	X			X		X		X								to 3	ST	120	to 100	24/230	8	—				
	17	X	X				X			X								1	DT	28	40	to 115DC	6	—				
	103		X			X	X			X		X						1	DBNO	28	200	28	20	—		X	X	
	275KXX	X	X							X			X				X	6	ST	to 480	5-15	to 550	6	12				
	A175KX	X	X							X			X				X	6	ST	to 440	15	24-230	8	16				
	214	X	X	X						X								1,2,3	DT	120	15	6-115	3	6		X		
	18	X	X			X				X								2	DT	115	15	6-230	6	5		X		
	A5	X	X							X		(latch)						1-4	DT	24-230	30	to 550	8	12				
	219	X	X	X						X								4	2DT/2ST	150	10	6-115	4	5		X		
	149	X								X					X			1	DT	120	2	to 440	4	12				
	235	X								X				X				2	1DT/1ST	120	10	to 115	—	5		X		
	211	X								X		(sequence)						2	DT	120	10	to 115	8	12		X		
	601	X	X	X						X								to 12	DT	600	10	to 550	14	30		X		
	6000	X		X						X								to 4	ST	600	30	to 550	—	16		X		
Telex/Aemco 10 State St. Mankato, Minn. 56002	83	X	X	X														1-2	DT	117	20	6-117						
	83	X		X														SP/ST	DM/DB	117	20	24/117						
	136	X	X	X														1-2	DT	117	20	6-117						
	136	X		X														SP/ST	DM/DB	117	20	24/117						
	121	X	X								X							1-4		117	5							
	151	X											X					3	DT/NO	117	3HP	to 230						
	ED													X				1-3	DT	117	10	6-117						
	LC													X				1-3	DT	117	10	6-117						
Union Switch & Signal Div. Westinghouse Air Brake 1789 Braddock Ave. Pittsburgh, Pa. 15218																					See Note 2	See Note 1	See Note 3					
																				D.C.		D.C.						
	"M"			X														6	C	28	2	26	.750	—	X		X	X
	"J"			X														6	C	28	5	26	.910	—	X		X	X
	"H"			X														4	C	28	10	26	.850	—	X		X	X
	904			X	Grid Header Crystal Case													2	C	28	2	26	.310	—	Microminiature		X	X
	903			X	"S" Header Crystal Case													2	C	28	2	26	.310	—	Microminiature		X	X
	902			X	Half Size Crystal Case													2	C	28	2	26	.250	—	Microminiature		X	X
	901			X	One-sixth Size Crystal Case													2	C	28	1	26	.115	—	Microminiature		X	X
	900			X	One-sixth Size Crystal Case													1	C	28	1	26	.085	—	Microminiature		X	X
	Note 1 – Also available with 6, 12, 48 & 76 volt coils and various non standard voltages																											
	Note 2 – Resistive load																											
	Note 3 – Pick-up at 25° C																											
Warco Industries, Inc. 569 Melville Ave. St. Louis, Mo. 63130	P-2			X														3	C	120 240	10 5	6-240 6-125	2.5	2.				
	P2-H	X																2	C	120 240	1/2HP	6-240 6-125	2.5	2.				
	P2-E			X														3	C	120 240	7 5	120V 240V	2.5	2.		(plug-in)	X	
	P2-SE	X		X														3	C	120 240	10 5	6-240 6-125	2.5	2.		X		

World Radio History

POWER RELAYS (Continued)

POWER RELAYS	TYPE NO. OF SERIES	AC CONTACTOR	DC CONTACTOR	GENERAL PURPOSE	HIGH VOLTAGE CONTACTOR	HIGH CURRENT CONTACTOR	LOW VOLTAGE CONTACTOR	MERCURY CONTACT	MOTOR FIELD	INDUSTRIAL	OVERLOAD	PLUNGER TYPE	REVERSING CONTACTOR	TIME DELAY	UNDER VOLTAGE	PHASE PROTECTION	PLUGGING RELAY	NO. OF POLES	CONTACT FORM	NOM. CONTACT VOLTAGE (V)	NOM. CONTACT CURRENT (A)	NOM. COIL VOLTAGE (V)	NOM. COIL POWER (W)	NOM. COIL VA	MINIATURE	ENCASED	HERMETIC SEAL	MIL SPEC
Price Electric Corp.	2109			X														2	1Z/1C	28	30/15	115		7.0				X
(Continued)	2109 HS			X														2	1Z/1C	28	30/15	115		7.0			X	X
	2112			X														4	C	28	15	115		11.0				X
	2112 HS			X														4	C	28	15	115		11.0			X	X
	2112			X														2	Z	28	30	115		11.0				X
	2112 HS			X														2	Z	28	30	115		11.0			X	X
	2118			X														6	C	28	15	115		13.0				X
	2118 HS			X														6	C	28	15	115		13.0			X	X
	8207			X														1 3	A A	28 28	150 25	28	10.0					X
	8208			X														2	A	28	150	28	10.0					X
RBM Controls Div.	75/80/85	X		X	X					X								2,3	NO	250	25	240						
Essex Wire Corp.	S 30	X		X	X	X				X								3	NO	250	30	24-230				X		
131 Godfrey St.	S 40	X		X	X	X				X								3	NO	250	40	24-230				X		
Logansport, Ind.	C 15	X		X	X	X				X			X					4	NO	600	15	24-440						
	C 30	X		X	X	X				X			X					3	NO	600	30	24-440						
	C 50	X		X		X				X								4	NO	480	50	24-440						
	60		X	X			X											1	NO	32	15	6-32				X		
	70		X	X			X											1	NO/DT	to 32	to 80					X		
	84	X		X						X								1	NO/DT	250	16	6-240				X		
	129	X		X						X								1	NO/DT	250	18	6-230				X		
	91	X		X						X								2	DT	277	15	240				X		
	92	X		X						X								3	DT	277	25	240				X		
	987	X								X								1-6	DT	250	15	240						
	59	X												X				1	NO/NC	250		240				X		
	128000								X																			
	83								X																			
Robertshaw Controls Co.	400-3002	X								X								1	DT	125	15	115						
Acro Div.	F	X								X								1	DT	240	2HP	to 230						
P. O. Box 449	400-1000	X	X	X														1	DT		15	to 230	6					
Columbus, O.	242-1000	X	X	X						X								2	DT		2HP	to 115						
	242-1100	X	X	X						X								1	DT		2HP	to 115						
	242-1200	X	X	X						X								2	ST/NC		2HP	to 115						
	242-1300	X	X	X						X								2	ST/NO		2HP	to 115						
Rowan Controller Co.	R-Fused	X		X														3	NO	250	50	to 550						
P. O. Box 306	R	X	X	X														to 10	NO/NC	600	10	to 550						
Westminster, Md.	FE	X	X	X														to 8	NO/NC	250	15	to 250						
	B	X	X	X														to 5	NO/NC	600	25/40	to 550						
	B	X	X	X														to 4	NO/NC	600	60/75	to 550						
	BR	X	X	X									X					to 5	NO	600	to 75	to 550						
	BX	X	X	X														6	NO/NC	600	to 75	to 550						
	BF	X	X	X														to 20	NO/NC	250	15	to 550						
	BTD	X	X		(solid state)									X				3	NO		10/40							
	SD										X							3	—	600	1/200	to 550						
	FER	X	X	X									X					8	NO/NC	250	15	to 250						
Schrack Electrical Sales Corp.	FA 0.6-FA25				(thermal)						X					X			C	to 500	1		25A					
1140 Broadway	FA 40				(thermal)						X					X			C	to 500	1		40A					
New York, N. Y. 10001	FA 100				(thermal)						X					X			C	to 500	1		100A					
Sigma Instruments, Inc.	61		X			X												4	ST*	120	20	6/150				X	X	
170 Pearl St.																												
S. Braintree, Mass.																												

* - Maximum number of poles, four and in single row arrangement.

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POWER RELAYS	TYPE NO. OF SERIES	AC CONTACTOR	DC CONTACTOR	GENERAL PURPOSE	HIGH VOLTAGE CONTACTOR	HIGH CURRENT CONTACTOR	LOW VOLTAGE CONTACTOR	MERCURY CONTACT	MOTOR FIELD	INDUSTRIAL	OVERLOAD	PLUNGER TYPE	REVERSING CONTACTOR	TIME DELAY	UNDER VOLTAGE	PHASE PROTECTION	PLUGGING RELAY	NO. OF POLES	CONTACT FORM	NOM. CONTACT VOLTAGE (V)	NOM. CONTACT CURRENT (A)	NOM. COIL VOLTAGE (V)	NOM. COIL POWER (W)	NOM. COIL VA	MINIATURE	ENCASED	HERMETIC SEAL	MIL SPEC
Ward Leonard Electric Co. Mt. Vernon, N. Y. 10550	—		X	(Accel. & Decel.)					X													230						
	—		X	(field loss)					X									1	DBNO	230	1	230		5A				
	—		X														X											
	105	X	X	X														1,2	DT		15	to 230						
	106	X	X	X														1,2	DT		20	to 115						
Westinghouse Electric Corp. Standard Control Div. Beaver, Pa.	MW	X	X	X	(thermal)					X	X							1	NO/NC	600	2	(to 170A. motor)				X		
	R & B	X	X		(thermal					X	X							1		600		(to 50A. motor)				X		
	TC	X	X							X	X							3		600		(to 125A. motor)				X		
	AF	X		X						X								to 10		600	10	to 550		90				
	BF/L	X	X							X								2-12	NO/NC	300	10		12	70				
	AM	X	X							X				X				3		600	15		16					
	BT	X								X				X				2		300	10			70				
	Z	X	X	X						X								2		300	10		3	10				
Wheelock Signals, Inc. Long Branch, N. J.	A	X	X	X																	1-10	to 230		9				
	B	X	X	X																	1-5			.5W				
	C	X	X	X																	.5-12	to 230		9.5				
	D	X	X	X																	1-12	to 230						
	E	X	X	X														1,2	NO		2-20	to 230						
	P & R	X	X	X																	2-15	to 230						
	S	X	X	X																	3-30	to 230						
	3040	X	X			X												2-5	DT		to 50	115						
	270/280	X	X	X														4	C	115	15	to 230		12				
	130/140	X	X	X														1,2	ST/DT	110	20							

CORRELATORS (Concluded)

create the image element in proper position for orthophoto production. Altitude information is obtained by reporting the height of the scanning disc. The orthophoto and altitude data are recorded photographically in a print out subassembly.

A diagram depicting correlator use in the stereomapper is shown in Fig. 6. The Nipkow disc is located on a carriage which travels at a fixed speed in the "Y" direction until a limit switch is triggered which causes the carriage to reverse direction and step over in the "X" direction from 1 to 5mm. The "X" and "Y" profiling continues over the entire model. The small rectangular aperature located at the intersection of the corresponding image rays is scanned by a revolving Nipkow disc and the diapositive information is converted to video signals by the photo multiplier tubes. The two video signals are amplified and connected to the correlator, Fig. 5. Output of the correlator is directly indicative of the magnitude and sign of the elevation error. It controls a servo motor which keeps the scanning aperature at the terrain elevation.

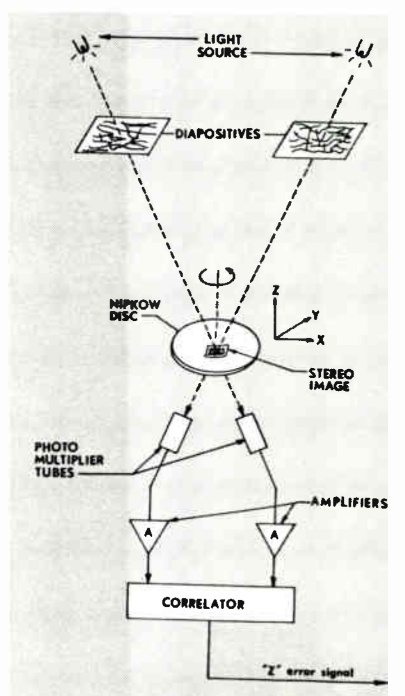
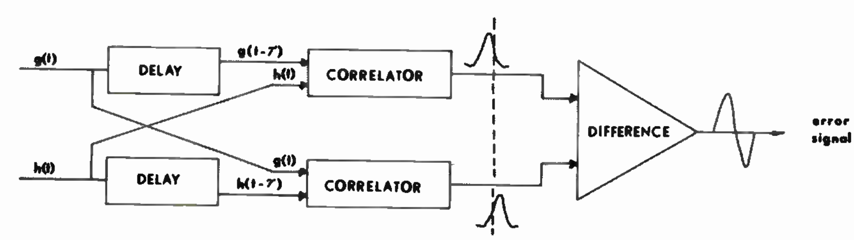


Fig. 6: Correlator use in a stereomapper.

Fig. 5: To adapt the correlator output to a servo positioning system, correlators are connected to delay lines and an amplifier.



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ELECTRONIC INDUSTRIES

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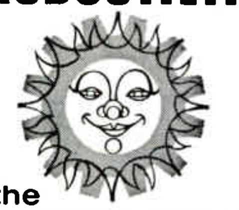
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Daytona Beach, Florida

Circle 107 on Inquiry Card

MOS-FET MODULATOR CHOPS ONE-MICROVOLT SIGNALS

An integrated dual P-channel MOS field effect transistor modulator capable of chopping signal levels as low as 1μv is now in production, reports Fairchild Semiconductor.

The new Planar II epitaxial device, designated the F10049, is designed for use in high performance low-level circuits. Fairchild says it completely eliminates the need for drive transformers in chopper circuits through isolation of input from output by an insulated gate.

The device's low chopping level is made possible by the fact that the F10049 has no offset voltages, and less than 1pa offset current.

The F10049 offers typical gate to drain transconductance of 4000μmhos; typical "ON" resistance of 250Ω; and threshold voltage of 5.0v.

MASTER-SLAVE TAPE SYSTEM DEVELOPED FOR COMPUTERS

A new master-slave magnetic tape system for computers has been introduced by Datamec Corp.

The Datamec master-slave tape unit combinations handle input/output access to several magnetic tapes through one input/output channel.

They come in 2 model lines. The Model D 3030 tape units operate at 75 in./sec. tape speed, writing and reading IBM standard computer format tapes at recording densities of 800, 556 and 200 characters/in. Model D 2020 tape units have 45 ips (or lower, if desired) tape speed.

CANCELED SPECS OFFICE

Department of Defense has set up a microfilmed archival service for industry on superseded military specifications and other standard documents required for contractual obligations.

The repository became operational July 1 in conjunction with the Defense Single Distribution Point for Specifications at the Naval Supply Depot, Philadelphia.

COLLECTOR LOGIC (Concluded)

By continuing on in this manner, it is seen that whenever an odd number of variables is to be combined, the "exclusive or" function equals the coincidence function. Whenever an even number of variables is involved, the "exclusive or" equals the negation of the coincidence function.

One application of this idea is the design of a parity generator whose output is a logical 1 if an odd number of its inputs are the logic 1 level. From the truth table for this operation, the parity function, P, is

$$P = A_1 \oplus A_2 \oplus A_3 \oplus \cdots\cdot \oplus A_n \quad (13)$$

where we are considering an n-bit word. By use of Eq. 12 and 13 a 4-bit generator is developed, Fig. 9.

Note that for every 2^n bits, n = 1, 2, 3, . . . , that 2^n-2 gates are saved over a conventional "exclusive or" mechanization, which results in about a 25% reduction in component and propagation delay path.

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CLASSIFIED

The Proprietor of British Patent No. 830,796 for "An improved Magnetic Recording and Reproducing method and an apparatus for Carrying out such method," is desirous of entering into negotiations for the sale of the Patent, or for the grant of a license thereunder. Communications should be addressed to Page, White & Farrer, 27, Chancery Lane, London, W.C.2.

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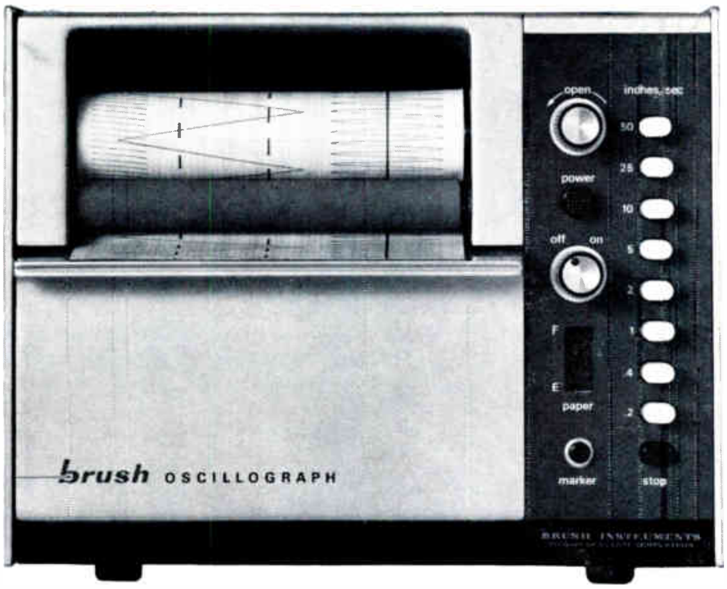
Another Brush Innovation in Recording:



The Brush 2300.

Best recorder around for getting lots of data down on one piece of paper.

No wonder the Brush 2300 light beam recorder can handle just about any industrial recording job you can name.

It's available with 1 to 16 analog channels. Writing speeds from 0 to 30,000 inches per second. Push-button choice of eight different chart speeds—or sixteen if you like. And all the frequency response you'll ever need.

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And here's the topper. *Anyone, anywhere* can operate a 2300. The controls are logically grouped, chart paper loads from the front and the galvos can be switched and adjusted in seconds. Simple. Rugged. Lightweight. Low cost per channel. That's the 2300. The common-sense selection for almost every industrial recording requirement.

A demonstration will prove it.

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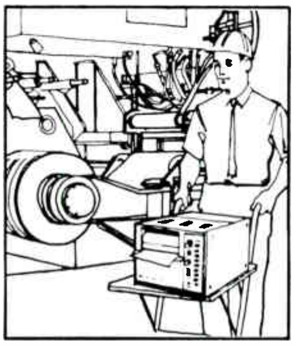

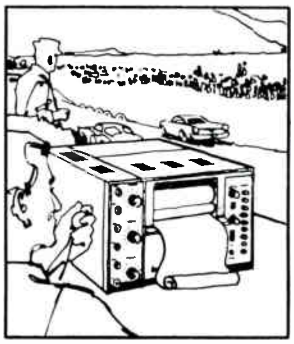

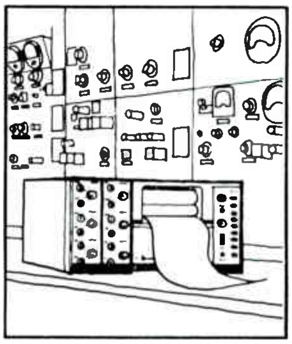

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MEDIUM VOLTAGE SUPPLY			
	2N3054 h_{FE} @ 0.5A = 25-100	2N3055 h_{FE} @ 4A = 20-70	2N3772 V_{CEO} (sus) = 60V h_{FE} @ I_C = 10A 15-60 P_t Max = 150 W f_T = 700 Kc/s (typ)
HIGH VOLTAGE SUPPLY, HIGH TRANSIENTS			
2N3440 h_{FE} @ 20 ma = 40-160 40256 $\theta_{j\text{-}c}$ = 15° C/W	2N3441 h_{FE} @ 0.5A = 20-80	2N3442 h_{FE} @ 3A = 20-70	2N3773 V_{CEO} (sus) = 140V h_{FE} @ I_C = 8A 15-60 P_t Max = 150 W f_T = 400 Kc/s (typ)

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