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**G-V**

G-V thermal time delay relays help Waltham gyro find the vertical fast!

As part of an airborne fire control system, Waltham Precision Instrument Company's WG-2 Vertical Gyro provides vertical reference information. In achieving either initial or in-flight erection of the gyro, G-V Thermal Time Delay Relays control torque motor field currents that help find the vertical within 30 seconds!

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

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**MAXIMUM RATING LIFE**
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Design Advances in DISPLAY

Mean New Era In Air-Traffic Control

HARD ON the heels of the Federal Aviation Agency's proposal for semi-automatic control of air-traffic (ED, Feb. 4., p 3) have come design details of new display equipment.

The designs show that display engineers are more than holding up their end of the rapidly advancing air-traffic technology. The advance in display breaks down into three stages.

First stage is improvement of existing equipment. The Raytheon scan-converter cathode ray tube described below fits this category.

The second stage is in R & D now for the most part. Some of it however, like the Stromberg-Carlson system described below, is advanced to the hardware stage. The FAA's integrated Data Processing Central, under development by General Precision Labs., characterizes this stage. Though it will make use of existing equipment, it will incorporate newly designed devices. The complete system will be installed in a few years to provide semi-automatic control of high-volume, fast-flying traffic.

Stage three will be completed after the Central is tested at Atlantic City and installed for proving at New York International Airport, Idlewild, Queens. Improvements will be added as the Centrals are installed throughout the country.

The three phases of display development can be described this way: (1) Present PPI systems using varying degrees of image persistance or scan conversion display; (2) Tomorrow's system using direct-view or projection equipment; (3) The eventual system, completely automatic and possibly using electroluminescense, dark tubes, transparent phosphors or developments not in sight at this time.

Scan-Conversion Display

Several companies, now make double-gun scan-conversion tubes for display applications: RCA makes the Graphicon; Intercontinental Electronic (INTEC) will shortly make the "Frenchicon," which the company now markets here under an arrangement with the French firm CFS that developed the tube; Rauland makes a tube similar to the "Frenchicon," and Raytheon is now producing a new scan-conversion tube designed to do the same job.

The Raytheon tube, called the "Quickicon" by the FAA, is substantially different from the others. A storage screen is used as the read-write target, RF-video separation is used to keep the writing and reading functions from interfering with each other, and a sensitivity-time-control circuit is included in the video amplifier stage to cut over-writing at the target's center.

A typical air-traffic-control system using the tube would work this way:

Ordinary scanning radar picks up a target. A

**Two Generations of Air-Traffic Display**

- **Scan conversion**—designed to improve existing equipment. This is Raytheon's version (above).

- **Direct-view display**—the next step. This is Stromberg-Carlson's approach (right).

**Scan converter** in Raytheon's system takes radar input, feeds it to one side of a storage screen at radio frequencies, reads it at video frequency from the other side of the screen and transmits the TV signal to multiple display tubes. The system is adaptable for alphanumeric display and is available in 525 and 945 lines, both at a 30-frame-per-sec rate of scan.
NEW MASER CIRCULATOR FOR L-BAND

MINIATURE, THREE-PORT
DEVICE WITH COAXIAL FITTINGS
MEASURES ONLY 7½ INCHES,
WEIGHS 9 POUNDS

An entirely new Raytheon technique has made possible the design of an extremely small low-frequency circulator. The three-port device has Type N coaxial connections and is designed for use with masers and parametric amplifiers at L-band.

The new circulator, designated CLL1, combines an extremely low insertion loss of 0.3 dB with 25 dB isolation and VSWR of less than 1.1 centered at any frequency from 900 to 1,600 mc. With a permanent magnet, as illustrated, performance is typically 0.4 dB and 20 dB with a maximum VSWR of 1.25 over any 50 mc band. However, with a tuned magnetic field, the same performance is obtainable over a 100 mc band.

To learn more about this significant development or other important Raytheon advances in microwave ferrite devices, please write stating your particular area of interest to the address below.

RAYTHEON MANUFACTURING COMPANY
SPECIAL MICROWAVE DEVICES
WALTHAM 54, MASSACHUSETTS

<table>
<thead>
<tr>
<th>TYPICAL SPECIFICATIONS</th>
<th>CLL1</th>
<th>CLL2</th>
</tr>
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<tbody>
<tr>
<td><strong>Frequency range</strong></td>
<td>1260 ± 25 mc</td>
<td>1400 ± 25 mc</td>
</tr>
<tr>
<td><strong>Isolation</strong></td>
<td></td>
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<tr>
<td><strong>Weight (max.)</strong></td>
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<td>9.0 lbs.</td>
</tr>
<tr>
<td><strong>Max. dimension</strong></td>
<td>7½ in.</td>
<td>7½ in.</td>
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</tbody>
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$975.00!
AVAILABLE IMMEDIATELY FOR YOUR APPLICATION.

How the alphanumeric and radar data are combined in Stromberg-Carlson's S-C 2000 display system.

信号是送到双枪变频管，其中雷达栅格型信息被转换成电视视频。同时一个光束在某一个记录上，另一个同时读出了屏幕的另一侧。这些数据被传输到并联的或者其他同轴电缆或微波线路到一个高分辨率显示屏幕。图中显示的显示屏幕作为一系列连接或几乎连接的脉冲，每个扫描的飞行路径。

**Direct-View Display**

FAA goals for this type of equipment are:
- The system should be non-volatile—if a power failure occurs not one bit of data should be lost.
- Display should be bright enough for viewing in a well-lighted room—60-100 ft lamberts ambient lighting.
- Resolution should be high—1000 lines per diameter.
- One-eighth-inch-high alphanumeric characters should be readable from two feet.

Many companies are developing bright display systems to meet the FAA goals and to improve the performance of scan-conversion systems, which are sometimes complex and have inherent resolution limits.

Most prominent design feature of one of these projects, the Stromberg-Carlson S-C 2000, is a xerographic processor that stores information gathered from the face of one or more small-screen tubes for projection onto a viewing screen. The S-C system uses a Characteron "shaped-beam" tube to project alphanumeric symbols through etched templates mounted in the tube. The alphanumeric symbols are superimposed opt-
only through a mirror-projection system on the images picked up from a radar-type tube.

The combined data sensitizes a xerographic plate. The plates are successively sensitized, rotated and displayed. Advantages of this type of operation are flicker-free display, fail-safe operation, and the variety of information that can be displayed with the radar data. Both tabular and situation display are possible with this equipment.

Beyond the Near Future

The FAA visualizes a completely automatic display system for traffic control that will use equipment now in only the earliest research stages. Some of these systems might resemble Westinghouse's electroluminescent display panel, which uses ferroelectric control; display is flicker free, and both tabular and situation display are possible.

Dark trace tubes are also being investigated. On these, data would be shown in dark trace on a light background.

Another possibility is display using transparent phosphors. Tubeface phosphor would be transparent to permit the inside surface of the tube to absorb ambient light. The tube's interior would be made as black as possible, providing contrast so great that the display would be visible under nearly all conditions.

Housefly Goes On "Outer Space" Binge

The "spacemen" recently selected to take the first sojourn in outer space may do well to equip themselves with a flyswatter. And don't look forward to a picnic in outer space to get away from insects. Perhaps this conclusion is hasty—but here are the facts.

Two technicians were making some environmental tests at the Bulova Watch Company, in Woodside, N.Y. They were harassed by a persistent fly who managed to get past the security guards.

The technicians caught the pest, placed him in a vacuum chamber, and raised the altitude. As the pump began to draw vacuum, the fly became restless but retained his faculties.

At 28,000 feet, his wings began to droop but he continued walking briskly. Even at 50,000 feet he was ambulant, but at this altitude, his gait resembled that of a man who, having tried a quart of bourbon, found he liked it, and decided to order some.

When released after being brought down to earth, the creature flew off, apparently undisturbed by his "outer space" adventure.
**Pokrovskiy's Funnel: A 60-Mi.-high Cosmic Tower Proposed in USSR**

One way to reach the upper atmosphere to conduct space studies is to build an "aerostatic" tower, according to a Russian scientist.

Professor Pokrovskiy proposes to use light plastic to make a funnel with a 60-mile-diam base. The funnel would be inflated with a gas lighter than air and would reach up 60 mi to where atmospheric pressure is only about a millionth as dense as on the ground.

The scientist believes an upper diameter of less than 35 ft would suffice and that a platform there could support a weight of about 200 tons.

**Facsimile Refined for Use in Japan**

Facsimile negative of Japanese newspaper is received in Sapporo, Hokkaido, 600 miles from home office. Japanese engineers had to refine the British-built (Muirhead & Co.) units so they could handle the fine lines of Japanese printed characters. Double-channeling is used to provide two sheets at a time at the receiving end.

**Ionoscatter Transmitter in NATO Use**

Turkish terminal of new NATO radio link is 1600 mi from Paris end of net. The VHF system uses forward scatter principles to achieve high reliability. Designs were worked out at the Dutch Defense Technical Center, The Hague.

**Jupiter's Emission Secrets Elude Russian Scientists**

Russian scientists say they have identified 13.5-meter waves coming from Jupiter, but they admit that the signal's source is still a mystery.

One of two solar-system bodies emits signals: the sun and the moon. Thermal radiation is the source of signals in both cases. But this does not apply to Jupiter, which gets little heat from the sun.

Temperature of Jupiter's cloud layer is -110 C. Therefore thermal radiation is very weak.
The theory that storm phenomena cause the emissions is countered by the observation that Jupiter's emissions always seem to come from the same spot, believed to be below the cloud layer.

**Russians Report Progress on Reading and Printing Machines**

Unconfirmed reports from the Soviet Union describe a pair of machines designed to solve the problem of literature searching. The Russians report development of a machine that can read a million pages an hour and that can be questioned by dialing. Literature stored in the machine, however, must be coded.

Perhaps part of the same development is a memory device that the Russians say can handle 4 million pages of conventional text an hour. The device, designed at the Electro-Modeling Lab of the USSR Academy of Sciences, is intended for use with language-translation machines.

And Moscow Radio reports that the Vilna Electrophylog Research Institute has developed a machine that records printed images on magnetic tape, through a photoelectric device, and then prints the image on ordinary paper—all in seconds.

**Russians Also Developing Self-powered Telephone**

From the Soviet's Physics Institute of the Academy of Sciences comes word of a Russian telephone said to be superior to all others in clarity and range.

A ceramic dielectric plate heated to 200°C and allowed to cool in a strong electric field is reported to store electrical charges for years. Energy “frozen” this way can be applied to a variety of instruments, according to the Russians. The telephone's mouthpiece is simply a charged ceramic disc covered by a membrane. One such telephone has been in institute service for over a year. Its range is more than 1000 mi.

**Now... from PHILCO**

**A complete family of Medium Frequency Transistors**

- High Dissipation: to 1 watt peak at 25°C
- High Current: Max. Ic = −400 ma
- High Temperature: 100°C Max.
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- High Frequencies: Min. fαb to 12 mc

Philco's complete family of PNP germanium alloy junction transistors is available in both studded and unstudded cases (TO-31 and TO-9), permitting operation at power levels as high as 1 watt peak. They offer the designer complete flexibility, providing a choice within each form factor to meet circuit requirements for voltage, gain and frequency. These transistors feature a unique, patented, cold-welded copper housing and internal construction that result in lower junction temperatures at normal operating power levels. (K factor as low as 0.1°C/mw.) Their design insures improved life and reliability at temperatures as high as 100°C.

The high beta of these transistors at high current makes them particularly applicable to medium speed flip-flops, logic gates, drum writers and core-driver circuits. The 30v to 45v collector rating provides the high level logic swings required in many data processing equipments. The entire family is available in production quantities ... and in quantities 1-99 from your local Philco Industrial Semiconductor Distributor.

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The full line offers meters of four degrees of precision ranging from one tenth of a millisecond to a tenth of a microsecond. Versatile 7000 Series instruments feature selectable sensitivity for noise discrimination, trigger level adjustable over a wide range slope selection and very high input impedance.

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GATING COUNTERS
The counting interval of these instruments can be accurately controlled by a broad variety of input signals. Widely useful as a systems building block, several of these units will perform as EPUT meters or time interval meters when operated in conjunction with an independent source of time signals.

PRESET EPUT METERS
These instruments will create direct digital indications of rotating speed, flow, pressure, temperature and similar physical quantities in any desired units—for example, rpm, gals/sec, psi, etc. Direct indication is made possible by a counting interval variable over a wide range in small increments.

COUNTER-CONTROLERS
Counters which deliver output signals when selected numbers are reached are widely used for precise control of diverse operations. Output signals may be relay closures, sharp voltage impulses or changes in dc level. 5800 Series instruments operate at speeds up to 40,000 counts per second and deliver output signals at one or two preset totals. 5800 Series controllers utilize miniature magnetic amplifiers for maximum reliability in industrial control applications. Operable at speeds up to 5000 counts per second, these units are obtainable with from 1 to 12 preset points.

Write for Catalog C706.

Beckman

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CIRCLE 8 ON READER-SERVICE CARD

NEWS

U.S. to Split Research Journal

The National Bureau of Standards will publish its Journal of Research in four sections after July 1 to meet the specialized needs of scientists, engineers and mathematicians. At the same time editorial scope of the publication is being broadened.

The Journal's content now is as broad as the Bureau's scientific program, embracing most of the physical sciences and branches of engineering. The new journal is being divided as follows, with subscriptions available from the Government Printing Office:

Section A—Physics and Chemistry, issued six times a year, annual subscription $4.

Section B—Mathematics and Mathematical Physics, quarterly, $2.25.

Section C—Engineering and Instrumentation, quarterly, $2.25.

Section D—Radio Propagation, six times a year, $4.

Besides research reports, the revised journal will present reviews by recognized authorities and information on subjects closely related to the Bureau's basic mission. Much of the material that the Bureau has been publishing in nonperiodical form will be carried in the Journal.

Two of the Bureau's nonperiodical series—"Circulars" and "Building Materials and Structures Reports"—are being discontinued. Two new series are being started: "Monographs" and "Technical Notes."

FCC Spectrum Hearings to Affect Electronic Designers

The allocation of spectrum space between 25 and 890 mc is under re-examination in Washington, and the findings will have an impact on designers throughout the electronics industry.

Months of testimony before the Federal Communications Commission will involve:

- Television—TV is now the largest area of spectrum and the most complex. Involved is uhf TV: 470-890 mc. The FCC has long tried, without success, to make uhf economically feasible on a broad scale. It is now considering other means of expansion beyond the 12 uhf channels.

- Industrial competition for uhf—AT&T has asked the FCC to establish a mobile telephone service using 765-840 mc—the heart of uhf TV. Mobile equipment manufacturers contend AT&T wants to monopolize the mobile service; they are urging the FCC to let AT&T experiment for five years but not to authorize service on a regular basis. The broadcasting industry, on the other hand, argues that uhf space must be retained...
until a better spectrum location is found for TV.

**Control of the spectrum**—The FCC has jurisdiction over only part of the 25-890 mc band. Other government agencies, primarily the military, control a large portion, much of it for aircraft communications, navigation, etc. The FCC is negotiating with these services to find out if they will swap some of their vhf spectrum for TV's uhf. This would give TV a more contiguous band. The shift in military equipment would cost billions.

**Congress, and its reaction**—The Senate Commerce Committee has criticized the FCC for not expanding TV and providing more competing stations. The House Commerce Committee has voiced concern over the split management of the spectrum by the FCC and other services.

**The Electronic Industries Assn.—**The EIA membership is responsible for most of the nation's electronics production. EIA is opposed to giving AT&T too large a foothold in the mobile field. It points to the following expected growth in mobile transmitter usage, and it wants its share: 695,000 transmitters in 1958; to 1,390,000 in 1963; to 2,650,000 in 1968; to 5,000,000 in 1978. EIA wants an additional 41 mc in the 25-890 mc region to take care of this growth.

It will be many months before the commission finally determines what rearrangements are in order.

**New Letter Sorter Tested**

Electronic letter sorting is now receiving a trial in the United Kingdom. The operator of this Thrissell Engineering Co. device has no problem competing with the machine; it adjusts to his speed. Letters are fed by keyboard operation to a waiting compartment, where they are "remembered" electronically. If the operator thinks he has misread the address, he can cancel the keying by pressing a button. As he moves on to the next letter, the machine moves the previous one to banks of other memories for ultimate sorting. A skilled operator can handle 70 letters a minute.

**DIFILM® DUAL DIELECTRIC**

**gives new BLACK BEAUTY® series of small, low-cost capacitors outstanding performance characteristics**

- withstand 105°C operation with no voltage derating
- moderate capacitance change with temperature
- excellent retrace under temperature cycling
- superior long-term capacitance stability
- very high insulation resistance

**NEW!** DIFILM Type 160P fully-molded case and Type 161P pre-molded case capacitors in 5/16" to 1" diameters for general commercial and entertainment electronics.

**NEW!** DIFILM Type 162P slotted-base multi-purpose molded case capacitors for auto radios and other severe vibration applications. Slot prevents collection of moisture around leads when capacitor is end-mounted against chassis.

- New DIFILM Black Beauty Capacitors represent a basic advance in paper tubular capacitor design. DIFILM Capacitors combine the proven long life of paper capacitors with the effective moisture protection of plastic capacitors...by using a dual dielectric of both cellulose and polyester film that's superior to all others for small, yet low cost, capacitors.
- Just check the characteristics listed above. This overall performance is fully protected by HCX®, an exclusive Sprague hydrocarbon material which impregnates the windings, filling all voids and pinholes before it polymerizes. The result is a solid rock-hard capacitor section, further protected by an outer molding of humidity-resistant phenolic. These capacitors are designed for operating temperatures ranging up to 105°C (221°F) ... at high humidity levels ... without voltage derating!


**SPRAGUE COMPONENTS:**
- CAPACITORS
- RESISTORS
- MAGNETIC COMPONENTS
- TRANSISTORS
- INTERFERENCE FILTERS
- PULSE NETWORKS
- HIGH TEMPERATURE MAGNET WIRE
- CERAMIC-BASE PRINTED NETWORKS
- PACKAGED COMPONENT ASSEMBLIES

**CIRCLE 9 ON READER-SERVICE CARD**
NEWS

Meter Reads Out in Feminine Voice

A new voltage meter tells the operator its findings in a clear, feminine voice. The device is the talking Vocameter, developed by the Cubic Corp. of San Diego.

For readings by sight, there is also an edge-lighted digital readout.

The voice reports are called especially useful to technicians working on high-voltage measurement. Their eyes can remain on the work area as the voice announces: "Plus-nine-nine-eight-point-three-volts." Measurements can be relayed through earphones, a loudspeaker or a sound system.

There are 14 channels of voice storage in the Vocameter. Each can store about a half second of wordage. The exact wordage is up to the user. Normally 11 tape-storage channels are used for the digits 0 through 9 and the decimal point. Three other channels contain such words as "plus," "minus," "volts," "ohms," etc.

The meter gives new vocal readings automatically with each change in instrument reading. Information can be recorded in a voice of the user's choice, in any language or with any data for special applications.

Girl's voice calls out measurements made by this voltmeter. Unit has a 14 word vocabulary.

MIT Expanding Its Soviet Data

Soviet scientific literature will soon be offered on a greatly increased scale by the Massachusetts Institute of Technology. The institute has started an extensive exchange system with Russian libraries and will also become the New England depository for translations by the Office of Technical Services, U.S. Dept. of Commerce. OTS will send MIT about 10,000 Russian scientific articles and 50,000 abstracts a year for physics, biology and chemistry.

The extreme prevalence of field representatives is a helpful thing. This means that engineering help, new instruments or repairs can be yours wherever, whenever — and in an unreasonably short time.

Almost 200 field representatives are in action daily around the world — over 150 of them in America. They're factory trained men, regularly re-equipped with latest data on new instrumentation and new measuring techniques.

Their basic dedication is to help solve your engineering problems, and then keep your instrumentation cooking.

Should an instrument malfunction (rare) your rep provides factory-level field service and parts — fast!

The list alongside includes your rep. Call him for engineering help, new instruments, repairs or parts. And please don't be bashful. It's his job.
First Tactical Airborne Plotter
For ASW is All-Transistorized

Performance previously available only aboard ship or in fixed stations is provided by a plotting system for anti-submarine warfare now undergoing Navy flight tests.

With the system, a plane can track a submarine through information relayed by radar, sonobuoys, countermeasures and other detection equipment. This equipment feeds analog data to an operator who evaluates and relays it to the plane's plotter.

The plotter, which continuously plots the aircraft's ground track, calculates the sub's position in relation to the plane's. The relationship is indicated by a succession of lights on a screen in the cockpit. The plotter can also show location of a third station.

The pilot "flies" the plotter—he tries to bring two arrows together. He does not have to evaluate data, though he can easily read the sub's speed and direction of travel from the fixes on his screen. The plotter is miniaturized and completely transistorized.

Range of the tactical system is up to 200 miles. It is used in a shipping unit. Both devices are made by the Loral Electronics Corp., Bronx, N.Y. The company is now producing a computer for 1960 delivery that will replace the human evaluators and make the system fully automatic.
device development project leader

If you are a man capable of heading a team of device physicists in the development of new and advanced transistors, diodes and other semiconductor devices, the Semiconductor Division of Hughes Products (Hughes Aircraft Company) can offer you an exceptional position. You should have a Ph.D. in Physics and several years experience in research and development. A substantial background in the theory of device design is essential.

The ultra-modern facilities of the Semiconductor Division in Newport Beach, Southern California, were just recently completed. This fully integrated division is responsible for semiconductor research, development, manufacturing, marketing and sales.

If you meet the requirements for the position of Device Development Project Leader, or if you're an engineer or physicist with semiconductor experience, please contact:

Mr. C. L. M. Blocher
Scientific Staff Representative
Hughes Semiconductor Division
500 Superior Avenue
Newport Beach 1, California

The Semiconductor Division of Hughes Products has one goal: to give you the best performing semiconductors—both today and tomorrow. Here's how we are doing this:

1. Start with a better manufacturing facility—The new Hughes multi-million dollar semiconductor plant has 300,000 square feet of space. Hughes has installed over $3 million worth of mechanized manufacturing equipment which will provide you with more uniform semiconductors... at a lower cost.

2. Encourage advanced thinking—A few of the projects now in progress: fundamental and device physics chemistry, new semiconductor materials, basic research into electronic solids, new methods of crystal preparation, new techniques for fabricating advanced solid state devices.

3. Have a passion for reliability—Hughes is recognized for the ability to translate the latest advances into components which meet your strictest reliability needs. This reliability is the product of an integrated effort beginning in earliest development through final inspection.

These factors enable Hughes to bring you a number of products which make a significant improvement in the state of the art. To date these include: a complete line of silicon and germanium
Two rigid, fiber-glassed sections hold about the same number of wires as conventional harness. Breakout wiring is encased in flexible tubing. Junction boxes ease replacement.
Now...an extensive line of
high performance, hermetically sealed,
silicon power rectifiers UP TO 35 AMPS.
JEDEC types exceeding MIL specifications.

NEW
SINGLE unit VERY HIGH VOLTAGE silicon rectifiers exhibiting these desirable characteristics...

- High Voltage
  - up to 2000 PIV
- Low Forward Drop
  - 1.5 Volts, DC
- Extremely Low Leakage
  - 1 nA
- Forward Current
  - up to 20 Amps.

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NEW
INSULATED STUD silicon rectifiers offering these quality features...
- Simplify mounting
- Save assembly parts & costs
- Obtain efficient heat transfer
- Give greater design flexibility

AVAILABLE UP TO 10 AMPS PER UNIT AND UP TO 2000 VOLTS PIV.

NEWS
Last Year Saw Drop in Component Shipments

Latest Department of Commerce figures (from the Electronics Division, Business and Defense Services Administration) show the following totals for the years from 1952 through last year.

Estimated Shipments of Selected Electronic Components

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<tbody>
<tr>
<td>Capacitors</td>
<td>200</td>
<td>220</td>
<td>198</td>
<td>218</td>
<td>212</td>
<td>216</td>
<td>192p</td>
</tr>
<tr>
<td>Relays for electronic applications</td>
<td>74</td>
<td>89</td>
<td>85</td>
<td>109</td>
<td>140</td>
<td>157</td>
<td>138p</td>
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<tr>
<td>Resistors for radio, TV, and other industrial and military electronic applications</td>
<td>123</td>
<td>139</td>
<td>130</td>
<td>148</td>
<td>171</td>
<td>192</td>
<td>177p</td>
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<tr>
<td>Transistors</td>
<td>19</td>
<td>26</td>
<td>26</td>
<td>40</td>
<td>90</td>
<td>151</td>
<td>210p</td>
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<tr>
<td>Crystal diodes</td>
<td>2</td>
<td>5</td>
<td>9</td>
<td>13</td>
<td>40</td>
<td>68</td>
<td>112p</td>
</tr>
<tr>
<td>Transformers and rectifiers (for electronic applications)</td>
<td>17</td>
<td>21</td>
<td>17</td>
<td>27</td>
<td>50</td>
<td>83</td>
<td>98p</td>
</tr>
</tbody>
</table>

1 Includes intra-plant and inter-plant transfers.
2 Includes both fixed and variable air capacitors.
3 Includes thermal, meter movement and motor driven relays.
4 Includes attenuators, voltmeter multipliers, varistors and thermistors.
5 Includes power rectifiers, diode type; light sensitive devices; and mixer crystals.

Fluoride Insulation Stands High Temperatures

Bell Labs' scientists inspect a strip of fluoride-coated aluminum. The coating was applied in a few minutes by exposing the aluminum to an oxidizing carrier of fluorine at a temperature below 600°C. Aluminum fluoride films show resistances of about $7 \times 10^6$ ohms at temperatures as high as 500°C, and do not break down at 450°C.

Satellite Dir.

A satellite, a rocket that remains in orbit around the earth, has been in orbit for more than three years.

The satellite, which was launched in 1958, is a three-stage rocket and has been orbiting the earth for more than three years.

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Reactance-Amplifier Receiver for Moon Research Has 1 db Signal-to-Noise

Low noise in a new reactance-amplifier receiver delivered to the Army will improve moon radar research.

The receiver is the AIL Type 7329, built by Airborne Instruments Lab of Mineola, N.Y. It will be used in the Signal Corps' Diana Project, which is measuring the ion density path to the moon.

Transmissions to the moon on 151 mc have already been made by the Army. With the new receiver, experiments will be conducted on 413 mc. This will permit cross-checking of estimates made thus far.

With the reactance-amplifier operated in the two-port, difference-frequency mode, receiver noise of less than 1 db is obtained with commercially available reactance diodes, Airborne reports. The unit operates in either the sum-frequency mode or the two-port difference and has been used to receive signals from below 100 mc up to 1000 mc.

In the sum-frequency mode, bandwidths of 30 mc, and over-all receiver noise of about 2 db, are obtained at 400 mc. In the two-port difference frequency mode, bandwidths of 5 mc and noise of 1 db are said to be typical at 400 mc.

The Signal Corps reports these key advantages of the low-noise receiver:

- Increased radar range, in effect.
- Performance equivalent to that obtained with a larger antenna.
- Greatest improvement of the over-all system at the lowest cost.

Saturable Reactor as Ballast Dims Fluorescent Lamps

A system for dimming fluorescent lights has been developed that reportedly overcomes previous obstacles of flicker and expensive operation.

The technique consists of a series saturable reactor used as a dimming ballast. The manufacturer, Day-Ray Products, Inc., of South Pasadena, Calif., reports that the control of large lighting installations is possible, because control power can be much less than lamp power.

The system is made to start the lamp at any lighting level. In an aircraft installation, it operates a 170-ma lamp over a range of 0.35 ma to 200 ma on 400-cycle power. The low-current level is described as a compromise of cost, weight and dimming ratio in excess of 700 to 1.

Installations are being made on two new jet transports and some new military aircraft, the company reported.
Captive Quick-Opening Fasteners:

Southco standards provide many benefits at low cost for access through doors, covers, panels and into drawers.

- **LION 1/4 TURN FASTENERS**
  - Quick, positive locking, by fractional turn.
  - Tight seal formed by compression of leaf spring.
  - Alignment and stack height not critical.
  - Approved for aircraft use.
  - Rugged.
  - Extra strength provided by swaged nose.
  - Vibration resistant.

- **RETRACTABLE SCREW FASTENERS**
  - Stand-off thumb screws from stock to eliminate costly, special fasteners.
  - Installed quickly without special tools.
  - Accommodate misalignment.
  - Complete range of standard sizes.

- **ADJUSTABLE PAWL FASTENERS**
  - Pre-assembled, quickly installed.
  - Accommodate variations in frame thickness up to 1/2 inch.
  - One-quarter turn closes, additional turns increase grip pressure.
  - Attractive appearance, long life.
  - Moving or pre-set pawl.
  - Miniature, intermediate and large sizes.

- **ADJUSTABLE PAWL FASTENER**
  - Has twin-knob control.
  - One knob controls pawl, pointer shows pawl position.
  - Other knob controls amount of pressure to seal closure with uniform pre-set compression.
  - Easily installed.

- **ADJUSTABLE PAWL FASTENER**
  - Compact and rugged.
  - Eliminates rivets or bolts to save installation time.
  - Three types cover grip range up to 3/8".
  - Supplied either with integral metal and plastic knob, plastic knob or for your knob.

- **ARROWHEAD DOOR LATCH**
  - Requires only one hole to install.
  - Operates on quarter turn.
  - Holds under spring tension.
  - Arrow shows pawl position; no pawl stops required.
  - Uses minimum inside space.

**Free Fastener Handbook**

Send for your complete Southco Fastener Handbook, just printed. Write to Southco Division, South Chester Corporation, 235 Industrial Highway, Lester, Pa.

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**WASHINGTON REPORT**

Ephraim Kahn

Better Component Design Needs Pushing

Need for encouragement of design engineering at the most basic level of electronics—the component—is starting to gain more and more attention from the Pentagon. Sparked by industry thinking on the point, a growing body of opinion is tending toward the view that a special group should be set up in the Defense Department to make at least a preliminary survey of the components problem.

The problem seems to be that basic components—the least glamorous part of a glamorous industry—are not being developed as rapidly as are some more esoteric devices. Yet, officials point out, it is the component that determines whether a weapons system will or will not function. To be sure, this is true of non-electronic components, too.

And there are those who think that the Defense Department might be wise to spend close to $1 billion a year on research, development, testing and evaluation of components for aircraft, missiles, and space vehicles. At present, it is impossible to tell how much is being spent for research and development work on electronic and mechanical components. It seems clear that it is less than $1 billion. But some funds that are nominally in other accounts are probably being "bootlegged" into R & D.

Object is to overcome the obsolescence that is overtaking many items long regarded as tried-and-true building blocks for weapons systems. As the systems become more complex and as performance requirements rise, it is becoming more and more apparent that there are too many weak links when off-the-shelf items are put to work in a brand new weapons system.

**Components Research: A Special Function?**

Financing of components research is going to present a big problem if the Defense Department decides to go in for it as a special function. Looking at the nature of many firms that make components for weapons systems, defense officials are struck by the relatively low capitalization of the average company. Demands on their limited capital are such that little can be devoted to long-term independently financed research and development. The money in hand is needed to keep...
the business going from day to day. Even large companies, it is said, can't spare a lot of cash for research and development of components. After all, it takes a lot of money for a prime contractor on a weapons system merely to do what he has undertaken.

If this analysis is correct, it appears as though the logical source of funds for extensive research and development in components is either the Defense Department or one of the Armed Services. And even these appropriation-bound agencies are handicapped.

Conviction is growing, however, that steps should be taken to solve the problems that are sure to come up in the components field, particularly in non-electronic areas where the art has not, in most cases, been advancing too rapidly. Object is to strike a balance wherein systems manufacturers do not have to make compromises and component makers no longer have to sacrifice any quality to the price and timing requirements of their customers—the weapons system prime contractors.

Even in the components business, however, the ubiquitous question of patents has arisen. Some industry people are known to feel that the protection offered to their patentable devices by the Armed Services Procurement Regulation is insufficient.

**DOD to Give Weapons Proposals the Hard Eye**

Defense Department plans to get even tougher in selecting weapons development projects that merit its support. The Director of Defense Research and Engineering, Dr. Herbert York, has said that the "highest degree of selectivity must be exercised in reaching decisions to continue or discontinue the development of some of the major weapons systems."

Right now, Dr. York's organization is looking at the military's proposals for Research, Development, Test and Evaluation for fiscal 1960 with a very hard eye. DDRE's chief wants to "be in the position either to approve, disapprove, or modify these programs and projects" by the time the military departments and the Advanced Research Projects Agency submit their apportionment requests.

According to Dr. York, it is most difficult to be selective during the research and earliest design and development stages. "Fortunately," he says, "these stages are the least expensive." But later on, in the costly advanced development and early production phases, Dr. York must make decisions "where a single item may not only involve an outlay of many millions of dollars but may also have a pronounced effect not only on military strategy but on the civilian economy as well."

E-I hermetically sealed terminations and custom sealed components have proven their ability to withstand the extreme environments encountered in today's critical applications. In addition to their complete dependability in all types of commercial and military service, E-I offers engineers wide design latitude... a complete line of standard seals, custom design service on "specials"... and custom sealing of components of your own manufacture. Check your next seal requirements with E-I, or request catalog on standard terminals, now!

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Save this
Guide to Oak Choppers

Lightweight side contacts
Leaf spring damping members
Side contact stubs
Lightweight armature and laminated amperance limit give remarkable phase angle stability and ajarment in any mounting and at low temperatures

MINIATURE SERIES 600—MOST STABLE IN ITS CLASS

METICULOUS ENGINEERING combined with exhaustive testing provides a line of SPDT choppers which exhibit unusual stability and low noise. While the specifications shown here are necessarily abbreviated, they will help you make a preliminary appraisal. For complete details on any unit, send us the type number and a description of your application with its circuitry.

STANDARD MOUNTING AND TERMINAL STYLES—Modifications Available on Special Order

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<th>SERIES 600</th>
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<td>For Shock and Vibration Conditions</td>
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<td>Phase Leg at Nominal Drive Freq. and Voltage</td>
<td>65° ±5° at 400 cps (25° C)</td>
<td>65° ±5° at 400 cps (25° C)</td>
<td>90° ±10° at 400 cps (25° C)</td>
<td>180° ±10° at 400 cps (25° C)</td>
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<td>Contact Rating Into Resistive Load (Maximum)</td>
<td>CONTINUOUS: 10 at 2 ma</td>
<td>CONTINUOUS: 50 at 2 ma</td>
<td>CONTINUOUS: 10 at 2 ma</td>
<td>CONTINUOUS: 10 at 2 ma</td>
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<tr>
<td>Life Expectancy (Optimum Conditions)</td>
<td>Up to 5000 hours</td>
<td>Up to 1000 hours</td>
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<td>Switching Speed With DC in Circuit</td>
<td>Less than 1 Millisecond</td>
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Phone: MOhawk 4-2222

CIRCLE 16 ON READER-SERVICE CARD
papers in each. A second innovation will be the introduction of a "panel of peers," a group of experts in the field, invited to comment on the group of papers at the completion of each session. Registrants will be able to obtain and review all papers prior to their presentation through the Convention Record.

14th ACM National Conference, September 1-3
Conference of the Association of Computing Machinery will be held at the Massachusetts Institute of Technology, Cambridge, Mass. Technical papers to be presented will cover numerical analysis, data processing, automatic programming, language translation, digital and analog devices, and various applications of computers. Chairman of Local Arrangements is: Frank M. Verzuh, Computing Center, MIT, Cambridge, Mass.

Paper Deadlines
July 15: Paper deadline for the Fourth IRE Instrumentation Conference and Exhibit to be held November 9-11, 1959 at the Atlanta Biltmore Hotel, Atlanta, Ga. An informative abstract of approximately 200 words is required. Earlier submission of papers is requested although final deadline for acceptance of abstracts is July 15. Send titles abstracts to W. B. Jones, Jr., School of Electrical Engineering, Georgia Institute of Technology, Atlanta, 13, Ga.
August 15: Submit by this date four copies of a 100 word abstract and a 1000 word summary of papers on any phase of computing for the 1959 Eastern Joint Computer Conference. The Conference will be held December 1-3, 1959. Forward abstracts to: J. H. Felker, Chairman, EJCC Program Committee, Bell Telephone Laboratories, Mountain Ave., Murray Hill, N.J.
August 3: Deadline for an original and four copies of an informative abstract of approximately 200 words for papers for the 1959 Electron Devices Meeting, IRE, Shoreham Hotel, Washington, D.C., being held October 29-30. Papers to be presented should deal with material of an applied or developmental nature in the broad field of electron devices. Emphasis should be on the device itself, or important new device technology. Send abstracts to: Dr. J. A. Hornbeck, Bell Telephone Laboratories, Murray Hill, N.J.
October 23: Deadline date for papers for the 1960 IRE Convention to be held March 21-24, Waldorf-Astoria Hotel and New York Coliseum, New York. Send a 100-word abstract in triplicate, including title of paper, name and address, and a 500-word summary in triplicate, including title of paper, name and address to: Gordon K. Teal, Chairman, 1960 Technical Program Committee, The Institute of Radio Engineers, Inc., 1 E. 79 St., New York 21, N.Y.
crimp-type

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Modular units by Burndy provide versatile, rapid and reliable answers to the problem of connecting a multiplicity of wires in relatively limited spaces. Crimped contacts—installed with any of several hand, pneumatic, semi-automatic or automatic tools—can be removed, re-inserted or replaced, providing the most complete flexibility in the connector field. Computers, ground-based radar, missile ground controls, and instrumentation are typical applications for Burndy modular connectors.

For complete information, write: OMATON DIVISION

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Norwalk, Connect.

NEW PRODUCT

Crimped Coax Hyfen Connector

Utilizing the HYFEN® crimp-type snap-lock principle, the Omaton Division of the Burndy Corp. has developed a completely new solderless connector for joining coax or shielded cable. This connector is a revolutionary development because it simplifies a process which was extremely complicated involving many parts.

The versatility of the snap-lock principle of the HYFEN is utilized and allows contacts to be snap-locked into and out of receptacles as needed. The connector itself allows rapid connecting and separation of circuits, either in multiple or singly. The connector has already been adapted for use in a rack and panel HYFEN—the ME7X-1, and in a modular terminal block, the MODULOK®. Other variations can be made available. These two are already in use in critical circuits. The coax HYFEN matches the characteristics of the cable over a wide frequency range. In crimping this connector, the contacts can be located in any circumferential position relative to the crimping dies. This crimp, a measurable quality control, is made quickly and uniformly by high speed precision installation tooling.

This crimp-type connector prevents the possibility of heat damage to either insulation or conductors. In addition, the design provides for firm cable strain relief. The speed and ease with which this connector can be installed are additional features.

Burndy Corporation, Norwalk, Connect.

CIRCLE 19 ON READER-SERVICE CARD

ELECTRONIC DESIGN • June 24, 1959
Open Letter to All Local Newspaper Editors

Editor, The Long-Islander
313 Main St.
Huntington, N.Y.

Dear Sir:

I would like to take advantage of your Letters to the Editor column to urge college-bound high school graduates, who have abandoned engineering as a possible career, to reconsider. There was a sharp decrease in engineering enrollment last fall—11 per cent, compared to a 7 per cent increase in overall enrollment. This drop off in engineer enrollment is largely due to a misunderstanding of what engineering is, according to a recent report by the Engineering Manpower Commission and the American Society for Engineering Education.

Blame for this decline is, according to Deans of Engineering, due primarily to misleading press reports. The Deans feel there has been a false appraisal of the long-range engineering opportunities by counsellors, students and parents because of numerous newspaper accounts of layoff of engineers during the 1957-1958 recession. There never has been any over supply of engineers, and it is not unusual for engineering seniors to receive four to nine job offers apiece before graduation.

Another reason for the lessened interest in engineering is increased concern about the rigors of the engineering curriculum, according to the deans. The report in describing this concern says: "Today's youth, living an easy life, has drummed into him the need for many years of hard study prerequisite to an engineering or science career . . . Faced with such prospects [of no higher salary] the young person may be selecting easier careers." Engineering education must be viewed as a good education for today's world, not just a way to a high paying job.

The report states that there is no shortage of engineering educational facilities at the freshman level and well-qualified applicants stand a very favorable chance of being accepted by the first college of their choice.

The nation and the world need engineers, not just to build missiles and defenses against missiles but to convert the earth's resources into food and products for a better standard of living for all peoples.

P.S. to ED readers: Please feel free to send this or a similar letter under your own signature to your local newspaper.
HYBRID MULTIVIBRATOR APPLICATIONS:
- Rectangular wave generators where ideal undistorted waveforms are required.
- Multivibrators where the ratio of the timing periods must be appreciably different from unity.
- Square wave generators where ideal symmetry is required.
- Timing circuits where periods greater than 1 msec are required and where the use of electrolytic capacitors is undesirable.
- Timing circuits where good temperature stability is required.
- Timing circuits which must operate to temperatures between 60°C and 100°C. The hybrid circuit using two germanium transistors can be more economical than a conventional circuit using two silicon transistors.
- One-shot multivibrators which must operate at high duty cycles.
- Multivibrators where independent adjustment of the two parts of the timing cycle is required.
- Multivibrators where it is important to avoid the danger of "lock-up" or non-oscillation.
- Circuits which must perform complex timing operations.
- Circuits where space economy is important. The hybrid circuit required fewer capacitors of smaller size.

T. P. Sylvan
Semiconductor Products Department
General Electric Company
Syracuse, N.Y.

One unijunction and two junction transistors are combined to provide highly desirable multivibrator characteristics. Examples of symmetrical, unsymmetrical, and one-shot types are given together with results obtained.

HYBRID MULTIVIBRATORS, using one unijunction and two junction transistors, provide ideal rectangular output, excellent timing stability, and independent adjustment of the length of both parts of the timing cycle. The junction transistors form a conventional flip-flop stage with the unijunction transistor performing the timing and triggering functions.

Transistor timing circuits are being applied in an increasing number of computer and control systems. Most of the timing functions can be performed by appropriate combination of two basic circuits; the multivibrator, or pulse generator, and the one-shot multivibrator, or delay generator.

In many applications, however, conventional transistor multivibrators\(^1\) have a number of serious limitations which restrict their use in timing circuits and rectangular wave generators. The cross coupling capacitors must serve as the timing capacitors and thus are required to have large values if long timing periods or heavy loads are required. Frequently, the required values of capacitance are so high that electrolytic capacitors must be used which severely limit the accuracy and stability of the timing periods. The coupling capacitors also result in considerable distortion of the collector voltage waveform so that optimum rectangular waveforms cannot be obtained. This is particularly true if there is an appreciable difference in the lengths of the two parts of the timing cycle.

Conventional Multivibrator Circuit

For the purpose of comparison, a typical multivibrator of conventional design is shown in Fig. 1. This circuit was designed to ensure oscillation to 75°C and assumes a maximum I\(_c\) of 0.5 mA at that temperature. The measured period at 25°C was about 1.0 second, decreasing by about 25 per cent at a temperature of 75°C. The collector voltage waveform for this circuit, as shown in Fig. 1, is seen to deviate considerably from an ideal square wave.

Unijunction Transistor

In all of the hybrid timing circuits to be described, the unijunction transistor\(^2\) serves the dual function of a timing and a triggering source. The circuit used is the basic relaxation oscillator shown in Fig. 2. The characteristics and design of the unijunction transistor relaxation oscillator are described elsewhere\(^3,4\) and will only be summarized here.

The period of oscillation of the relaxation oscillator is determined by the values of \(R_T\), \(C_T\),
and the intrinsic standoff ratio, \( \lambda \), of the unijunction transistor. The period is given with sufficient accuracy by the equation,

\[
t = R_T C_T \ln \left( \frac{1}{1 - \lambda} \right)
\]  

(1)

Trigger pulses are developed across resistor \( R_A \) in Fig. 2. The value of \( R_A \) is determined primarily by the required pulse amplitude but should generally be made as small as possible consistent with this requirement. Values of \( R_A \) generally fall in the range from 1 to 100 ohms. For values of \( C_T \) greater than 1 nF, the trigger pulses have a sharp leading edge followed by an exponential decay. The time constant of the decay is \((R_A + R_S) C_T \) where \( R_S \) is the dynamic resistance of the unijunction transistor between emitter and base-one and generally lies in the range from 5 to 10 ohms. Trigger pulses of positive polarity may be obtained by using the circuit of Fig. 2A; trigger pulses of negative polarity may be obtained by using the circuit of Fig. 2B. When using the latter circuit, it is important to note that the current pulse flows through the supply; therefore, good regulation or isolation will be required to prevent detrimental effects on other circuits working from the same supply.

The resistor \( R_S \) in the base-two circuit is used to reduce the peak power dissipation of the unijunction transistor during the discharge of the capacitor \( C_T \) and also to provide temperature compensation of the timing period. The interbase resistance \( R_{bb} \) of the unijunction transistor increases with temperature at approximately 0.8 per cent/deg C so that \( R_S \) will cause the peak point voltage of the unijunction transistor to increase with temperature; this, in turn, will cause the timing period to increase with temperature. The value of \( R_S \) should be chosen to compensate for the temperature variations of \( R_T \), \( C_T \) and the unijunction transistor, itself. The principal temperature variation in the unijunction transistor, of importance in timing applications, is a decrease in the peak point voltage \((R_S = 0)\) of 3 millivolts/deg C.

The final parameter of importance in the design of the relaxation oscillator circuit is the peak-point emitter current, \( I_P \). The peak-point emitter current corresponds to the minimum current which must flow into the emitter of the unijunction transistor for it to fire. It is found that \( I_P \) is inversely proportional to the supply voltage and is generally specified at a supply voltage of 25 volts. This puts a maximum limit on \( R_T \) in accordance with the equation:

\[
\frac{V_1 - V_F}{R_T} = \frac{(1 - \lambda) V_1}{I_P (\text{max})} \frac{25}{V_1}
\]

(2)

The specified maximum value of \( I_P \) is 12 which gives,

\[
R_T \frac{(1 - \lambda) V_1^2}{300}
\]

(3)

where \( R_T \) is in megohms and \( V_1 \) is in volts. For a specified maximum timing period, this condition also determines the minimum value of \( C_T \) which can be used. Eq. 3 indicates that for long timing periods it is advantageous to use high supply voltages so as to reduce the value of \( C_T \) required. However, voltages above 35 v should be avoided; otherwise, the power dissipation will result in excessive heating of the unijunction transistor and will cause the emitter reverse leakage current to be a problem. For this reason, when high supply voltages are employed, it is wise to use unijunction transistor types with the highest values of interbase resistance. Improved performance can also be obtained by selecting unijunction transistors for low values of \( I_P \), or by using a power supply with incomplete filtering. The ripple voltage from the power supply acts as a trigger for the unijunction transistor and can reduce the effective peak point current by a factor of 10 or more.

**Symmetrical Multivibrator**

The simplest version of the hybrid multivibrator circuit is the symmetrical multivibrator or square wave generator, shown in Fig. 3. In this circuit, the two npn transistors are used in a simple saturating flip-flop designed in the normal manner\(^\circ\). The unijunction transistor triggers the flip-flop from one state to the other by means of the negative trigger pulses developed across \( R_A \). Collector or base triggering of the flip-flop can also be used, if desired, but the emitter triggering method shown in Fig. 3 is generally simpler.
and requires fewer components.

Note that the circuit of Fig. 3 is designed with the same supply voltages, load resistors, and period as the conventional multivibrator of Fig. 1. The circuit was designed to operate at a temperature of 75°C and actual tests indicated satisfactory performance at 84°C. The change in period between 25°C and 80°C was less than 3 per cent and it was found that most of this variation was due to the change in \( R_7 \). In comparing the circuit of Fig. 3 with that of Fig. 1, the improvement in the output voltage waveform is apparent. It will also be noted that the conventional circuit requires two 200 \( \mu F \) capacitors whereas the hybrid circuit requires only one 10 \( \mu F \) capacitor. This would permit the use of a paper capacitor in the hybrid circuit whereas the conventional circuit would require the use of electrolytic capacitors. Another apparent advantage of the hybrid circuit is that perfect symmetry of the waveform is obtained without requiring the use of a balance control.

If the use of a synchronizing signal is desired, it is best to use a negative trigger pulse at base-two as shown in Fig. 3. The trigger pulse width should be greater than 0.5 microsecond.

Most of the advantages of the hybrid multivibrator circuit occur where periods longer than 100 \( \mu \text{sec} \) are required. However, by using smaller values of \( C_7 \), it is possible to operate the hybrid multivibrator at periods as low as 10 \( \mu \text{sec} \). At the lower periods it will usually be found necessary to use nonsaturating flip-flops with the base triggered\( ^6 \).

**Unsymmetrical Multivibrators**

If an unsymmetrical waveform is desired, the circuit may be modified to that shown in Fig. 4. This circuit also illustrates the use of an npn transistor flip-flop. Two separate charging resistors, \( R_{71} \) and \( R_{72} \), are connected to the collectors of the npn transistors as shown. Assume that initially transistor \( Q1 \) is off. The voltage at the collector of \( Q1 \) will then be about 12 v and voltage at the collector of \( Q2 \) will be about 2 v. The capacitor \( C_T \) will be charged through \( R_{71} \) until the unijunction transistor fires; at this time, the flip-flop will be triggered to the opposite state and \( Q2 \) will be off. The capacitor \( C_T \) will then be charged through \( R_{72} \) and the silicon diode \( D1 \) will isolate \( R_{71} \) from the timing circuit. It is seen that \( R_{71} \) and \( R_{72} \) determine independently the lengths of the two parts of the timing period. The two periods for the circuit shown are about 4 sec and 400 msec. It is evident that if independent adjustment of the two parts of the period are not required, the circuit can be simplified by replacing \( R_{72} \) with a 43 K resistor, removing \( D1 \) and connecting \( R_{71} \) from the emitter of \( Q3 \) to the positive supply.

**One-Shot Multivibrators**

A one-shot multivibrator circuit may be easily obtained from the hybrid multivibrator circuit of Fig. 4 by removing either of the timing resistors \( R_{71} \) or \( R_{72} \). A typical circuit is shown in Fig. 5. Here, the timing resistor \( R_T \) is connected to the collector of \( Q1 \) and the quiescent state for the circuit occurs when \( Q1 \) is off and \( Q2 \) is on. A positive trigger applied at the base of \( Q2 \) will turn \( Q2 \) off and cause the voltage at the collector of \( Q1 \) to increase to about 20 v. The capacitor \( C_T \) will then be charged through \( R_T \) and at the end of the timing cycle, the unijunction transistor will fire and trigger the flip-flop to its quiescent state. Note that once the timing cycle is started by a trigger pulse at the base of \( Q2 \), additional trigger pulses at this input will not affect the timing cycle. Another important advantage of the circuit is apparent from the waveforms shown in Fig. 5. It is seen that at the end of the timing cycle all the voltages in the circuit have been restored to their initial values. For this reason, the timing period will be independent of the trigger rate and the duty cycle. The circuit shown was tested at a duty cycle from 0 to 99.5 per cent and the observed change in period was less than 0.4 per cent. This contrasts with conventional types of one-shot multivibrators where duty cycles are limited to less than 70 per cent to maintain timing accuracies of 5 per cent. It should be noted in the circuit of Fig. 5 that the resistor \( R_1 \) is used to bias the emitter of the unijunction transistor to about 2.0 v when the circuit is in the quiescent state. This ensures that the

---

Fig. 3. (left) Typical hybrid multivibrator circuit with collector voltage waveform.

Fig. 4. Unsymmetrical multivibrator circuit.

---

24
emitter voltage returns exactly to its initial value at the end of the timing cycle.

Complex Timing Circuits
The nature of the circuits described is such that many complex timing functions can be achieved by simple intercombinations and variations of basic circuits. For example, a form of pulse-width modulation may be obtained with the circuit of Fig. 3 by connecting the lower end of $R_2$ to a variable voltage source. The circuit of Fig. 4 may be modified to work with a ring counter with a separate timing resistor for each stage of the counter. This allows a different time delay for each stage. In a similar manner, a large number of useful timing functions, such as pulse length discrimination and frequency division, may be synthesized from the basic circuits.

References


Thomas A. Edison Industries
INSTRUMENT DIVISION
55 LAKESIDE AVENUE, WEST ORANGE, N. J.
CIRCLE 20 ON READER-SERVICE CARD

ELECTRONIC DESIGN • June 24, 1959
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Unique, new, ferrite sleeve and core construction provides 10,000 to 1 inductance range in a tiny package, yet it still allows for high current rating at 125°C operating temperature.

WEE-DUCTOR is the latest addition to the Essex Electronics line of standard R.F. Choke Coils. Write today for detailed data sheet describing this amazing new miniature choke with the expanded range of inductances!

<table>
<thead>
<tr>
<th>Essex Part Number</th>
<th>L µH</th>
<th>Max. Res. Ω</th>
<th>I Max. ma</th>
<th>Dia.</th>
<th>Length</th>
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<td>3000 - 150</td>
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<td>0.375</td>
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<td>0.188</td>
<td>0.44</td>
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<td>0.04 - 21.0</td>
<td>2700 - 125</td>
<td>0.25</td>
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<td>RFC-L</td>
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<td>0.03 - 80.0</td>
<td>4000 - 80</td>
<td>0.31</td>
<td>0.90</td>
</tr>
</tbody>
</table>

Soils shine when exposed to the "black" light of this lamp.

Residual solder flux, almost invisible in ordinary light, glows brightly under the Blak-Ray.

Black Ray
Spotlights Soils

Many soils and contaminants form their own beacon lights when exposed to the light of this Blak-Ray lamp. This high intensity, near-ultra-violet lamp illuminates soils like solder flux, hydrocarbons, resins, and lint, and makes them fluoresce in brilliant colors, though they may be invisible in ordinary light.

The lamp, a product of Black Light Eastern Corp., 201-04 Northern Blvd., Bayside, N.Y., obviates expensive, time-consuming tools like the inspection microscope in many soil-searching applications.

The usefulness of the lamp depends on the fluorescence of many soils. Fortunately, most of the soils which trouble the electronics designer fluoresce. Fluorescent additives are available for contaminants which don't.

Often the contaminant is not a "soil" in the usual sense. It may be a very clean substance which isn't where it belongs. A highly refined damping fluid or a lubricating oil is such a "soil" when it leaks onto a wiring harness.

The lamp, available in bench-mounted or in portable models, can detect fluorescent particles on a non-fluorescent field. An example of the former is in revealing residual solder flux on a printed circuit board. The latter is exemplified in inspecting a damping fluid for tiny dust particles.

For production line inspection, the
Blak-Ray lamp is normally used near the cleaning apparatus so an operator can quickly check cleaned parts for residual contaminants. He can return soiled parts to the cleaner if necessary.

Most soils are readily detected under the lamp in normal ambient lighting. Higher contrasts, where desirable, can be obtained by shielding the parts from direct white light with a simple hood over the top and sides of the lamp.

**Many Soil-Searching Applications**

Some of the many uses of the lamp are:

<table>
<thead>
<tr>
<th>For</th>
<th>To Detect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Printed circuit boards</td>
<td>Solder flux</td>
</tr>
<tr>
<td>Electronic sub-assemblies</td>
<td>Brazing flux, welding slag, lint</td>
</tr>
<tr>
<td>Instruments &amp; meters</td>
<td>DC55 and lubricating oil leaks</td>
</tr>
<tr>
<td>Wiring harnesses</td>
<td>Fluorinated hydrocarbons</td>
</tr>
<tr>
<td>Gear trains</td>
<td>Many soaps and detergents</td>
</tr>
<tr>
<td>Servo &amp; gyro mechanisms</td>
<td>Plastic particles</td>
</tr>
<tr>
<td>Viscous damped mechanisms</td>
<td>Leaks</td>
</tr>
</tbody>
</table>

For more information about this illuminating instrument, turn to the Reader-Service Card and circle 103.

---

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Step into the "space age" with the greatest name in industry . . . General Motors. Just write the Director of Scientific and Professional Employment: Mr. Robert Allen, Oak Creek Plant, Box 716, South Milwaukee, Wisconsin.
Atmospheric Transmission In Infrared

In the design of infrared equipment, atmospheric transmission is perhaps one of the most variable quantities. It is predictable to a certain extent for given weather conditions, but the weather itself is the unpredictable element. Nevertheless, the IR system designer must make certain predictions for systems design purposes and thus, it is necessary to arbitrarily take an average weather condition and work from this reference. In this article, Thomas Altshuler discusses a procedure for calculating atmospheric transmission.

Atmospheric absorption of infrared is due to three independent phenomena. The first is molecular absorption, principally from water vapor and carbon dioxide. The second is due to scattering by water droplets such as mist, fog, and clouds. The third is due to absorption by solid particles such as dust and haze. For most applications in clear weather, only molecular absorption is important. In essence, the atmosphere acts like a window in certain spectral regions and isopaque to energy in other spectral regions.

Atmosphere is relatively transparent between 2 and 2.6μ, 2.9 to 4.1μ, 4.4 to 4.9μ, and 8-13μ, and relatively opaque in the excluded regions. However, the degree of transmission is a strong function of CO₂ and H₂O concentration in the air. H₂O, in particular, varies by large amounts with ambient temperature and altitude.

With the aid of Figs. 1 through 6 the molecular absorption of radiant energy can be calculated. Figs. 1 through 4 assumed the ARDC model atmosphere with the top of the troposphere at 11 km altitude. The CO₂ content was assumed to be constant at all altitudes and equal to 0.032 per cent by volume. A constant relative humidity was assumed in the troposphere and a constant mixing ratio in the stratosphere. The optical thicknesses of the gases were corrected for linear pressure broadening, and square root temperature broadening. Flat earth was assumed.

With these assumptions, the following procedure can be used to calculate atmospheric transmission $T_a$:

Let: $d =$ equivalent sea level path length, km for CO₂ in infrared beam.

$d_h =$ horizontal equivalent sea level path length, km, for CO₂ for 1 km actual path length.

$d_e =$ equivalent sea level path length, km, for CO₂ in a vertical path from $h$ to infinity.

$h_o =$ observer altitude, km

$h_l =$ target altitude, km

$h =$ altitude, km

$R =$ range, km

$R.H.$ = relative humidity. Take $R.H.$ value of 0.80 if not given in a specific problem.

$T_a =$ transmission of atmosphere.

$T_{H_2O} =$ transmission through water vapor in atmosphere.

$T_{CO_2} =$ transmission through CO₂ in atmosphere.

$W =$ precipitable centimeters water vapor in infrared path, corrected to standard temperature and pressure (STP).

$W_s =$ precipitable centimeters water vapor
Fig. 1. Carbon dioxide horizontal optical thickness.

Fig. 2. Carbon dioxide vertical optical thickness.

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Increasing speed, accuracy and reliability requirements of digital-to-analog conversion led Packard Bell Computer to develop the MULTIVERTER, the first completely solid state high speed (4 microseconds per bit) conversion system accurate to .01%—and the only conversion system with compatible solid state Multiplexer and Sample and Hold.

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Water vapor horizontal optical thickness

Fig. 3. Water vapor horizontal optical thickness.

Water vapor vertical optical thickness

Fig. 4. Water vapor vertical optical thickness.

in a horizontal path 1 km in length, corrected to STP.

\[ W_v = \text{precipitable centimeters water vapor in a vertical path from } h \text{ to infinity, corrected to STP.} \]

\[ \lambda = \text{wavelength, microns} \]

1. To find \( d \)
   a. if \( h_o = h_i \):
      Read \( d_k \) in Fig. 1
      \[ d = d_k \times R \]
   b. if \( h_o \) does not equal \( h_i \):
      Read \( d_s \) in Fig. 2 for both \( h_o \) and \( h_i \)
      \[ d = \frac{(d_s \text{ for } h_o) - (d_s \text{ for } h_i)}{h_i - h_o} \times R \]

2. To find \( W \)
   a. if \( h_o = h_i \):
      Read \( W_h \) in Fig. 3
      \[ W = R.H. \times W_h \times R \]
   b. if \( h_o \) does not equal \( h_i \):
      Read \( W_s \) in Fig. 4 for both \( h_o \) and \( h_i \)

\[ W = R.H. \times \frac{(W_s \text{ for } h_o) - (W_s \text{ for } h_i)}{h_i - h_o} \times R \]

3. To find \( T_{CO_2} \)

Fig. 5 gives the transmission of carbon dioxide versus wavelength for \( W = 1 \) cm precipitable \( H_2O \). For any other value of \( W \), merely displace the curve vertically by the distance between the value of \( d \) on the "Optical Thickness" scale on the right hand side of Fig. 5 and the value 10 on the same scale. Thus, for \( d = 30 \) km, \( T_{CO_2} = 64 \) per cent for a wavelength of 4.9 microns.

4. To find \( T_{H_2O} \)

Fig. 6 gives the transmission of water vapor versus wavelength for \( W = 1 \) cm precipitable \( H_2O \). For any other value of \( W \), merely displace the curve vertically by the distance between the value of \( W \) on the "Optical Thickness" scale and the value 1 on the same scale. Thus, for \( W = 0.2 \) cm, \( T_{H_2O} = 61 \) per cent for a wavelength of 4.9 microns.

5. To find \( T_A \) (transmission of the atmosphere)

\[ T_A = T_{CO_2} \times T_{H_2O} \text{ all at the same wavelength.} \]

Thus, in our previous example
\[ T_A = 0.64 \times 0.61 = 0.391 = 39 \text{ per cent.} \]
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1953—Sub-miniature sealed relay
1955—Micro-miniature sealed relay

1959
NEW 4-pole micro-miniature relay
NEW Unimite relay

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General Electric has added the world's smallest one-amp relay, the single-pole Unimite, and a new four-pole micro-miniature to its sealed-relay line. Both new relays incorporate an important advance in relay manufacture. No solder and no solder flux are used anywhere in either relay's structure. A new inert-arc welding process lends headers to cans, eliminating a major cause of contact contamination.

The new Unimite and four-pole relays lend themselves admirably to printed-circuit-board work. The Unimite relay can be soldered into the board or is available for stud, lug, or bracket mounting. Its flexible leads can be formed or fanned for any circuit requirement. The four-pole relay terminations are on 0.2 inch centers in accord with the popular grid-spaced pattern.

These new relays, combined with a full line of miniature and double-pole micro-miniatures, offer equipment designers a new dimension in relay flexibility. Both new relays meet or exceed applicable requirements of MIL-R-5757 and MIL-R-25018.

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The slim cylindrical shape of the new Unimite relay saves space in the important vertical dimension. Its high-speed operation—operates in 1.5 milliseconds max., release time 3.5 milliseconds max.—offers a new approach to automatic switching. Its welded, totally isolated contact capsule eliminates organics from switching chamber, provides lifetime freedom from contact contamination. Every Unimite is a dry-circuit relay.

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New micro-miniature provides four-pole configuration and exceptionally long life performance—minimum of 10 million low-level operations, test units have run over 50 million operations. Suitable for continuous operation in a 160C ambient, the relay provides a valuable safety factor in application to 125C equipments. Vibration performance is excellent; it withstands 55 to 2000 cycles at 30G acceleration without contact opening. Operate power is only 400 mw.

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GENERAL ELECTRIC

CIRCLE 24 ON READER-SERVICE CARD
Encoder pattern (actual size) will generate a binary output equivalent to the sine of the input shaft angle with a resolution of one part in 216. After octagonal edges have been trimmed, disc measures 3.5 in. diam.

Computer-Designed Encoders

Using a computer to design a 3.5 in. diam code disk for a shaft-to-digital encoder resulted in resolution of one part in 216. The least significant bit track of this code disk undergoes 1024 transitions as the input shaft makes one complete rotation.

Wes Stupar of Librascope, Inc., Glendale, Calif., designed a mathematical model of the transition angle relationships for the LPG-30 computer. The idea, he said, is that a computer's good accuracy cannot be used to best advantage unless its support equipment is at least as accurate. When the computer itself designs the support equipment, accuracy is aided.

Problems

To get an accurate correlation between analog input and digital output, brush transition from conducting to non-conducting segments must be closely controlled. Encoder-track leading and trailing edges must be precisely aligned along the radial line. Misalignment will result in the brushes making and breaking contact out of synchronization—with a resulting erroneous count.

In computing transition angles, brush contact area must be allowed for since switching brushes have finite lengths.

This width in the direction of motion means the brush will make contact with the approaching segment before the center point of the brush passes over the transition point. Conversely the brush will lose contact with the receding segment after the center has passed over the transition point, as in Fig. 1. Actual transition points are displaced half a brush contact length in both directions. To allow for this displacement, the theoretical transition angles must be modified.

Mr. Stupar's program is shown in Fig. 2. The actual transition angle of the mathematical model is θ. θ is the theoretical transition angle, C₁ the rotating contact, and C₂ the non-conducting edge.
Fig. 2. Program set up on LGP-30 computer to calculate desired transition angles. Angles will be used to guide an optical jig borer, which will cut master pattern for encoder disc. In diagram, β is \((T_{max} - T)\).

---

### Pattern Construction

The transition angles calculated by the computer are used at Librascope to guide an optical jig boring machine. A large master of the encoder disk is machined from a plastic stock, which consists of a white lamination between two black laminations. The top black laminate is cut, exposing the white according to the switching pattern required by the transition angle.

The resulting master is then photographed, and production encoders are etched in a printed circuit process.

For further information, turn to the Readers Service Card and circle 101.

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<table>
<thead>
<tr>
<th>Alloy</th>
<th>Columbium-zirconium</th>
<th>Columbium-tantalum-zirconium</th>
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<td>4550°F</td>
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<td>10.26 g/cc (0.371 lb/cu in)</td>
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<td>70°F; 55,000 psi</td>
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**FANSTEEL 80 METAL**

**FANSTEEL 82 METAL**

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CIRCLE 26 ON READER-SERVICE CARD
Plastic Dielectrics ... Based on Hollow Glass Microspheres

William R. Cuming
Emerson & Cuming, Inc.
Canton, Mass.

This article discusses applications of a material which offers a number of possibilities for producing low weight, high temperature, and accurately controlled dielectrics. It is free flowing powder resembling fine sand. Each particle is a hollow glass sphere of micron dimensions.

Glass microspheres for dielectric applications are usually bonded together to produce a foam. Additives such as metal flake or titanates can be included for dielectric property adjustment. Bonding agents can be organic or inorganic. Epoxide and silicone resins are among the organic materials used. Sodium silicate and aluminum phosphate are among the inorganic bonding agents.

Table I—Foams Based on Hollow Glass Microspheres

<table>
<thead>
<tr>
<th>Designation</th>
<th>Self Bonded</th>
<th>Epoxide Bonded(^1)</th>
<th>Epoxide Bonded(^2)</th>
<th>Polystyrene Bonded(^3)</th>
<th>Silicone Resin Bonded</th>
<th>Inorganic Bond using Silica Sol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight, lbs/cu ft.</td>
<td>12</td>
<td>20</td>
<td>23</td>
<td>32</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Dielectric Constant</td>
<td>1.25</td>
<td>1.45</td>
<td>1.55</td>
<td>1.67</td>
<td>1.6</td>
<td>1.55</td>
</tr>
<tr>
<td>Dissipation Factor</td>
<td>0.002</td>
<td>0.01</td>
<td>0.01</td>
<td>0.001</td>
<td>0.002</td>
<td>0.004</td>
</tr>
<tr>
<td>Compressive Strength, psi</td>
<td>150</td>
<td>1010</td>
<td>1500</td>
<td>5000</td>
<td>750</td>
<td>350</td>
</tr>
<tr>
<td>Operating Temperature Range, °F</td>
<td>-70 to (+1000)</td>
<td>-70 to (+300)</td>
<td>-70 to (+500)</td>
<td>-70 to (+350)</td>
<td>-70 to (+800)</td>
<td>-70 to (+1100)</td>
</tr>
</tbody>
</table>

1. Two component, room-temperature cured.
2. One component.
3. Cross-linked.
agents. Glass microspheres have been self bonded, i.e., no other material is added. Bonding takes place at the surface of each particle to adjacent particles.

**Properties**

Particle diameter is in the range from 30 to 300 microns; wall thickness is about 3 microns. Softening temperature is in excess of 1200°F. Bulk density is about 12 lbs per cu ft.

At microwave frequencies (3000 to 10,000 mc), glass microspheres, trade-named “Ecospheres,” Fig. 1, have a dielectric constant of 1.2 and a dissipation factor of 0.002 as loose material (12 lb. per cu ft.). When self bonded into a rigid foam of the same density, the dielectric properties are, of course, the same. Thus, this sets the lower limit of the material at its present stage of development.

When glass microspheres are bonded together with a separate bonding agent, the density of the resulting foam is increased. In general, strength is improved. Dielectric constant increases. Dissipation factor is somewhat dependent upon that of the bonding agent. Service temperature of the foam may be limited by the thermal stability of the bonding material.

Properties of foams based on glass microspheres are given in Table I. Densities other than those given are possible by varying the binder to microsphere ratio. None of the foams listed in Table I contains loading material. By loading material is meant metal and/or titanate particles which, when dispersed throughout a foam, increase dielectric constant without a significant increase in weight. Loaded foams are often referred to as artificial dielectrics.

**Making The Foam**

In making the foams of Table I, the bonding agent is first prepared. This may be a liquid resin monomer, a resin in solution or, as in some inorganic systems, a colloidal aqueous suspension. Curing or gelling agents are added. The dry glass microspheres are then mixed in. For most foams, the resultant mix has the consistency of damp sand.

Exact proportions of glass microspheres to binder is determined experimentally in light of the final physical and electrical properties desired. The binder-microsphere mix is tamped into a mold or cavity. The term “pack in place” is used to designate this type of foam. A small air hammer fitted with a flat plate may be used, or simply a hand tamping rod.

The mix is packed to maximum density; it fills the cavity completely and uniformly. A cure next takes place which welds the discrete particles together. Once cured, it can be machined. Molding to exact contour is also possible. Fig. 2 shows

---

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CIRCLE 28 ON READER-SERVICE CARD

Fig. 3. Disks and a sphere are typical shapes fabricated from glass microballoons.

a typical "pack in place" foam and the cured molded piece.

Artificial Dielectric Foams

For artificial dielectrics, finely divided metal flake is usually used. This is added to, and dispersed in, the binder prior to addition of the microspheres. Aluminum flake of micron dimensions is effective. For high temperature dielectrics, silver may be used since aluminum oxidizes rapidly in air about 700 F. Blocks or sheets of foam are again made by packing into a mold. If dispersion of the loading material is thorough and packing is done with care, excellent uniformity of electrical properties is possible. Table II gives data on loaded foams.

A special case of the artificial dielectric foam is that in which the loading material is of high loss. In this instance, an absorber is produced. Carbon has been found to be an effective lossy material. By varying carbon content, it is possible to vary dielectric constant and dissipation factor of the foam. Graded free space absorbers have been produced by packing in place successive

Table II—Artificial Dielectric Foams Based on Hollow Glass Microspheres

<table>
<thead>
<tr>
<th>Designation</th>
<th>One Component Epoxide Resin Bonded</th>
<th>Silicone Resin Bonded</th>
<th>Silicone Resin Bonded</th>
<th>Inorganic Bond Using Silica Sol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loading</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight, lbs/cu ft.</td>
<td>Aluminum Flake</td>
<td>Silver Flake</td>
<td>Titanate</td>
<td>Titanate</td>
</tr>
<tr>
<td>Dielectric Constant and Dissipation Factor Range</td>
<td>2.5 and 0.013</td>
<td>2.0 and 0.008</td>
<td>1.7 and 0.002</td>
<td>1.7 and 0.002</td>
</tr>
<tr>
<td>10&quot; to 10^10 cps</td>
<td>7.0 and 0.03</td>
<td>to</td>
<td>to</td>
<td>to</td>
</tr>
<tr>
<td>Compressive Strength, psi</td>
<td>1500</td>
<td>700</td>
<td>600</td>
<td>500</td>
</tr>
<tr>
<td>Operating Temperature Range, °F</td>
<td>-70 to +500</td>
<td>-70 to +800</td>
<td>-70 to +800</td>
<td>-70 to +1200</td>
</tr>
<tr>
<td>Commercial Designation</td>
<td>Ecofoam Hi</td>
<td>Ecofoam Hi</td>
<td>Ecofoam Hi</td>
<td>Ecofoam Hi</td>
</tr>
<tr>
<td>K 625 D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ELECTRONIC DESIGN • June 24, 1959
Layers of absorptive foam wherein properties varied in the proper manner from the front or incident surface to the rear. These, of course, could be used in radome nacelles to prevent unwanted reflections from nearby metal surfaces. Fig. 3 shows some typical shapes.

Uniformity

As indicated previously, foams based on microspheres are uniform from point to point and completely isotropic electrically. Techniques have been worked out so that dielectric samples can be taken from a packed mass of uncured foam. The samples are cured and measured for dielectric properties. If these are acceptable, the foam mass is cured. If dielectric properties are not acceptable, the foam mass is broken up and repacked.

Radome Cores

For radome applications, the foam can be packed into a layer for use as the core in a sandwich construction, or it can be packed into a honeycomb core. Dielectric constant can be adjusted to that of the skins of the radome. See "Artificial Dielectric Foams for Radome Core" by W. R. Cuming in the June 1957 Proceedings of the OSU-WADC Radome Symposium. This described the use of a loaded epoxy "pack in place" foam in making a radome. The same general procedures are possible for use of the other foams of Tables I and II.

At the present time, laminates and honeycomb are not available with temperature capability as high as that of some of the foams listed. Inorganic laminates and ceramic skins are under development. If these become available for use in sandwich structures, foams based on hollow glass microspheres will find utility as core materials.

In the meantime, the foams are being used in antenna and microwave lenses and as dielectrics in wave guide systems. Electronic circuits and components are readily embedded in these foams for structural support. A wide variety of thermal insulating applications make use of the foams.

Development work is proceeding on higher temperature, lower weight and lower loss microspheres and suitable bonding and loading agents. Because of the versatility, inherent uniformity and good physical properties of the "pack in place" foam system, it is expected that it will find general acceptance in the dielectric materials field.

Acknowledgment

Aspects of the work described herein were sponsored by:
U. S. Navy, Bureau of Aeronautics, Mr. Jay Stevens, Technical Monitor.

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Cam-Follower is Slow
In the cam-follower technique, an arm rides on a specially machined cam and positions a potentiometer slider. The voltage available at the slider varies with the cam’s radius.

Weaknesses of this method are:
- It is not adequate for rapidly varying functions.
- It requires precise machining to produce a cam whose radius varies with the desired function.

The flux sensing system can follow a curve drawn on paper without touching the paper or the curve. But the curve must be drawn with a special silver ink or a fine wire must be taped over the curve.

An inductive pickup probe is servo driven to follow the flux pattern set up by a high frequency current which is sent through the plotted curve. The servo motor which drives the probe also drives the shaft of a potentiometer which generates the function.

This method suffers from the fact that:
- The probe tends to round off sharp corners as a result of unsymmetrical magnetic flux patterns.
- The method requires an rf power oscillator, a phase detector, a servo amplifier, and an inductive pickup probe.

Electrostatic System is Simple and Fast
The electrostatic system, developed by the Data Trak Function Generator, retains only the servo amplifier. Like the magnetic system
An inadvertent break in the graphite boundary does not collapse the electrostatic field as it would the magnetic field about a "transmission line" carrying current.

- The desired function can be altered easily by erasing the pencil boundaries and drawing the new function level.
- A function can be cycled by wrapping the graph paper around a rotating drum as shown in Fig. 1.
- Rounding of sharp corners can be eliminated by "shading" the inside corner with a graphite pencil as in Fig. 2. The desired function can thus be reproduced to accuracies better than one percent of full plotting scale.

For more information on this electrostatic curve follower, turn to the Reader-Service Card and circle 102.

---

**Fig. 1.** (left) Simple circuitry of the electrostatic line follower. The probe never touches the paper.

**Fig. 2.** (below) A typical graph preparation. The magnified view shows how to compensate for rounding of sharp corners.
“Maybe it will work” is too prevalent an attitude in papers on memory design. Authors Barnes and Schneider wrote this article to offset this attitude and to show the importance of proper attention to drive current tolerances.

In the photo, Robert Schneider (seated) is checking a sense amplifier of a direct-drive memory as George Barnes adjusts the simulated arithmetic and control inputs.

High Speed, Word-Organized Memory Techniques

R. P. Schneider and G. H. Barnes

Burroughs Research Center
Paoli, Pa.

Three specific techniques for designing word-organized memories are described here, along with their advantages and disadvantages. These techniques differ mainly in their method of coupling the drive current to the selected memory word, so these coupling schemes are emphasized.

The word-organized memory can be defined as one electrically organized into words; the memory elements storing a given word are driven by a single selection element associated with that word, rather than by a pair of selection elements in a row/column selection matrix. The word-organized memory has also been referred to as a "linear selection memory" or "word selection memory."

The first design technique uses square loop, metallic-tape cores to couple the drive current, by transformer action, to the memory cores storing a given word. The other two schemes use direct coupling.

Although these drive current configurations are applicable to memories built of other devices such as twistor, thin-film, and cryogenic memories, the discussion in this article is concerned with the complete switching of square loop ferrite cores of the type commonly used in coincident-current memories.

Transformer-Coupled-Drive Memory

A particular 512 word memory, now operating in a special purpose computer, uses read-write drive currents which are transformer-coupled to the memory words by a switch-core matrix. Each switch core is associated with one particular word in the memory. The switch-core arrangement is shown in Fig. 1a.

Matrix selection is not entrusted to the non-linearity of the switch cores; diodes are added to prevent possible parallel paths. The switch core associated with the word to be addressed is selected by the proper combination of transistor drivers and switches.

The selection of one of 16 transistor drivers and one of 32 transistor switches selects one of 512 switch cores. Each switch core has three windings: one winding receives the primary drive current; the second receives a dc reset current; and the third is the output winding to the 32-bit memory word and a swamping resistor.

During the read cycle, a current pulse in the primary winding of the switch core overcomes the dc reset ampere turns applied to this core and, in addition, supplies the full read current to the output memory core word.

Flux reversal occurs in the switch core during the read cycle. Reverse polarity write current flows at the end of the primary drive current, when the dc reset current returns the flux to its original direction. If the dc reset and output turns ratio is unity, and if magnetizing ampere turns are neglected, the write current will equal the dc reset current. The write current will continue to flow until the switch core is reset to sat-
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the voltage-time statements for read and write can be combined, and the write time becomes

$$T_W = \frac{I_R}{I_W} T_R + \frac{(M_R - M_W) \Phi_M}{I_W R} L$$

The memory core characteristics determine \(I_R\) and \(I_W\), as well as the minimum \(T_W\) and \(T_R\). In addition, a minimum \(T_R\) is required to satisfy the minimum \(T_W\) in the equation for \(T_W\). The largest \((T_R + T_W)\) sets a maximum permissible repetition rate. Adjusting \(T_W\) to be slightly higher than that required by the memory cores will reduce the maximum \(T_W\), and improve the repetition rate.

The output currents are related to the primary drive currents as

$$N_1 I_R = N_1 I_1 - N_R I_{DC} - F_R$$

and

$$N_1 I_W = N_R I_{DC} - F_W$$

where \(I_1\) is the primary drive current through \(N_1\), \(N_R\) is the dc reset amperes-turns, and \(F\) is the magnetizing amperes-turns. The number of turns \(N_1\), \(N_R\), and \(N_H\) are also dependent upon the magnitude of \(F_R\) and \(F_W\).

In the design, \(F_R\) and \(F_W\) should be held to a very small percentage of the total amperes turns so that current tolerances are not adversely affected by the uncertainties of magnetizing amperes-turns in the square-loop cores.

Distributed winding of \(N_1\), \(N_2\), and \(N_R\) is required to reduce leakage inductance and to improve coupling. Sector winding usually results in intolerable current waveforms.

The temperature variation of flux in ferrite memory cores results in a temperature coefficient of drive current of approximately -0.3 per cent per deg C. To maintain an essentially constant core output and switching time over a temperature range of 0 C to 100 C. The pulse threshold current (that is, the current necessary to begin core switching) has a temperature coefficient of approximately -0.6 per cent per deg C. Therefore, of a constant core output is desired, the noise immunity of the memory cores will effectively decrease as temperature increases.

This particular design, using ferrite cores of 80 mil outside diameter and 50 mil inside diameter, will operate well from 0 C to 55 C on a worst case basis. Excessive noise currents are predicted to occur at 90 C to 100 C. At 55 C, the worst case noise currents are only 75 per cent of the minimum allowable pulse threshold.

The read-write cycle time of this memory is 5.5 \(\mu\)sec. The allowable amplitude tolerance on the read-write pulse is 10 per cent. The information current pulse tolerance is 15 per cent. The ferrite memory core specifications are relaxed by an amount approximately 5 per cent above that specified by the manufacturer. This change is made to eliminate core rejection after the cores are wired into memory planes.

The additional tolerances should absorb any differences between procedures of the manufacturer and the testing section. The memory circuits use three transistor types, all germanium pnp, including two low-level types and one core-driver type.

Two Direct-Drive Memories

Two other word-organized memory drive techniques, which will now be discussed, use direct drive, eliminating the transformer coupling to the memory word. One of these techniques is shown in Fig. 2.

This scheme requires opposite polarity current drivers (one for read and one for write) and a bi-directional current switch. During the read cycle, one read driver and one bi-directional switch are selected. The current path created is through one memory word. During the write cycle, the corresponding write driver is selected, delivering write current through the same word, but in opposite direction.

This system lends itself to complementary transistor circuits such as npn read drivers and pnp write drivers. The width of the read and write pulses are dependent solely upon memory core switching time. Read-write cycle times of 2.5 \(\mu\)sec are attainable on a worst case basis using conventional cores.

Diodes are required to block parallel paths in both the read and write drive lines.

A 16 word breadboard using this technique was designed with high-speed operation as the primary goal. The design was operated at a read-write cycle time of less than 2 \(\mu\)sec. The speed was attained by using a high read current drive and an optimum write current versus information current ratio. The use of 50-50 mil ferrite cores eased the drive current requirements to obtain this speed.

An alternate direct-drive configuration is shown in Fig. 3. During the read cycle, one read driver and one read switch are selected. During the write cycle, the corresponding write driver and write switch are addressed. The current is delivered through the chosen path. Here the driver designs and the switch designs can be identical for both read and write. The memory circuitry can use all npn transistors or all pnp transistors.

A 512 word design based on this configuration had environmental tolerance and small size as primary goals. This memory was required to operate through a 150 C change in ambient temperature.

Because of the circuit complexities involved in making the drive currents temperature-insensitive over this wide temperature range, the memory elements were heated, and allowed to vary only over the upper 20 C change in temperature. No drive current compensation was used. The peripheral circuitry, requiring all silicon semi
conductors, had to operate over the full 150 °C spread in ambient temperature.

A great reduction in the size of the memory was achieved by using multturn windings on the memory cores. Eleven turns of wire were placed through each 50-30 mil ferrite core. Four of these turns associated with the read-write drive line were placed individually on each core. Seven turns were accomplished by stringing cores on one seven-stranded wire.

Six of these were used for the information drive line, and one for sensing. The result was a reduction of over 50 per cent for the complete memory in the size and power required.

No power transistors were required with this design. This memory could operate with a read-write cycle time of 5 μsec. All drive currents were worst case designed to 15 per cent.

Comparison of Drive Types

The advantages derived from switch-core drive are the core reliability and the lack of a need for write addressing. The reversed flux stored in the switch core during read automatically produces correct polarity write current at the end of the read pulse.

The major disadvantage of the switch core is speed. A definite time is required to permit reset of the switch core, this time being a function of the flux switched during read. Another disadvantage of switch core drive is the additional collector voltage requirement imposed on the driver transistor. The voltage that is developed across the dc reset winding during the write cycle, a transformer coupled to the primary drive line, and the driver transistor must be able to tolerate this additional collector voltage.

The direct-drive configurations allow faster operation because the write time is now limited only by the memory core specifications. However, write addressing is required with these schemes. The first direct-drive scheme requires positive and negative current drivers and a bi-directional switch. The second direct-drive scheme, allowing similar read and write driver and switch designs, requires separate read and write switches.

The Proper Choice

The proper choice among the three drive configurations is not obvious. Consideration must be given to such items as desired memory speed, component availability, memory size and cost, and the mode of operation as specified by the arithmetic and control section of the associated computer.

Reference


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ELECTRONIC DESIGN • June 24, 1959
Measure a Gain of a Million
with a VTVM and a Scope

This technique is a direct means of measuring gain by an output and input measurement with commonly available laboratory instruments. The method is independent of meter calibration and requires only a vacuum tube voltmeter with an output amplifier such as the Hewlett-Packard 400C, and an oscilloscope such as the DuMont 304.

General Procedure

Hook up the equipment as in Fig. 1, with the output of the meter feeding the oscilloscope through a simple filter. First, place the meter input lead at \( e \), and set the meter attenuator to give a maximum undistorted signal on the oscilloscope.

The signal level into the scope is \( K e \), where \( 1/K \) is the attenuation indicated by the meter range switch. (For the Hewlett-Packard, if the signal is less than one millivolt, \( K \) is 50 db. Thus, the signal at the input appears at the output terminals at a 50 dB higher level).

Adjust the oscilloscope by means of its attenuators, to yield a peak-to-peak display that touches the ends of the reticule's calibration marks. Do not touch the fine attenuator after this. Note the settings of the meter attenuator and scope coarse attenuator. Switch the meter to a safe scale and put the probe at \( e \). Adjust the meter attenuator for maximum undistorted display on the scope. The test amplifier gain is then the sum of the absolute meter scale readings. This assumes the scope coarse attenuator was not touched and the picture obtained is as large as it was when the probe was at \( e \). This will rarely be so; so follow the next procedure.

If the test amplifier gain exceeds 90 dB the display will extend beyond the face of the scope and it will be necessary to operate the oscilloscope coarse attenuator to permit the entire picture to be viewed. Merely add 20 dB to the meter reading for each step of the scope attenuator.

If the resultant picture does not extend to the ends of the reticule, subtract an amount equal to the difference. Thus, use \(-6 \) dB for half-scale display, \(-2 \) dB for 80 per cent of full scale, etc.

A typical example is given in the table.

**Filter Design**

Between scope and vtvm in Fig. 1 is a filter whose design depends on the measurement to be made. The choice is dictated by the frequency to be measured. If there is excessive high frequency hash on the scope use Fig. 2a. Choose \( C \) so that \( 1/2\pi f C = 50 \) K at \( f \) at least two octaves removed from the test frequency, \( f_o \).

Choose Fig. 2b when the hum level in the circuit is excessive and when \( f_o \) is less than 15 cps or greater than 240 cps. At fifteen cycles or 240 cycles the filter insertion loss may be taken as 2 db which is added to the gain.

It is worthwhile to note that it is not necessary to read the meter face except to note that a particular reading is not off scale, since this would distort the voltage at the output terminals.

The technique eliminates calibration errors as well as errors due to non-sinusoidal waveshapes and noise. The combination thus permits measuring amplifier gains for irregular waveforms within the frequency range of the test equipment. The response of the equipment used was approximately 10 cycles to 100 kc. It could have been extended to dc through use of a dc vacuum tube voltmeter with an output amplifier.

Emanuel Katell, Sr. Project Engineer, Reeves Instrument Corp., Garden City, L.I., N.Y.
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These sensitive Leach subminiature relays deliver big relay performance...in a crystal can size that makes them ideal for use in missile control circuits in airborne or ground equipment and in computer and printed circuits.

Torture-tested to perfection in the Leach Production Reliability Center, these subminiatures are designed to meet the critical extremes of vibration, shock and other stringent environmental requirements in military and commercial applications.

They meet the specifications of both MIL-R-25018 and MIL-R-5757C—as well as MIL-R-6106C, including the minimum current test requirements. Uniform contact pressure and overtravel are guaranteed for the life of these balanced-armature relays. They are available in a wide range of socket, stud and bracket mountings to meet specific customer requirements.

Write today for Leach Crystal Can Relay Brochure containing specifications, typical ratings and other information on these subminiatures! Or contact your nearest Leach sales representative to discuss your specific subminiature relay requirements.

LEACH RELAY DIVISION...LEACH CORPORATION
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CIRCLE 34 ON READER-SERVICE CARD
IDEAS FOR DESIGN

One-Way Trigger
For Bistable Multi

We have a bistable multivibrator which flips every time it is triggered. Our problem was to reset the multi at specified time intervals so it would always start in the proper state. If it missed a trigger, it was to be reset in the proper sequence.

Our solution calls for a minimum number of parts and does not interfere with the circuit operation. It eliminates the possibility of resetting to the wrong side of the multi. If the multi is in the proper state, the reset trigger has no effect.

The reset trigger in this multi will turn off T2 if on. The trigger has no effect if T2 is off.

The positive reset trigger returns the base T2 to ground through the saturation resistance of the reset transistor T3. This action cuts T2 off if it was on when the reset trigger was applied. If T2 was off, no change in output takes place.

Paul Margolin, Project Engineer, Allen B. D. Mont Labs., E. Paterson, N.J.

Zener-VR Team
Makes Better Voltage Regulator

VR tube voltage regulators fail to regulate when the supply voltage is too low to ignite the VR tube. An obvious solution is to replace the VR tube with an equivalent Zener diode. But higher voltage Zener diodes are very costly.

An economical solution lies in using a low voltage Zener in series with the VR tube. The Zener has no voltage drop till the VR tube conducts, whereupon the Zener and the tube regulate together.

For example, assume 90 volts are requi...
across a load. A VR90 requires 125 v to fire. If the VR90 is replaced by a VR75 and a 15 v Zener, the combination will start at 105 v and regulate at 90 v, as required. The 15 v (500 mw) Zener is inexpensive.

As another example, a VR105 and a two watt, 45 v Zener will regulate at 150 v and fire at 113 v. This combination has advantages over the VR150 in never permitting the regulated load voltage to exceed 150 v, and in regulating as soon as the voltage reaches 150 v.


Flux Loops Spot Bad Wheels On the Fly

Here's a simple circuit to detect broken flanges on railroad wheels. The concept can be extended easily to checking other symmetrical, ferrous, moving parts.

Since it is highly unlikely that both wheels on an axle will have a part of their flanges missing from exactly the same location, a method which compares one wheel with the other will indicate when there is a bad wheel.

Since the wheels are ferrous, a comparison of magnetic properties provides adequate sensitivity, and is unaffected by most environmental conditions.

![Bad wheel detector](image)

**Bad wheel detector** compares wheel flanges. The good flange provides... a small magnetic air gap. The bad flange provides a large one.

Several variations of bridge or balance circuits can be used. The common feature of all of them is that no current flows through the actuating component till there is a difference in the magnetic paths.

Thus, when one wheel has a broken flange, different currents flow through the two detector coils and current then flows through the actuator. The actuator can be part of a signal circuit, or it can cause paint to be sprayed on the axle carrying the bad wheel.

The circuit shown is a simple, non-resonant one, with a 60 cycle power supply. The actuator is in the center-tap lead.

Robert A. LeMassena, Senior Engineer, Mining-Honeywell, Heiland Div., Denver, Colo.

*Electronic Design* • June 24, 1959

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**SILVERCEL® BATTERY-POWERED TORPEDOES**

**STALK THEIR PREY—WITH DEADLY ACCURACY!**

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Manufacturers of YARDNEY SILVERCEL®, YARDNEY SILCAD® and YARDNEY ARCTIC® Batteries

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*Trade Mark*
IDEAS FOR DESIGN

Light Bulbs
For Dynamic Compression

Dynamic compressors have been used for ages, but they worked on the variable-gain vacuum-tube principle, in a circuit akin to audio ave. The resulting distortion was unacceptable in many applications.

Philips, of The Netherlands, has a different solution. They use the variation in the resistance of incandescent lamps when they heat.

The figure shows the essentials of the circuit. The output of an audio power stage is applied to a loudspeaker through a bridge. The loudspeaker is of the high-impedance, direct-drive type where there is no output transformer.

This dynamic compressor uses light bulbs as the volume-varying element. By changing the resistors in the bridge, one can convert it to a dynamic expander.

When the lamps are cold, their resistance is about 200 ohms, and a good part of the output voltage appears across the loudspeaker. When a strong audio signal comes in, and the output power goes up, the lamp filaments heat up and their hot resistance reaches 1200 ohms. The bridge is then much closer to equilibrium and only a small part of the output voltage appears across the speaker.

Notice that, by reversing the unbalance of the bridge, for example by using two 150 ohm resistors instead of 1800 ohm units, the circuit is transformed into that of a dynamic expander.

Dr. A. V. J. Martin, Carnegie Institute of Technology, Pittsburgh, Pa.
VISUAL MICROWAVE ANALYSIS
4 microwave analyzers cover every application, 10–44,000 mc

MODEL TSA SPECTRUM ANALYZER - 25 kc resolution, 400 kc to 25 mc dispersion. 5 sensitive tuning units.

MODEL TSA-S COMBINATION SYNCHROSCOPE SPECTRUM ANALYZER - 5 kc to 5 mc adjustable bandwidth, 400 kc to 25 mc dispersion. Time and frequency display. 5 sensitive tuning units.

MODEL TSA-W VERY WIDE DISPERSION SPECTRUM ANALYZER - 7 kc and 50 kc resolution, 100 kc to 70 mc dispersion. Logarithmic amplitude display. 5 sensitive tuning units.

MODEL SA-84 MULTI-BAND SPECTRUM ANALYZER - 10 to 40,880 mc in a single unit.

POLARAD ELECTRONICS CORPORATION
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43-20 34th Street, Long Island City 1, N.Y.

MAIL THIS CARD for specifications. Ask your nearest Polarad representative (in the Yellow Pages) for a copy of "Notes on Microwave Measurements".

POLARAD ELECTRONICS CORPORATION:
Please send me information on
☐ Microwave Spectrum Analyzers
☐ Model R Receiver (see reverse side of this page)

My application is:

Name
Title
Company
Address
City
Zone
State
Purpose and precision

Now—one basic instrument serves for general communications as well as for detection and complete quantitative analysis of microwave energy.

Polarad Model R Receiver accepts all microwave signals: AM, FM, CW, MCW and pulse. Power and frequency are read directly on front panel indicators.

It permits all standard forms of signal monitoring: special output jacks for audio and video; trigger output to reproduce pulse width and repetition rate; recorder output to transcribe signals through commercial recording equipment.

Model R is simple to operate, extremely sensitive, highly accurate, and is designed for quick, easy inspection and servicing. It provides AFC, AGC, and continuous UNI-DIAL tuning. Eight interchangeable tuning units cover the entire frequency range.

Business reply card

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43-20 34th St., Long Island City 1, N.Y.

Representatives in principal cities
**Modified Multi Starts Every Time**

Conventional transistorized multivibrators, like the one in Fig. 1, are not always self-starting. An overload, or mere chance when power is applied, can cause both transistors to conduct at the same time. If this happens, the transistors saturate and loop gain drops to near zero. Oscillations cease and do not start unless something is done to raise the loop gain and restore oscillation. From the viewpoint of reliability, the conventional multivibrator is simply not reliable.

![Fig. 1. Conventional multivibrator may not start oscillating when power is applied.](image1)

![Fig. 2. Slightly modified mult always works.](image2)

In addition to giving visual warning to the operator, the NLS 50 gives go/no-go commands to such electrical devices as cut-off relays, sorting chutes, data printers, tape or card punches, and audible warning equipment. Extremely versatile, the instrument may be used as a high-accuracy voltmeter without modification and may be adapted easily to detect resistance limits.

The broad applications of the NLS 50 Voltage Comparator include the following:

- Automatic checkout of missiles and electronic systems.
- High-speed, high-accuracy warning systems involving any parameter that can be converted to voltage (speed, temperature, liquid level, distance, angle, acceleration, magnetism, weight, pressure, flow, light or other radiation flux).
- Automatic component test equipment for testing resistors, relays, diodes, transistors, vacuum tubes, batteries, tachometers, motors, speed regulators and slip rings.
- Automatic process control, receiving inspection, production quality control.

Write today for more detailed information concerning the capabilities, applications and operation of the new NLS 50 Go/No-Go Voltage Comparator.

**PRICE $177.50 COMPLETE • F.O.B. DEL MAR**

**Originators of the Digital Voltmeter**

**non-linear systems, inc.**

**DEL MAR (San Diego), CALIFORNIA**

**CIRCLE 39 ON READER-SERVICE CARD**

**NLS — Digital Instruments That Work . . . And Work . . . And Work!**
Higher-Temperature Capacitors:

New Dielectric Materials Help Break the Heat Barrier

By Marc F. Warmuth, Staff Engineer, Airborne Accessories Corporation

Special Mylar®, Teflon® and mica constructions permit continuous operation up to 600°F

Three new types of special high-temperature motor-starting capacitors, utilizing Mylar, Teflon and mica dielectric respectively, have been developed recently by Airborne. The Mylar and Teflon types are wound of very thin metallized film for greatest possible miniaturization. The mica type is wound of a sandwich of aluminum foil and thin, pure mica ribbon, metallized mica not being procurable. All are encapsulated with thermoplastic polyamide or thermostetting epoxy resins (depending on temperature range) in sealed, colddrawn steel cans with fused glass terminals. This construction provides low inductance units of exceptional mechanical sturdiness and environmental resistance.

As an alternate construction for less demanding applications, encapsulation in epoxy sleeves, with leads brought out through potted ends, is also available.

Mica for highest temperatures

The great advantage of mica as a dielectric is its ability to maintain its physical and electrical characteristics at temperatures up to 1000°F. All dielectric materials undergo severe reductions in insulation resistance at high temperatures, but with mica the critical value is reached around 600°F. Full voltage ratings up to this point are thus permitted. And with the right epoxy resin impregnant, mica capacitors are well able to withstand overtemperatures without damage ... if not simultaneously subjected to full rated voltages.

Mica capacitors are three to four times larger than Mylar or Teflon units of comparable capacitance and voltage rating. This is because a greater thickness of dielectric must be used in addition to a separate layer of aluminum foil.

Mylar and Teflon for intermediate high temperatures and small size

Mylar can be worked continuously up to 300°F and Teflon up to 400°F. For applications below these limits, but above the normal 185°F limit of more conventional insulating materials, metallized Mylar and Teflon offer high dielectric strength. They make possible wound capacitors of very small size with good voltage ratings and excellent capacitance-to-volume ratios.

A further advantage of metallized Mylar and Teflon capacitors is their self-healing characteristic. The short occurring when the dielectric is ruptured instantly burns the thin metallic coating back from the edges of the rupture, making further flashover impossible. Yet the amount of metallic coating burned away is so minute that hundreds of such self-healings have little effect on capacitance. Resistance to overvoltages can thus be considered excellent. Resistance to overtemperatures, on the other hand, is not an outstanding characteristic of Mylar or Teflon—or a design factor to keep in mind.

Summary

MYLAR: For intermediate high temperatures, high voltage and smallest size. Continuous operation at 300°F with ratings up to 1000 WVDC. Capacitance variation with temperature good, but not as good as that of Teflon or mica types.

TEFLOM: For intermediate high temperatures and small size. 600 WVDC up to 400°F without derating.

MICA: For highest temperatures. Continuous operation, 600 WVDC without derating up to 600°F. Higher temperatures possible with derating. Larger in size than equivalent Mylar or Teflon capacitors.

For proposals on your specific capacitor requirements, write AIRBORNE ACCESSORIES CORPORATION, HILLSIDE 5, N.J.

*DuPont's for its polyvinyl film
†DuPont's for its tetrafluoroethylene resin

IDEAS FOR DESIGN

Drilled Clear Plastic Keeps Diodes Shipshape

In many labs, crystal diodes always tend to get lost, damaged, or simply mixed up. The method shown here is a simple one for keeping the diodes out of the way of harm, and for keeping match pairs in proper order.

Holes, drilled in Lucite, keep diodes in order on a safe while an ordinary paper clamp keeps the holes upright on the bench. Masking tape keeps the diodes in place and helps identify them.

Holes are drilled in a clear strip of Lucite or other clear plastic to allow the diodes to fit and lie the way into the material. The plastic should be clear enough to allow reading the markings on the diodes without removing them. The holes should be drilled in pairs so matched crystals are close together.

A strip of masking tape, over the holes, will keep the diodes in place, while another strip, across one surface of the diode holder can be used for marking.

The plastic strip can be mounted on the work bench with an ordinary paper clamp, as shown in the figure.

Morton Stillman, General Electric Co., Ithaca, N.Y.

A Better Driver

For Cathode Followers

For high fidelity use and many other applications, a cathode follower output stage is ideal except for one grave disadvantage; it requires a tremendous voltage input because its voltage gain is less than unity.

To supply this large swing at low distortion levels, several techniques are in common use:

1. Transformer coupling with a step-up voltage ratio. Unless the transformer is very expensive iron core distortion is severe at low frequencies, and the low- and high-frequency response suffers.

2. The conventional RC coupled stage. This technique...
When the grid of VI swings negative (toward cutoff), the cathode of V2 becomes more positive, raising the effective plate voltage of VI.

John A. Mooney, Associate Aircraft Engineer, Lockheed Aircraft Corp., Marietta, Ga.

Ohmite offers you a complete line of quality tantalum capacitors including three types... all available from stock in reasonable quantities. SERIES TS POROUS SLUG-TYPE TANTALUM CAPACITORS employ a porous anode of sintered tantalum sealed into a fine silver case, externally uninsulated. Size "U" unit offers a range of 1.75 microfarads to 30 microfarads. Working voltages to 125 are available, depending upon capacity. These capacitors are polar units intended for d-c applications. BULLETIN 159.

SERIES TW WIRE-TYPE These capacitors are tantalum foil, electrolytic units for low-voltage, a-c and d-c applications. Three sizes now available...25 to 140 mfd over-all capacitance range. Standard tolerance is ±20%. Working voltages up to 150. Polar and nonpolar units available. BULLETIN 152.

SERIES TW WIRE-TYPE TANTALUM CAPACITORS These Mylar® insulated, subminiature, wire-type units feature greater capacitance per unit volume, lower leakage current and power factor, and small capacitance drop at extremely low temperature as compared to other kinds of electrolytics. Ultrasmall for low-voltage, d-c, transistorized electronic equipment. Available in nine subminiature sizes; .01 to 80 mfd over-all capacitance range. Smallest size is .080 x .203 inch; largest is .134 x .812 inch. BULLETIN 148.
SERVICES FOR DESIGNERS

Complete Radiation Lab Service

A complete service of planning, designing, engineering and constructing radiation facilities and radiation laboratory equipment, is being offered by Hughes Aircraft Company. Hughes is prepared to offer to industries, research institutes and universities:

1. A complete service, from consultation to finished buildings, to plan, design and construct custom-engineered radiation facilities to meet specific requirements of the purchaser.

2. A Linac, an extremely high current linear electron accelerator, the most powerful of its kind; or a nuclear reactor designed to simulate any desired radiation condition; or a radioactive source such as cobalt; or any combination of these in one facility to fit the specific needs of a research organization.

3. A Mobot manipulator remote control handling machine with flexible steel hands and television camera eyes which can work in a "hot lab" and operated by a man far removed from the shielded room. This robot can perform a variety of lifting, inverting, placing and dismantling operations with radioactive materials and equipment.

Hughes has gained a background in the design and construction of radiation facilities by building its own underground "hot" laboratory and has obtained data on the effects of nuclear radiation upon electric components by using Linac accelerators and pulse reactors to "flash test" parts used.

Flash Tester—A gamma Linac, most powerful of its kind, will "flash test" components and other equipment by bombarding them with short, intense pulse equal to the radiation of an atomic or hydrogen bomb. The traveling wave type of linear electron accelerator operates at 10,000,000 volts or more, and uses microwave energy to accelerate electrons against a target of heavy metal, producing a gamma environment for testing parts.

For Highest Purity:

GENERAL ELECTRIC
FUSED QUARTZ COMPONENTS

EXCELLENT ELECTRICAL PROPERTIES

General Electric Fused Quartz Components are made by the fusion of quartz sand and ultra-pure silica. They are used where purity is essential and high reliability is required.

Almidst complete freedom from non-conducting impurities...and high temperature resistance. They are available in a wide range of sizes and stock items.

BOOKLET AVAILABLE. For full technical information, write for the new publication, "G-E Fused Quartz Components," free, no obligation. General Electric Co., Willoughby Quartz Plant, Dearborn, Michigan, Ohio.

CIRCLE 42 ON READER-SERVICE CARD

PHOTOGRAPHS ARE REPRODUCED FROM MAGAZINES AND CONSUMER PUBLICATIONS AND ARE NOT INCLUDED AS PART OF THE TEXT.
RADIO INTERFERENCE TESTING

The organization Labs—Shown in sketch of typical gamma rays is a Linac linear electron accelerator designed to produce a very intense pulse of gamma rays. A beam of electrons is directed at a heavy-metal target, such as tungsten, producing a gamma ray environment that testing components of other test specimens which are placed in front of target. Before Linac is turned on, one leaves the shielded room to operate the accelerator from a control console, where they can read the armament control systems of the U. A. Air Force's all-weather jet interceptors.

Hughes Aircraft Company, Nuclear Electronics Group, Research Laboratories, Building 20, Dept. D, Mail Station 1515, Florence and Teale Avenues, Culver City, Calif.

CIRCLE 44 ON READER-SERVICE CARD

RFI Testing

The newest addition to the extensive Environmental Testing Laboratories of Acton Laboratories, Inc., is a complete Radio Interference Testing Facility. This facilitates testing of equipment to various military and Federal Communications Commission specifications is provided along with consultant services to design engineers in eliminating radio interference problems from their projects. Facilities include Empire Noise and Field Intensity Meter Model NF-105 for measurements in accordance with specifications: MIL-E-6181B, MIL-E-3078A, MIL-E-11683A, MIL-E-11748A, MIL-E-8910A. With this equipment, Acton Laboratories can provide field intensity measurements, interference measurements in accordance with commercial and military requirements, spectrum pattern analysis, determination of harmonic and spurious frequency output of transmitters, and oscillator radiation of receivers, and determination of shielding effectiveness. The shielded enclosure is 10' x 20' x 8' with opening 6' wide 7' high to permit sizable devices to be moved for testing.

For details, write L. Bower, Acton Laboratories, Acton, Mass.

CIRCLE 45 ON READER-SERVICE CARD

FREQUENCY STANDARDS

PRECISION FORK UNIT

TYPE 50

Size 1" dia. x 3 3/4" H. Weight, 4 oz.

Frequencies: 240 to 1000 cycles

Accuracies:

Type 50 (±.02% at -65°C to 85°C)

Type R50 (±.002% at 15°C to 35°C)

Double triode and 5 pigtail parts required

Input, Tube heater voltage and B voltage

Output, approx. 5V into 200,000 ohms

*C.1% high

400 - 1000 cy.

CIRCLE 610 ON READER-SERVICE CARD

PRECISION FORK UNIT

TYPE 2003

Size 1 1/2" dia. x 4 1/2" H. Weight, 8 oz.

Frequencies: 200 to 4000 cycles

Accuracies:

Type 2003 (±.02% at -65°C to 85°C)

Type R2003 (±.002% at 15°C to 35°C)

Double triode and 5 pigtail parts required

Input and output same as Type 50, above

CIRCLE 611 ON READER-SERVICE CARD

FREQUENCY STANDARD

TYPE 50L

Size 3 3/4" x 4 1/2" x 5 1/2" High

Weight, 2 lbs.

Frequencies: 50, 69, 75 or 100 cycles

Accuracies:

Type 50L (±.02% at -65°C to 85°C)

Type R50L (±.002% at 15°C to 35°C)

Output, 3V into 200,000 ohms

Input, 150 to 300V, B (6V at .6 amps)

CIRCLE 612 ON READER-SERVICE CARD

FREQUENCY STANDARD

TYPE 2005

Size, 8" x 8" x 7 1/2" High

Weight, 14 lbs.

Frequencies: 50 to 400 cycles

(Specify)

Accuracy: ±.001% from 20° to 30°C

Output, 10 Watts at 115 Volts

Input, 115V. (50 to 400 cycles)

CIRCLE 613 ON READER-SERVICE CARD

FREQUENCY STANDARD

TYPE 2121A

Size, 8 3/8" x 18" panel

Weight, 25 lbs.

Output: 115V

60 cycles, 10 Watt

Accuracy: ±.001% from 20° to 30°C

Input, 115V (50 to 400 cycles)

CIRCLE 617 ON READER-SERVICE CARD

FREQUENCY STANDARD

TYPE 2111C

Size, with cover 10" x 17" x 9" H.

Panel model

10" x 10" x 8 3/4" H.

Weight, 15 lbs.

Frequencies: 50 to 1000 cycles

Accuracy: ±.002% at 15°C to 35°C

Output: 115V, 75W. Input: 115V, 50 to 75 cycles.

CIRCLE 618 ON READER-SERVICE CARD

ACCESSORY UNITS

for TYPE 2001-2

L—For low frequencies

multi-vibrator type, 40-200 cy.

D—For low frequencies

counter type, 40-200 cy.

H—For high freq, up to 20 KC.

M—Power Amplifier, 2W output.

P—Power supply.

CIRCLE 614 ON READER-SERVICE CARD

American Time Products, Inc.

Telephone: Plaza 7-1430

Timing Systems

580 Fifth Ave., New York 36, N. Y.

CIRCLE 610-618 ON READER-SERVICE CARD
RESOLVERS—WHEN AND HOW YOU WANT THEM AND AT MASS PRODUCTION PRICES

From twenty years’ experience in designing and manufacturing resolvers, we have developed the means of predicting exactly how resolvers of various mechanical and electrical characteristics will perform in your system under any given operational conditions.

Nothing could be surer. You tell us the system performance you need. We analyze the requirements and supply the resolvers which will help bring you that performance. If none of our many standard resolver models fills the bill, we’ll build “specials” that will.

Because we make, as standard items, just about every type of resolver and other synchros, we can usually deliver quickly and at volume production prices. Available are frame sizes 8, 10, 11 and 15. We also make cascade resolver chains, using resolvers as small as frame size 10 with accuracy of 1/8° without using booster amplifiers.

MORE FOR YOUR MONEY. Our unique ability to pre-determine performance—and then to “tailor-make” to your needs—means that you get maximum value for your component dollar. Write for details.

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Teterboro, N.J.
District Offices: Burbank and San Francisco, Calif.; Seattle, Wash.; Dayton, Ohio; and Washington, D.C. Export Sales & Service: Bendix International Division, 205 E. 42nd St., New York 17, N.Y.

SERVICES FOR DESIGNERS
Free Film on Design Machines

A new 16 mm color sound film, “Engineered Screw Machine Tooling Applications,” produced by Brown & Sharpe Mfg. Co. of Providence, R.I., features eight practical applications of the latest design automatic screw machines. Utilizing close-up views and slow motion, some of the sequences detail the relative position of tooling during close timing operations. Standard and special attachments with explanations of the tool engineering involved in their practical application are featured. Running time is 35 minutes. This film is available on a no-charge loan basis from the producer.


MACHINING “UNMACHINABLE” MATERIALS

The Ultrasonics Division of Connecticut Instrument Corporation is offering a new service—Ultrasonic Impact Grinding. This machining technique may be used for drilling, broaching, shaving, slicing, dicing, engraving and shaping materials previously impossible to machine by conventional methods, including glass, quartz, silicon, tungsten, germanium, hardened steel, sinterite, sapphire, and aluminia. Applications of the process cover ceramics, glass, transistor components, precious stones, and die making.

Well equipped with ultrasonic machine tools together with a completely equipped tool making facility, the company will assume responsibilities for other phases of the component fabrication including securing of raw material. Sales engineers are available for consultation on machining problems. The company’s Ultrasonics Division is set up to turn out volume production of components—

P.S. and don’t forget these other quality products at the BENDIX “SUPERMARKET”

With our greater variety and greater volume of the precision components listed below, we have become the “supermarket” of the industry. We feature fast delivery and mass-production economy—plus the highest precision quality.

400-CYCLE SYNCHROS
(Frame sizes: 8, 10, 11, 15, 22)
Control Transformers
Differential • Receivers
Transmitters

GYROS
Directional, Free, Rate, Roll and Vertical Gyro Transmitters
• Stable Platforms

MOTORs AND GENERAtORS
Gear Head Motors and Motor Generators • Low-Inertia Servo Motors • Motor Generators • Precision Induction Tachometer Generators • Rate Generators

PACKAGED COMPONENTS
Analog-Digital Converters • Azimuth Counters • Cam Compensators • Clutch Synchros • Dual-Speed Synchros • External Slip-Ring Synchros • Follow-Up Mechanisms • Miniature Differential Gear Assemblies • Servo Assemblies

RADAR DEVICES
Airborne Radar Antennae • Ground Antenna Pedestals

YCB7BS
You Can’t Beat The Bendix “Supermarket”! Try us.

Eclipse-Pioneer Division
Teterboro, N.J.
and will undertake the whole project if desired—obtaining material, supervising machining operations, etc.


CIRCLE 99 ON READER-SERVICE CARD

Custom-Made Arrays

Kearfott Company’s Solid State Physics Laboratory now provides a unique service to the electronic tube industry by designing and manufacturing a wide variety of permanent magnet periodic focusing arrays specifically tailored to the user’s traveling wave tube requirements. Because

complete formulating, sintering, and machining equipment is available in the lab, arrays having properties providing compensation over virtually any ambient temperature range specified may be readily supplied.

A typical array utilized Kearfott’s PM-3 material together with specially designed pole pieces, resulting in a design which is both smaller and lighter than other arrays of equivalent magnetic field strength. Pole pieces may be provided according to specification.

G. Toker, Kearfott Company, Inc., Dept. ED, 500 Main Ave., Clifton, N.J.

CIRCLE 107 ON READER-SERVICE CARD

Computer Research Lab Available

Laboratory facilities at Washington University, St. Louis, will be opened soon to private industry and the Government for research in computers and computing devices.

The laboratory, which will be in full operation at the beginning of the fall semester, will stress studies of digital computers, network analyzers and electronic control devices for computers. The facilities include electronic and electrical measuring, testing and recording apparatus; electrical instruments for low and high frequencies; power and signal sources for high and low frequencies, electronic computer apparatus.

Computing Devices Research Lab., Engineering Laboratory Building, Dept. ED, Washington University, 6740 Millbrook Blvd., St. Louis 5, Mo.

CIRCLE 108 ON READER-SERVICE CARD

how many Resistors have you soldered recently?

It’s no trick today to obtain resistors that give everything you need in the way of conventional characteristics such as load life, resistance-temperature, temperature cycling, and so on.

But what a whale of a difference when it comes to “solderability”? Try the different makes for yourself and see. Whether you solder by hand or by automatic dipping, you’ll find that Stackpole Coldite 70+ resistors solder better, lots faster and lots more surely.

Just hit ’em with solder and they stay soldered—because they’re the only resistors whose leads get an extra final solder dip in addition to the usual tin-lead coating. You get faster production, fewer rejected assemblies. And there’s less chance of trouble developing after your products reach the field.

COMPARE THESE “SPECS”! — Write for Stackpole Resistor Bulletin giving complete scorecard for Coldite 70+ (cold-molded) resistors in relation to MIL as well as commercial specifications. And remember that they give you unmatched solderability in the bargain—at no extra cost!

Electronic Components Division STACKPOLE CARBON CO., St. Marys, Pa.

STACKPOLE Coldite 70+
fixed composition resistors

CIRCLE 109 ON READER-SERVICE CARD
A personal and (let us hope) encouraging message to an
ELECTRONICS ENGINEER IN A QUANDARY:

When Dame Destiny crooks her finger at you and says,
"Let's go with Bendix in Kansas City, old boy!" you face
a set of small problems that are well worth solving...

There is an excellent possibility that very soon we shall be offering
you the position you've been waiting for. It could be a position at a higher
level than the one you now hold and—
have little doubt about this—you'll be

You may, during this period of de-
cision, suffer tortures like the engineer
we picture above. (We sympathize with him... most of us have been
through it ourselves.) We'd like to
help you then but we know that you
yourself must measure these personal
cataclysms and weigh them against
the advantages of your professional future
here. We can only suggest that Kansas
City abounds with other potential play-
mates or sweethearts, other teams hope-
fully waiting for a star player, and—
who knows?—your new dress may
need only slight alteration to fit Kansas
City windows.

We're supremely confident that some-
how you will find the resolution and
ingenuity required to solve these prob-
loms if we give you sufficient in-

So let's talk about incentive.

Because Bendix, Kansas City, is a
long term prime contractor for the
AEC, we can say little here about our
products except that they are advanced
electronic, electro-mechanical devices de-
signed and manufactured to extraor-di-
narily high levels of reliability. After
only ten years we have become the city's
largest manufacturer, and we're still ex-
panding. Recently-inaugurated programs
make most likely that we can offer you
a position that will fully utilize your
talents in design, production or super-

You should find our salary offer of
more than passing interest.

In general, we need electronic engi-
neers with at least a BS degree, although

in some openings a degree in physics
is acceptable. Experience should range
upwards of 5 years.

We welcome design and development engi-
neers qualified in the design and develop-
ment of miniaturized airborne electronic equipment, radar, servos, video, IF amplifiers or vacuum
tube applications.

Automation engineers with a degree EE or
physics would be well-advised to learn about
our current major expansion into fully auto-
mated testing of electronic assemblies.

Vacuum tube application engineers will
find us attentive when they speak of their
work in ruggedized sub-miniature tubes, planar
triodes, thyatrons or special purpose micro-
wave tubes.

Reliability engineers (preferably with an
electrical degree and at least 7 years experi-
ence, including some statistical work) will
discover that our ever-increasing emphasis on
reliability assures them a place in the sun.

We wish we could present all the
facts you'll need to weigh, but we find
we've barely started. There's much more
to say... how the Bendix environment
stimulates professional creativity and
personal progress, how this area provides
pleasant, easy-going, economical living,
educational advantages, cultural and
recreational facilities, etc... but these

We're ready to get very specific re-
garding your financial incentive. We
must first hear from you. May we, soon?

Send Mr. R. H. Tillman, Professional Personnel,
Bendix, Box 302-IB, Kansas City, Missouri.

KANSAS CITY DIVISION

CIRCLE 900 ON CAREER INQUIRY FORM

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Designing Your Future
Signposts For Engineers
On the Road to Management

G. A. Barnard, 3rd
Ampex Corp.
Redwood City, Calif.

Top posts as managers are beckoning talented engineers today. But
the switch is not without pitfalls. It entails surrendering some of the
orientation instilled by scientific training, some of the relentless curi-
osity of the engineer to want to know everything about a tangible
"thing." The managerial role carries with it a strong portion of the
intangible. This may not be worthwhile for some engineers. Others
may find it challenging. This article will help you evaluate whether
you are suited for a career in management.

CAN engineers become good man-
gerers?
A problem receiving considerable at-
tention today is that of providing enough
management and supervision within the
middle ranks of expanding defense indus-
tries. The initial reaction is to divert op-
erating personnel into managerial posts.
Such personnel are usually engineers.

That engineers can become good man-
gerers is being demonstrated more and
more as a growing number of executive
positions are filled. This is particularly
ture in mechanical and electrical manu-
facturing. In the relatively young elec-
tronics industry, for example, engineers
are assuming top executive positions in a
wide range of companies.

Personal Qualities Essential
Like successful executives in other
fields, engineers who have excelled pos-
sess qualities that include not only com-
prehension of the technical problems of
their business but personal characteristics

that fit them for dealing with time, man
and money.

To some management experts, the
additional qualities spell "administrative
ability," and some extremists have even
said that these are the only important
requirements of an executive. The engine-
er will find that most of these management
qualities are not unique to a man of pub-
business training but can be develop-

Requirements Listed
What are the requirements for becom-
ing a good executive? Here are some sal-
ent points:
A good executive is achievement
minded. To be satisfied with his work,
feels he must be accomplishing some-
things worthwhile. By his own examina-
tion and enthusiasm, he instills in his subor-
dinates this same desire to achieve. While
t this feeling that he can handle one job,
seeks additional responsibility, and he ex-
pects those under him to do the same.

He recognizes the need for lines
authority. He accepts and respects the authority above him, so long as it is applied fairly and according to principle; when it is otherwise, he makes his constructive criticisms through proper channels. He delegates his authority to those under him, and when he makes assignments, they are well defined.

He is a good organizer: his own affairs are always kept in good order and his actions well-planned. In leading an activity, he maintains clear direction, leaving no doubts about the goals to be reached and the methods for arriving at them. He strives for communication between his group and his superiors.

Decisions . . . Decisions

He is decisive. Not only does he analyze problem and implement its solution, but he also recognizes there are times when making a decision is more important than the decision itself.

He has a genuine interest in aiding his company's growth. He is conscious of the profit in every undertaking.

He maintains a broad perspective of activities in his company and the industry. Though his interests range wide, he limits most of his action to activities that are the most immediate and practical.

He is a good teacher. He conducts his subordinate group in such a way that it can run itself without him. He strives to see each man know the essentials of every other man's job, including that of the manager. He allows neither himself nor any of his men to become indispensable, and where procedures are intricate and potentially confusing, he insists that they be recorded and kept readily available.

At all times he maintains the highest integrity. He knows there may be occasions when it is prudent to refrain from making a commitment or when bluffing is the wisest strategy, but when direct action is called for, he is always honest. His own interests are secondary to those of his group.

Positive Approach Stressed

The positive approach is one of his biggest assets. He receives suggestions with an open mind and never rejects them without concrete reasons. All will admit that many of these attributes are personal outlooks developed by men of stature, regardless of their field of specialty, whether exact and specialized or broad and loosely defined. A few of these characteristics, however, are not always included in an engineer's formal training or technical experience. He often tends to think only of the technical requirements of his work, while the competent manager must think of the economic implications, the way the end product is used by consumers and how it is produced by employees. The best technical product may not sell as well as one that sacrifices a few mechanical refinements for ease of use or for early marketing.

New Viewpoint Needed

Such considerations are usually taken care of outside of the engineering department, and the engineer is accustomed to accepting them as restrictions on his work. But when he assumes a role in management, he will be forced to accept this other side of the picture. Recognition of this point early in his career will help him attain a managerial point of view.

Usually an engineer organizes his technical affairs orderly, but it may be difficult for him to communicate these ideas to those above or below him who are not technically trained. The realization that management may not think in the same technical terms that he does should spur the engineering-trained man to use everyday language in his reports, recommendations and requests, so his word will be heeded. Sometimes this is necessary even between two different scientific fields, such as between the human engineering psychologist and the electrical project engineer.

(continued on following page)
DESIGNING YOUR FUTURE

One of the engineer's strongest points as a manager is this trained ability to attack problems analytically. But such considerations as personnel relations or predicted market conditions are not always subject to cold logic. The engineer-manager may find he needs to do some investigation outside working hours to develop an appreciation of this seemingly nebulous aspect of his job.

Are all of the manager's activities aimed at aiding the company as a whole? Not unless he is thoroughly familiar with the over-all aims of the company. Usually, with minor variations, these can be expressed simply as an effort to make a consistent profit. This basic goal is easy to overlook when one is striving to perfect his engineering output—to serve the highest technical ideals of his calling.

Must Learn to 'Guess'

Strengthening his ability to see in broad perspective is the engineer's main task in aiming his career toward management. By all his exact formal training and all his experience in producing a precise product, he has learned to concentrate on details, to rely on mathematical proof and to back up every decision with facts. In taking a management position, he must learn to do the opposite: to continue to be decisive but without the comfortable security of tangible reasons for everything he does. Many of his actions will now be based on "if," and his definitive actions will be based on "educated guesses."

For many engineers, assuming such an attitude is distasteful, and early recognition of these management responsibilities can save them the discontent of pursuing the wrong course; at the same time their companies will not face losing good engineers, only to gain uncertain managers.

To alleviate such potential personnel problems, many technical companies now offer equal advancement opportunities for engineering and management talent. Separate career ladders are established, with comparable salaries and privileges. Individuals who are qualified may be transferred laterally between the professional and supervisory positions. But high-caliber engineers or scientists who have little inclination toward administrative activities need not change to receive equal rewards.
The Special Products Division of IBM, less than 60 years old, emphasizes its growth and development potential for the engineer applicant. The work of SEPD is described generally and nine areas of activity in which they operate are listed. Typical project is described and follow through is spelled out. Opportunities existing now for the engineer in the electronic-computer field are itemized. Copies of the illustrated brochure from Mr. T. F. Bianco, Special Engineering Products Division, IBM, Dept. ED, North Hamilton Street, Poughkeepsie, N.Y.

CIRCLE 870 ON READER-SERVICE CARD

Servo Corporation

Spectrum of Capabilities" presents the research, development and manufacturing capabilities of the organization. A chart showing areas in which Servo Corp. has been "first" introduces the reader to the actual accomplishments, areas of specialization and specific fields of application. Products of the company are itemized alphabetically. There is a brief description of production facilities, research and test facilities, quality control and inspection procedures, field service and warranting facilities. Servo Corporation is interested in staff engineers, development engineers and design engineers in each of the areas of specialization listed in the front of the booklet.

Felix Gardner, Supervisor, Employment Services, Dept. ED, Servo Corporation of America, 60 John Turnpike, New Hyde Park, N.Y.

CIRCLE 871 ON READER-SERVICE CARD

PROJECT STAR

In 2000 B.C. man sought to chart the heavens and created the Zodiac, an imaginary belt, which was believed to control his destiny. Today, man, no longer willing to surrender his fate to the stars, seeks to explore them instead.

America's determination to win the race for space is evidenced by the formation of projects such as Airborne's STAR (Space Technology and Advanced Research). Here in our Laboratory a hard core of scientists and engineers are designing electronic systems for space vehicles. These programs are not company proposals, but firm orders of continuing duration for customer hardware. The esoteric nature of each piece of equipment places a premium on technical skill and ingenuity, as normal engineering procedures become overwhelming problems when transferred to the unworldly vacuum of space.

Project STAR is a culmination of our long-standing interest in electronic research and development. Space technology, and other new challenging areas open to electronic engineers at Airborne, have created select positions in the following fields:

Advanced Electronic Design Engineering • Product Design • Operational Analysis • Data Processing • Reliability • Circuit Design • Electronic Counter-measures • Field Engineering • Radar Systems • Antenna Design Systems Analysis and Management • Microwave Systems • Systems Test

General Benefits Program and Relocation Expenses. Send resume to Howard J. Gresens who will arrange a technical interview at your convenience.

CIRCLE 903 ON CAREER INQUIRY FORM

CIRCLE 872 ON READER-SERVICE CARD
join TI engineers in such challenging programs as micro-miniaturization

TI develops new semiconductor solid circuit with component densities up to 34 million per cubic foot!

From one of many stimulating research and development programs at Texas Instruments comes another major "first" . . . new semiconductor solid circuits! Born from TI-sponsored research studies, the basic concept was carried through to reality by the Semiconductor-Components division. Utilizing TI developments in semiconductor manufacturing techniques (controlled masking, etching, diffusion), TI has formed diode and transistor elements, as well as passive elements of resistance and capacitance, to provide a complete circuit function normally requiring up to 12 components!

Such significant developments naturally result from TI's great emphasis on creative ability and freedom of professional expression. You'll find many challenging opportunities at Texas Instruments where such technological advances are a frequent occurrence. At the Apparatus division, weight and size are critical factors in its missile and aircraft electronic and electromechanical systems. You may explore new possibilities for making these systems even smaller and more reliable using the new semiconductor solid circuits. Or, with the GeoSciences and Instrumentation division, you may exercise this new concept in circuitry to create new and more compact commercial and industrial instrumentation.

A rewarding opportunity awaits you in one of the many programs now in progress at TI's Central Research Laboratory, Semiconductor-Components, Apparatus, and GeoSciences and Instrumentation divisions.

You will also benefit from TI's up-to-date personnel policy which include profit sharing plan (in 1958, 15% of base earnings), semi-annual salary and advancement reviews, educational assistance, insurance, hospitalization, and retirement programs. You will enjoy the temperate Southwestern climate and the many year-round recreational, amusement and cultural activities.

To join this fast-moving company at the forefront of science and technology, please write to activity of interest shown at right enclosing a short resume.

(Graph courtesy of Dallas Times Herald, January 7, 1958.)

Dallas' 12-month weather chart shows that temperature averaged 68° in 1958, with humidity at a comfortable low level. Dallas skies are predominantly clear and sunny, devoid of industrial haze.
specific career opportunities now open at Texas Instruments

SEMICONDUCTOR-COMPONENTS DIVISION

DEVICE DEVELOPMENT - Develop new semiconductor devices; conduct experimental and theoretical studies on the effects of nuclear radiation on semiconductor materials and devices; evaluate experiments in the analysis of gases and electro-chemistry; conduct physical measurements on semiconductor surfaces; determine the effects of chemical reaction on semiconductor surfaces; studies in device stability, reliability and characterization; materials research and development including crystal growth and crystallography.

MECHANIZATION — Design and develop high speed automatic machinery.

Please write to H. C. Lauer, Dept. 1102, P. O. Box 312, Dallas, Texas

APPARATUS DIVISION

ELECTRICAL DESIGN AND DEVELOPMENT ENGINEERS (minimum 3 years experience) To apply technologies of radar, sonar, infrared, magnetics, microwave, telemetry, special-purpose computers, and servos to submarine detection, missile guidance and instrumentation, combat surveillance and reconnaissance, and aerial object detection and tracking.

Conduct studies and analyses, and circuit development, electronic and electromechanical component design, transistorization, and miniaturization. Educational requirements: BS, MS, or PhD in Physics.

MECHANICAL DESIGN AND DEVELOPMENT ENGINEERS (minimum 3 years experience) Design and develop servo systems, X-Y plotters, strip recorders, optical techniques, vibration damping and isolation packages, antenna structures and drives, sonar rears, cooling and heating systems and electronics packaging. Guide drafting, environmental testing, and model making; give consultation to manufacturing engineers to solve project production problems. Environmental studies. Educational requirements: BS, MS, or PhD in Electrical Engineering.

QUALITY CONTROL ENGINEERS (minimum 3 years experience) Establish and maintain standards of quality and inspection methods for all raw materials and manufactured products. Three years experience in statistical methods, manufacturing processes, equipment inspection and/or design with minimum of 1 year in electronics industry. Educational requirements: BS, MS, or PhD in Electrical Engineering.

MANUFACTURING ENGINEERS (minimum 1 year experience) Production planning, tooling, and guidance and control of all phases of general production activity, or of an assigned project. Mechanization for short-run equipment manufacture. Educational requirements: BS, MS, or PhD in Electrical Engineering.

COST ESTIMATING ENGINEERS (minimum 3 years experience) Estimate or supervise estimation of material, labor, tooling, and indirect costing factors on unusual electronic and electronic electromechanical systems and equipment. Electromechanical manufacturing experience desired. Educational requirements: BS, MS, or PhD in Electrical Engineering.

SALES ENGINEERING — Theory of electron devices; marketing philosophy; effective sales presentations; sales experience.

INDUSTRIAL ENGINEER — EE with 3 to 5 years experience in Industrial Engineering or related work.

Quality Assurance Engineer — EE or ME with experience in electrical products, particularly in commercial and industrial areas.

Please write to John Pinkston, Professional Placement, Dept. 1102, 6000 Lommon Avenue, Dallas 9, Texas

GEOSCIENCES AND INSTRUMENTATION DIVISION

MANUFACTURING ENGINEER—EE or ME with 2 years or more similar experience in production planning and control.

ELECTRICAL ENGINEER — EE with 3 to 5 years experience in electronic design.

EE or Physics sustaining engineering of semiconductor products.

SALES ENGINEER — Science degree from a recognized university.

INDUSTRIAL ENGINEER — EE with 5 years in electronic circuitry design and development.

Please write to Dave Turner, Dept. 1102, 6000 Buffalo Speedway, Houston, Texas

CENTRAL RESEARCH LABORATORY

HEAD—PHYSICS SECTION — 4 to 5 years experience in semiconductor physics and proven ability to direct a variety of technical projects. Responsible for directing work on the measurement and understanding of electrical, thermal, magnetic, optical, and transport properties of semiconductors. Educational requirement is PhD in Physics.

HEAD—DEVICE SECTION — 4 to 5 years experience in semiconductors plus experience in group leadership and proven ability to supervise a variety of technical projects. Will be responsible for directing work on design, fabrication and evaluation of new solid state devices. Educational requirement is MS or PhD in either Physics or EE.

SOLID STATE THEORIST — Responsible for the understanding and interpretation of the physical properties of semiconductors and other solid state materials. Educational requirement: PhD in Physics with concentration in quantum mechanics. Solid state experience desirable but not necessary.

DEVICE THEORIST — Responsible for the design of new solid state devices and interpretation of their characteristics in terms of physical and fabrication parameters. Educational requirement is PhD in Physics or EE, or MS with 3 years experience in solid state device theory.

SEMICONDUCTOR TECHNOLOGY — Responsible for the design and interpretation of experiments on the technology of semiconductors, including impurity diffusion and alloying. Educational requirement is PhD in Physical Chemistry or Metallurgy. Experience requirement: 3 to 4 years experience in semiconductor technology.

TEORETRICAL PHYSICIST — 2 to 3 years experience in electron or nuclear magnetic resonance with interest and experience in magnetic materials. Will be responsible for developing or improving existing techniques and experimental apparatus for the measurement of magnetic properties of solids.

PHYSICISTS — Either MS or PhD with 1 year minimum experience in the fields of superconductivity and low-temperature physics. Should be acquainted with conventional techniques of transferring and handling liquid helium and charged particles in a variety of systems.

Please write to A. E. Prescott, Dept. 1102, 6000 Lommon Avenue, Dallas 9, Texas

Airborne Instruments Laboratory

"Freedom for Initiative at Airborne Instruments Laboratory" keynotes the approach of this 28-page illustrated brochure. The company, which offers diversified opportunities in the fields of air traffic control, automation, aviation systems, medical electronics, radar tracking, radio astronomy, reconnaissance systems, space technology, special systems and test equipment, presents an integrated picture of its plant, personnel, products and progress. A brief company history, and a photographic assembly of products in the news, precedes a detailed section covering activity reports in Research and Engineering, Applied Research and Engineering and Production. Specific projects are outlined and orientation of each section illustrated. Life at AIL includes a listing of employee benefits, the overall working philosophy, and special services available in technical service departments which free engineers for engineering. Historical briefing on the parent company, Cutler-Hammer, is discussed in conjunction with estimates of future opportunities and indications of company growth in staff, facilities, and transactions.

Director of Personnel, Howard J. Greensen, Airborne Instruments Laboratory, Dept. ED, Mineola, L.I., N.Y.

CIRCLE 873 ON READER-SERVICE CARD

CIRCLE 904 ON CAREER INQUIRY FORM
SPACE ORIENTED ELECTRICAL ENGINEERS AND PHYSICISTS

Fast new space and missile projects have created outstanding opportunities in research, development and design at Douglas. Here are some of the areas in which we have immediate openings for engineers and physicists with advanced degrees (B.S. also considered):

SPACE NAVIGATION — Utilize Bode and Nyquist techniques, root loci, Z plane, quasi linear, non-linear and other techniques in the analysis and development of guidance and control systems.
SPACE COMMUNICATIONS — Telemetry system research and development, research in wave propagation in ionized gas, high frequency breakdown and many other areas.
SPACE POWER — Unconventional power research and development to supply power in space stations and on other planets.
LOGICAL DESIGN — Solid state digital circuits as applied to automatic test and firing equipment, utilization of complex switching and logic circuitry, and utilization of computers in detailed circuit design.
ANTENNA DEVELOPMENT — Complete research, advance design and development of antenna and radome systems for use on space vehicles.

For full information write to Mr. C. C. LaVere, Staff Vice-presidential Engineer, Los Angeles, California.

CIRCLE 905 ON CAREER INQUIRY FORM

FREE — Information for Authors

This booklet describes how easy it is to write for ELECTRONIC DESIGN. Complete details are included concerning types of articles needed, treatment, payment, etc. For your copy simply circle the reader service number shown below.

CIRCLE 972 ON READER-SERVICE CARD

CAREER OPPORTUNITIES

Republic Aviation

A packet of four booklets entitled "Home of Tomorrow Thinkers" is offered by Republic Aviation. An illustrative folder shows a map of Long Island, pictures life in the surrounding communities and lists general benefits for employees. An information sheet presents a brief history of the company, describes its activities and operations, discusses the training program, and lists each type of engineering job available. A third pamphlet consists of a ready-to-mail qualification form for the interested applicant. An Annual Report for 1958 is enclosed for financial information about the company.
Republic Aviation Corp., Dept. ED, Farmingdale, Long Island, N.Y.

CIRCLE 876 ON READER-SERVICE CARD

We asked this question of the first four engineers we saw.

DID YOU EVER THINK OF BECOMING AN EDITOR?

Answer. NO.

This reply is not at all startling except for the fact that the four people asked are not ELECTRONIC DESIGN editors. Their answer was true right up to the time they read one of our help wanted ads.

It never occurred to them there was a career in editing.

There is.

If you have a BEE degree and a year or two of design engineering experience, a little disillusionment with the space of engineering, but flair for writing, why don't you inquire? Send resume...

James A. Lippke
Managing Editor
ELECTRONIC DESIGN
830 Third Avenue
New York 22, New York
CIRCLE 907 ON CAREER INQUIRY FORM

A SHORT SURVEY
# Advancement

## Your Goal?

## New Form

## Speeds Action

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

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

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

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

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

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

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

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**ELECTRONIC DESIGN**

**CAREER INQUIRY SERVICE**

USE BEFORE AUG. 5, 1959

After completing, mail career form to **ELECTRONIC DESIGN**. Our Reader Service Department will forward copies to the companies you select below.

*(Please print with pencil or type.)*

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**Educational History**

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Recent Special Training

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Outstanding Engineering and Administrative Experience

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Published Articles

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<th>Minimum Salary Requirements (Optional)</th>
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*Use section below instead of Reader Service Card. Do not write personal data below this line.*

Circle Career Inquiry numbers of companies that interest you

| 900 | 901 | 902 | 903 | 904 | 905 | 906 | 907 | 908 | 909 | 910 | 911 | 912 | 913 | 914 | 915 | 916 | 917 | 918 | 919 | 920 | 921 | 922 | 923 | 924 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 925 | 926 | 927 | 928 | 929 | 930 | 931 | 932 | 933 | 934 | 935 | 936 | 937 | 938 | 939 | 940 | 941 | 942 | 943 | 944 | 945 | 946 | 947 | 948 | 949 |

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**INFORMATION**

1. **ELECTRONIC DESIGN**'s Reader Service Card is printed on a non-adhesive paper, and the form is designed to be detached from the Reader Service Department's file. It is not necessary for you to fill in any personal data.

2. When you complete the form, do not fill in any personal data, such as your Social Security number, home address, or telephone number. These are not necessary for the process of sending your resume to the companies you select.

3. Use the form to circle the numbers of the ads that interest you. These numbers will be used by **ELECTRONIC DESIGN**'s Reader Service Department to help you locate companies that match your qualifications.

4. The form is designed to be sent to the Reader Service Department, where it will be photocopied and distributed to the companies you select. This process is quick and efficient, and it will allow you to advertise your qualifications to a wide range of potential employers.

5. If you desire only company brochures, you can use the regular Reader Service card. This will save you time and effort, as you will not be bombarded with resumes from companies that are not interested in your qualifications.

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What The Russians Are Showing

... Sputniks

Here, in pictures, is a story of one of Russia’s most boastworthy achievements—Sputniks. The pictures were taken at the recent Agricultural and Industrial Exhibition in Moscow where visitors could admire models representing man’s first successful venture into space.

These revealing pictures were brought here by Mr. Richard E. Stockwell of Avco Manufacturing Company, Cincinnati, Ohio.

The doghouse in Sputnik II. The cylinder on top of the unit is an oxygen tank. The dog faced to the left and fitted snugly inside, so she couldn’t turn around. The area occupied by the dog was fur-lined for comfort. She was fed automatically by a trip-mechanism, timed to feeding hours. A small fan circulated the air.

ELECTRONIC DESIGN • June 24, 1959

A model of Sputnik I is the first thing a visitor sees when he enters the Academy of Sciences Pavilion at the Agricultural and Industrial Exhibition in Moscow. Mounted on a sweeping arm that projects over the visitor’s head, it gives a diaramic effect of space, with a backdrop showing a deep blue skyline with Moscow’s tallest buildings in the background. Sputnik I trails its four long antennas.

Models of Sputnik II and III are in a large room next to the entrance hall. Shown in this photo is Sputnik II. It carried a small dog into space. The cylinder housing the dog was in the base of the unit (with window). The spherical cylinder above it was a pressure tank for operating some of the equipment. The large spring at the top was for pushing the cap free of the unit after it went into orbit.
Sputnik III on display. The model is about eight feet long and nearly six feet across at the base, indicating that the Russians had to use a very large rocket to shoot Sputnik III into orbit.

There were no signs of any effort at miniaturization, and there was lots of evidence that standard, unrefined items of equipment had been adapted to Sputnik III's needs. Simplicity, always a commendable factor in Soviet design, was used here too. Extra thrust was used to compensate for the lack of refinement.

Close-up of another part of the nose shows an opening for a recessed mass spectrometer tube used to study the ion composition of the ionosphere. A radio frequency mass spectrometer was used to determine the mass spectrum of positive ions.

Two magnetic manometers measured pressure encountered at low and high altitudes.

Two electrostatic fluxmeters (one shown here) measured the satellite's own electric charge and the intensity of the electrostatic fields in the upper layers of the atmosphere. The Russians said this device could be opened and closed 1500 times per second. The plate immediately below the fluxmeter was not described, but is believed to be a meteorite recording device.

Close-up of the nose of Sputnik III shows the cosmic ray counters or photomultipliers, the small solar battery plates arranged around the nose, and the casing on a magnetometer.

This model is not an exact duplicate of Sputnik III. Most of the metallic parts appeared to be of a light aluminum alloy which had been shined to a high lustre. One of the guides at the Exhibit identified the magnetometer as an "orientation device" that had been used to put Sputnik III into orbit.

The magnetometer encased in the nose of Sputnik III. The Russians described it as "an instrument whose measuring pickups are automatically oriented towards the earth's magnetic field, whatever the orientation of the satellite."

This capability was demonstrated with the unit shown here behind a plastic case. A guide opened the case, plugged in the magnetometer, and waved it about in an arc.

An electromagnet on the underside of the wheel caused it to react to even the slightest movement. The Russians explained that this was a part of Sputnik III's guidance system as well as a device for measuring the magnetic field in outer space.

(Continued on p. 66)
FIRST
Miniature 10 amp relay

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Sputnik III from the side and rear. Three different antenna types were used for messages to and from ground stations. Several micro-meteor impact plates were used in the base, as well as a solar battery plate (not shown here).

Three antennas, equally spaced around the nose, measured ionic density. Eight pairs of adjustable flaps could be swung in or out to change the coefficient of radiation moved in and out of the earth's shadow.

Optical equipment used to track Sputnik III. The schematic on this wall shows how a central control panel directed messages to the satellite and, in turn, received them through a series of ground stations. Radar tracking is located by the figure at the left.

Historical picture of early Russian rocket launching efforts. Schematics of Sputnik tracking techniques were exhibited on shelves around the carried samples of equipment used to record messages. Spatniks. There also models of early size rockets.
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Choose from 15 different Mallory Tantalum Types

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<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAT</td>
<td>Microminiature size</td>
<td>XTL: 200°C rating</td>
</tr>
<tr>
<td>TAP</td>
<td>Miniature, 100°C rating</td>
<td>XTH: 200°C, small diameter</td>
</tr>
<tr>
<td>TAP2</td>
<td>Miniature, wide range of ratings</td>
<td>XTK: 175°C, smaller case</td>
</tr>
<tr>
<td>TAS</td>
<td>Solid electrolyte</td>
<td>XTV: high capacity, 175°C</td>
</tr>
<tr>
<td>TNT</td>
<td>Miniature, axial leads</td>
<td>M2: miniature, 150°C</td>
</tr>
<tr>
<td>STNT</td>
<td>Subminiature</td>
<td>TAF: tantalum foil</td>
</tr>
<tr>
<td>XTM</td>
<td>Miniature, 175°C rating</td>
<td>TAM: encapsulated</td>
</tr>
</tbody>
</table>

ELECTRONIC DESIGN's serial translation of Professor Kharkevich's monograph concludes in this issue. The complete translation in book form will soon be available. For more information, turn to the Reader-Service Card and circle 800.

Part 21

A. A. Kharkevich

(Translated by J George Adashko

Chapter 4

Parametric Phenomena

42. Frequency Division

In many cases an oscillator of a given frequency is available while a lower frequency, particular, frequency is required. The operation of obtaining \( 1/n \) of the initial frequency is called frequency division. Most frequently encountered is division by 2, obtaining half the frequency.

Frequency division, i.e., the production of fractional frequencies called subharmonics, is possible in nonlinear resonant circuits and in certain nonlinear circuits. In this section we consider...
Consider a circuit consisting of a sinusoidal voltage source

\[ E = E_m \cos 2\omega t \]

and an alternating admittance

\[ Y = Y_m (1 + m \sin \omega t) \]

The current in such a circuit is

\[ I = I_m Y_m (\cos 2\omega t + \frac{m}{2} \sin 3\omega t - \frac{m}{2} \sin \omega t) \]

We note the presence of a current component having half the source frequency. In addition, there are components having the source frequency, \( \omega \), and one-and-a-half times the frequency, \( 3\omega \). These components are filtered out and the oscillations of frequency \( \omega \) used to control the admittance, we have the basic circuit of a divider, as shown in Fig. 146. The divider circuit must thus

**Fig. 146. A basic frequency divider.**

---

**INDUSTRIAL AUDIO 100°C OPERATING**

<table>
<thead>
<tr>
<th>BVcc volts</th>
<th>BVce (R = 10K) volts</th>
<th>ho (Vcc = 6V, Ic = 1 ma)</th>
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</thead>
<tbody>
<tr>
<td>2N652</td>
<td>45</td>
<td>30</td>
</tr>
<tr>
<td>2N651</td>
<td>45</td>
<td>30</td>
</tr>
<tr>
<td>2N650</td>
<td>45</td>
<td>30</td>
</tr>
</tbody>
</table>

\( T_i = 100°C \) Operating & Storage \( P_c = 200 \text{ mw} \)

**COMMERCIAL AUDIO 85°C OPERATING**

<table>
<thead>
<tr>
<th>BVcc volts</th>
<th>BVce (R = 10K) volts</th>
<th>ho (Vcc = 6V, Ic = 1 ma)</th>
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<tr>
<td>2N1193</td>
<td>40</td>
<td>25</td>
</tr>
<tr>
<td>2N1192</td>
<td>40</td>
<td>25</td>
</tr>
<tr>
<td>2N1191</td>
<td>40</td>
<td>25</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>PERFORMANCE DATA</th>
<th>Vertical (TW)</th>
<th>Horizontal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>.054 v/trace width</td>
<td>0.30 v/trace width</td>
</tr>
<tr>
<td>Nominal Spot Size (trace width)</td>
<td>0.002 inch</td>
<td>0.02 inch</td>
</tr>
<tr>
<td>Deflection</td>
<td>27 v/inch (nominal)</td>
<td>150 v/inch</td>
</tr>
<tr>
<td>Frequency Response</td>
<td>DC to greater than 3,000 mc</td>
<td>0-2,000 mc</td>
</tr>
<tr>
<td>Input Impedance</td>
<td>50 or 100 ohms</td>
<td>3 x 10^11 trace widths/sec.</td>
</tr>
</tbody>
</table>

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**RUSSIAN TRANSLATIONS**

contain a feedback element, which causes the parameter (specifically the admittance) to oscillate at the fractional frequency.

The variable admittance may be the transconductance of a triode, which is a function of the grid voltage. If the characteristics of the tube are specified in the form

\[ I_s = f(U) \]

the presence of a quadratic term in the function \( f \) results in a transconductance that is linear with the grid voltage. Let

\[ f(U) = a_0 + a_1U + a_2U^2 \]

then

\[ S = \frac{dI_s}{dU} = a_1 + 2a_2U. \]

The simplest circuit employing this possibility is shown in Fig. 147. This circuit differs from the ordinary tuned-plate oscillator only in the presence of an ac source \( E \) in the grid circuit. The circuit of Fig. 147 does not differ in principle from the regenerative receiver, or in general from any potentially self-oscillating system acted upon by an external source. The source frequency is \( 2\omega \).

The tank circuit is tuned to half this frequency, \( \omega \). The grid voltage is the sum of the source voltage \( E \) and the voltage induced in the coupling coil. To be able to actually generate the half-frequency voltage, certain conditions must be satisfied; these will now be derived in simple form.

The circuit of Fig. 147 can be considered as some sort of an oscillator operating at half the frequency. To determine the excitation conditions of this oscillator, we use the phase and amplitude balance conditions. For this purpose, let us open the circuit at the point indicated by the dotted line in Fig. 147 and redraw it as shown in Fig. 148. Assume that the input voltage is

\[ U_1 = U_m \sin \omega \]

The grid voltage becomes

\[ U_s = U_1 + E = U_m \sin \omega + E_m \cos 2\omega. \]

**Fig. 147. A simple half-frequency oscillator.**
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- Full outputs for simultaneous operation of two klystrons
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- Safety lock when transferring from + to - grid voltage
- External triggering of internal pulse generator

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Fig. 148. The circuit of Fig. 147, redrawn with the grid circuit open.

The plate current is

\[ I_p = f(U_p) = a_v + a_1(U_1 + E) + a_2(U_1 + E)^2 \]

If the tank circuit is tuned to \( \omega \), the voltage components with different frequencies will be practically eliminated, and we obtain for the voltage of frequency \( \omega \)

\[ U = I_RR = R(a_1 + E_a)U_1 \]

The output voltage is

\[ U_2 = \frac{M}{L}U = kU \]

where \( k = M/L \) is the coupling coefficient. Thus

\[ U_2 = kR(a_1 + E_a)U_1 \]

To be able to maintain oscillations at a frequency \( \omega \) in the closed circuit (i.e., in the circuit of Fig. 147, which we now restore by connecting the input and output terminals of the circuit of Fig. 148), we must satisfy the condition

\[ U_2 > U_1 \]

hence

\[ kR(a_1 + E_a) > 1. \]  (1)

This indeed is the excitation condition for the circuit of Fig. 147, operating as a frequency divider. However, we must at once make the following important remark concerning this condition. Formula (1) shows that the circuit can be excited when \( E = 0 \), i.e., if

\[ kR_a > 1. \]  (2)

The meaning of this relation becomes quite clear if we examine the circuit of Fig. 147: if the source voltage \( E \) is eliminated, we have an ordinary oscillator, capable of oscillating at the frequency \( \omega \) (to which the tank circuit is tuned).

Formula (2) is none other than the self excitation condition for this type of oscillator. Consequently, for the circuit of Fig. 147 to be excited as a divider and not as an oscillator, the following two conditions must be satisfied simultaneously:

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RUSSIAN TRANSLATIONS

\[ kR(a_1 + E_i a_2) > 1 \]
\[ kRa_i < 1 \] (3)

A few other remarks are also in order. First, the phase balance condition is satisfied in our analysis automatically, since, on the one hand, we choose \( U_1 = U_m \sin \omega t \), and \( E = E_m \cos 2\omega t \) (i.e., we choose, beforehand, suitable initial phases for the two voltages), and on the other hand we assume that the tank circuit is tuned to exact resonance. A more detailed analysis shows that division is possible within a certain range of detuning.

Secondly, the way we state the problem we can establish only the excitation condition, but cannot find the steady-state amplitudes. The point is that by considering only the quadratic term of the characteristic (the term necessary to produce division) we reduce the parametric problem to a linear one. A steady state is possible, as is known, only in a nonlinear system.

To investigate the steady state condition it is necessary to include at least a third-power term in the expression for the characteristic of the triode. A more detailed investigation of this type serves as the basis for the theory of the so called "second-order resonance."

In conclusion we must also note that simultaneous satisfaction of both conditions (3) is difficult in practice. The ability of the circuit of Fig. 147 to operate as an ordinary oscillator is one of its shortcomings. Regenerative frequency dividers, to which the next section is devoted are free of this shortcoming.

43. Regenerative Frequency Division

A characteristic of parametric excitation is that oscillations can be generated at a frequency other than the frequency at which the parameter is varied. In particular, as we have seen, it is most easy to excite oscillation at a frequency

\[ \omega_0 = \frac{1}{2} \omega \]

where \( \omega_0 \) is the frequency of variation of the pa-

Fig. 149. Block diagram of a regenerative frequency divider.
rameter. This circumstance can be used for frequency division.

Let us examine the block diagram shown in Fig. 149. The input voltage $U_1$ is applied to multiplier $M$, to which a voltage $U_2$ is also applied. The output of the multiplier $U_3$ is proportional to the product of the two inputs $U_1$ and $U_2$.

The voltage $U_2$ is filtered by filter $F$, amplified by amplifier $A$, and the amplifier output voltage $U_3$ is fed back through phase shifter $FS$ to the multiplier. We shall show that such a circuit is capable of dividing the frequency in two. Let the input voltage be

$$U_1 = \sin \omega t.$$ 

Assume that the frequency division takes place, so that

$$U_4 = \sin \omega t$$

then

$$U_2 = U_1 U_4 = \sin \omega t \sin 2 \omega t = \frac{1}{2} \cos \omega t - \frac{1}{2} \cos 3 \omega t.$$ 

The filter blocks the triple-frequency component, so that its output is $1/2 \cos \omega t$. If the voltage gain of the amplifier is 2,

$$U_3 = \cos \omega t,$$

i.e., the output frequency is half the frequency of the input. If the phase shifter now introduces a 90 deg phase shift, we get

$$U_4 = \sin \omega t$$

as assumed beforehand. Circuits such as shown in Fig. 149 are called regenerative frequency dividers. This term implies the essential presence of feedback from the output of the circuit to its input.

It should be noted that the above analysis shows only that frequency division is possible with the aid of a regenerative divider. But this does not determine conditions under which the division actually takes place. Nor does it permit us to observe the essential features of the phenomenon.

One of these features is that the division begins only at a fixed value of the input voltage $U_1$. To examine these important details, let us consider some specific circuit, for example, that shown in Fig. 150. The multiplier in this circuit is a ring modulator (see Section 12). We shall assume that

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**RUSSIAN TRANSLATIONS**

It performs pure multiplication of the voltages applied to it. We write the current equations for the plate circuit of the triode

$$C_0 \frac{dU}{dt} = \frac{1}{R} U + \frac{1}{L} \int U \, dt = SU$$  \hspace{1cm} (1)

where $S$ is the transconductance. The voltage induced in the feedback coil is

$$e = M \frac{dI_L}{dt} = \frac{M}{L} U$$  \hspace{1cm} (2)

The voltage acts in the $rC_1$ network. The voltage across $r$ is

$$U_r \approx rC_1 \frac{de}{dt}$$  \hspace{1cm} (3)

(provided the capacitor voltage is much greater than $U_r$). The $rC_1$ network serves as the phase shifter. The voltage $U_r$ is applied to the multiplier: this indeed is the voltage designated earlier as $U_r$. Next, the voltage picked off the ring modulator is equal to (see Section 12)

$$U_2 = U_1 - 4R_r a_1 U_1 U_4$$  \hspace{1cm} (4)

From (2), (3), and (4) we obtain

$$U_r = \frac{4a_1 R r C_1}{L} U_1 \frac{dU}{dt} = kU_1 \frac{dU}{dt}$$  \hspace{1cm} (5)

Inserting this value into (1) and grouping the terms containing $dU/dt$, we obtain an equation with variable coefficients

$$(C_0 - kSU_1) \frac{dU}{dt} + \frac{1}{R} U + \frac{1}{L} \int U \, dt = 0$$  \hspace{1cm} (6)

This is the equation for the current in a tank circuit whose capacitance varies with the input voltage. If the input voltage varies as

$$U_1 = U_m \sin 2\omega t$$

we have for the effective capacitance

$$C(t) = C_0 - kSU_m \sin 2\omega t$$

$$= C_0 \left( 1 - \frac{kS}{C_0} U_m \sin^2 2\omega t \right)$$

It is now clear that the mechanism of regenera-

---

**Fig. 151.** In this regenerative divider the feedback element is an $(n + 1)$ multiplier and the input frequency is $n\omega$. **Example: 6**
The frequency division reduces to that of parametric excitation of oscillation. In our case the excitation condition

\[ n > 2d \]

becomes

\[ \frac{kS}{C_0} U_m > 2d \]

\[ U_m > \frac{1}{2} \frac{d}{a_2 \omega_0^2 \tau R_1 C_1 M S} \]  

(7)

Let us recall the meaning of the quantities contained in this formula: \( \omega_0 \) is the natural frequency of the tank circuit and equals \((LC_0)^{1/2}\), \( d \) is the damping of the tank circuit, \( a_2 \) is the coefficient of \( \alpha \) in the equation for the characteristic of the linear element of the ring modulator, \( R_1 \) is the modulator load resistance (remember that in design (4) we assumed this resistance to be small compared with the internal resistance of the modulator itself), \( r \) and \( C_1 \) are the feedback-loop resistance and capacitance (remember that \( rC_1 \) must be much less than \( 1/\omega_0 \)), and \( M \) is the coefficient of mutual inductance.

Equation (7) gives the input-voltage amplitude which the divider circuit goes into operation.

In the preceding analysis we attempted to use the most favorable feedback phase, and before used a suitable phase shifter in the feedback loop. This is not essential: the divider will also operate at different phase relationships, if a suitably increased input voltage must be used for the excitation. Practical circuits usually contain no special phase shifting networks.

Various versions of regenerative-divider circuits are possible. One modification of the circuit of Fig. 149 results in a divider operating at any desired frequency fraction.

If the feedback element is a multiplier with ratio \( n + 1 \) (Fig. 151), and if the input frequency is \( \omega_0 \), the output frequency is \( \omega \). The frequency of the output of the multiplier in the feedback loop is \( n + 1 \omega \).

Multiplication of the two frequencies \( n \omega_0 \) and \( (n + 1) \omega_0 \) produces the sum and difference \( n \omega_0 + (n + 1) \omega_0 = n \omega = \omega \), the latter being filtered and fed to the output.

Division by large factors is possible by other means, naturally, by cascading several dividers. The ratio of each divider is, say 1:2, the overall ratio is 1:2^m, where \( m \) is the number of cascades. This completes Electronic Design's serial translation of Professor Kharkevich's book. The complete translation will be available soon, in form from Hayden Publishing Company's Advanced Electronics Division. For more information turn to the Reader-Service Card and circle 800.)
Waveguide Flange Connections

Reflections which occur at flange connections of waveguide sections can be traced to several causes. The approximate formulas for the reflection factors caused by each of these individually, and in combinations, are summarized. The reflections at the flange connections of rectangular guides are caused by the following:

1. Two sections may have different cross-sectional dimensions due to manufacturing tolerances. This is the principal cause of reflections and cannot be eliminated by careful assembly.

2. Two sections with identical cross-section may be displaced (offset) parallel to each other.

3. Two sections with identical cross-section may be twisted with respect to each other, and/or the symmetry axes may be "kinked" with respect to each other.

The approximate formulas for the reflection factors due to these effects are given in the Table. The expressions for \( r_i \) are applications of the appropriate iris formulas and are experimentally confirmed. In the table \( a \) is the nominal shorter dimension of the guide, \( b \) is the width.

The effect of kink is negligible for \( a \geq 1 \), the reflection factor due to the several other causes occurring simultaneously can be estimated from the formula:

\[
F = \sqrt{r_i^2 + (r_i + r_o)^2}
\]


Phototransistor Action

Photoeffects at a p-n junction can be represented as an ideal current source. In the equivalent circuit of the photodiode, Fig. 1, the current source appears in parallel with a "dark" p-n junction in the region of operation where the photoelectric effect and the rectifying effect can be superposed.

The volt-ampere characteristics of a p-n photodiode is shown in Fig. 2 with light intensity as a parameter. Since, for \( v = 0 \) (short circuit), the p-n diode portion of the internal circuit has high back resistance, the contribution to the total current of the photoeffect is the short circuit current \( I_s \) at every light intensity. As indicated on Fig. 2, \( I_s \) is related to the open circuit voltage, \( v_o \), through the (dark) diode characteristics.

Two types of operation for the photojunction are distinguished, depending on whether the diode voltage is connected in the reverse or in the forward direction. These two situations correspond to operation in the first and second quadrant of Fig. 2 respectively.

Using the representation of Fig. 1, a phototransistor can be represented as the combination of a photodiode and an ordinary transistor by either Fig. 3 or Fig. 4.

In Fig. 3 the photoelement is on the collector side. Denoting the current amplification factor in the emitter configuration by \( a' \), the collector current \( I_c \) is given by

\[
I_c = (1 + a') I_{ph}
\]

(1)

In Fig. 4 the photoelement is on the emitter side and the collector current is

\[
I_c = a' I_{ph}
\]

(2)

Although Eqs. 1 and 2 appear very similar, the collector current in two cases, for equal light intensities, will be very different because the control...
Reflection Factors Due to Flange Connections

<table>
<thead>
<tr>
<th>Cause</th>
<th>Reflection factor (approx.)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cross-section: $a \times b$, joined $a + 2\Delta b$, $b + \Delta b$</td>
<td>$r_f = \frac{1}{2} \left( \frac{\Delta b}{b} - \frac{\Delta a}{a} \right) n^2 = 1 - \frac{(f_c/f)_{r_e}}{f_c}$</td>
<td>$\Delta g = \text{guide wave length}$</td>
</tr>
<tr>
<td>Active placement: loss sect. at angle: $a (b - d)$</td>
<td>$r_f = \frac{\pi^2}{2} \frac{b}{\lambda g} \left( \frac{d}{\lambda g} \right)^2$</td>
<td>$f/f_c = 1.5$</td>
</tr>
<tr>
<td>Passive placement: loss sect. at angle: $a (b - d)$</td>
<td>$r_f = \frac{\pi^2}{4} \frac{a}{\lambda g} \left( \frac{d}{\lambda g} \right)^2$</td>
<td>$r_{sh} = 0.15 a^2$</td>
</tr>
<tr>
<td>Reflected at angle $\alpha$ in $h$ plane</td>
<td>$r_f = \frac{1}{2} \sin^2 \alpha$</td>
<td>$r_{le} = 0.1 a^2$</td>
</tr>
<tr>
<td>Reflected at angle $\alpha$ in $E$ plane</td>
<td>$r_f = 0.15 a^2$</td>
<td>$r_{sh} = 0.15 a^2$</td>
</tr>
</tbody>
</table>

Abstracted from an article by A. Hoffman in Physik, Vol. 10, No. 9, Member 1958, pp 416-418.

Fig. 4. The combination of photodiode and transistor as used to represent a transistor with illuminated emitter side.

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in Diameter... very compact... reduces
the size of your equipment.

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noiseless... no rattling of gears or ratchets.

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can replace larger motors in recorders, con-
trols and telemetering equipment.

HIGHEST RELIABILITY...
Longer life... no one-way gears or ratchets
to fail... provides millions of operations
without any trouble.

PATENTS

Cathode Ray Character Tracer

Patent No. 2,872,669. Reynold B. Johnson,
William C. Dersch. (Assigned to Inter-
national Business Machines Corp.)

Three-dimensional flying spot tech-
niques are used to trace selected char-
acters on a monitoring oscilloscope.

The scanning light beam is generated
by CRT 21 and the light splits to pass
through slides 34, 26, and 30, contain-
ing line density patterns exemplified by 46,
and 47 respectively. Phototubes 32,
28, and 32 are excited to produce the
x and y deflection waveforms and the
intensity control signal. A typical trans-
mission pattern which produces the first
digit is shown. In a similar manner,
the slide may be coded and the scanning
adjusted to produce any chosen display.
Solid State Magnetic and Dielectric Devices

The authors present a complete account of the solid state devices and components with the exception of the transistor. The volume begins with a classical treatment of magnetization and polarization—the essential electric properties—and later shows the general application of these principles to electrochemical phenomena, to square loop material, and to microwave frequencies. The remaining papers are concerned with certain magnetic and dielectric devices.

The first four chapters present the main body of theoretical background: Electrostatic and Magnetostatic Field Theory, Origin of Magnetic and Dielectric Properties, Electrostrictive and Magnetostriuctive Systems, and Nonlinear Magnetic and Dielectric Materials. The succeeding seven chapters present specific applications of magnetic and dielectric devices: Electromechanical, Small Signal, Ferrites at Microwave Frequencies, Magnetic and Dielectric Amplifiers, Digital Techniques Employing Square Loop Materials, Magnetic Recording, Magnetic and Dielectric Measurements. Four appendices cover Reciprocity in Linear Systems, Tensor Dielectric Constant of a Plasma, Magnetic resistance, and Parametric Devices. Tables and an index supplement the volume, while each chapter is summarized in a preface.

**you’ll need help!**

If you earnestly feel the only way to get the kind of pots you need is to build ‘em yourself — a word of caution. Don’t start off alone — gather a few choice friends around to assist with the problems you might run into. There’s the little matter of metals engineering, plastics, contact engineering, chemical, metallurgy and other assorted engineering areas. Otherwise, you might never get through all these little details!

But don’t waste time putting your friends through engineering school — Ace has a staff of specialists and consultants all recruited for just such design problems! They save us — and in turn — our customers, needless concern over the stumbling blocks which may arise. So if a unique design solution to your pot requirements is what you’re after, don’t hesitate! See your ACErep!

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BOOKS

**Magnetic Amplifier Engineering**

Presented in the language of the electronic circuit and systems engineer, this volume offers guidance on theory, operating principles, and practical application of all types of magnetic amplifiers. Basic information on electric and magnetic variables is given and their interrelation through the questions of Faraday and Oersted are described. Special characteristics of the magnetic amplifier reactor are clearly discussed, and the magnetic amplifier reactor is contrasted with the performance of the linear inductor.

Against this background the various types of amplifiers are analyzed. A consistent analytical method applicable to all types of magnetic amplifiers is presented and specific types are treated from the same general basis.

Special topics not previously covered in a work of this kind include: hybrid circuits, bidirectional output amplifier, volt-

**Symbolic Logic and Intelligent Machines**

The principles, methods and purposes of symbolic logic and Boolean algebra, on which the programming of intelligent machines is based, are explained in a practical manner. Answers to basic questions toward ideas and terms needed to understand the subject as a whole are logically developed. The material of symbolic logic abounds in comparisons and examples, as does the discussion of intelligent machines. The design and principles of both small and large machines are included, along with specific problems that confront these machines.

The role of symbolic logic in the programming of automatic computers as such complex devices as robots complete this volume.

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photo courtesy Ace Electronics, Somerville, Mass.
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in resistance element for one complete sweep of wiper than in conventional pots, for more accurate trimming.

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eliminates expansion-contraction effects to give exceptional thermal stability.

5 **MACHINED ALUMINUM CASE**  
with superior heat dissipating characteristics also contributes to high power ratings over extremely wide temperature ranges.

### ELECTRICAL

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature coefficient of potentiometer</td>
<td>50 ppm/°C max. 0° to 100°C</td>
</tr>
<tr>
<td>Stability (as voltage divider)</td>
<td>0.2% or 1 resolution max.</td>
</tr>
<tr>
<td>Load life at rated power</td>
<td>1000 hrs. min. per MIL-R-19A</td>
</tr>
<tr>
<td>Insulation resistance</td>
<td>50 megohms min. (500 v. DC)</td>
</tr>
<tr>
<td>Dielectric strength</td>
<td>500 v. AC, 1 minute</td>
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</table>

### ENVIRONMENTAL

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shock</td>
<td>30 shocks, 30g, MIL-STD-202, Method 202</td>
</tr>
</tbody>
</table>
### Subminiature Trimming Potentiometers

<table>
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<tr>
<th>Resistances Ohms ±5%</th>
<th>Power Rating (Watts)</th>
<th>Maximum Operating Temp.</th>
<th>Typical Resolution (50K)</th>
<th>Humidity Version Available</th>
<th>Size</th>
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<tbody>
<tr>
<td>10Ω to 50K</td>
<td>1.0</td>
<td>150°C</td>
<td>0.086%</td>
<td>Yes</td>
<td>1/2 x 1/2 x 0.187</td>
</tr>
<tr>
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<td>1.0</td>
<td>150°C</td>
<td>0.086%</td>
<td>Yes</td>
<td>1/2 x 1/2 x 0.255</td>
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<tr>
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<td>1.5</td>
<td>150°C</td>
<td>0.070%</td>
<td>Yes</td>
<td>3/4 x 3/4 x 0.280</td>
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<tr>
<td>20Ω to 1 meg.</td>
<td>0.5</td>
<td>85°C</td>
<td>Infinite</td>
<td>No</td>
<td>1/2 x 1/2 x 0.187</td>
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<td>200°C</td>
<td>0.086%</td>
<td>Yes</td>
<td>1/2 x 1/2 x 0.187</td>
</tr>
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<td>140°C</td>
<td>0.14%</td>
<td>Yes</td>
<td>0.32 x 0.28 x 1.25</td>
</tr>
</tbody>
</table>

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For more information, including all environmental specifications, circle No. 500 on inquiry card for Trimmer Data File.
Circle No. 501 for Subminiature Potentiometer Data File.
Circle No. 502 for Data File covering both Trimmers and Subminiature Potentiometers.
Electromechanical Energy Conversion


The authors start from the fundamentals of analytical dynamics to establish a sound base for understanding the interactions in an electromechanical system. These fundamentals are then used to analyze typical energy converters. The essential concepts of electromechanical energy conversion are illustrated by the analysis of several simple transducers. In recognition of the importance of dynamic behavior in system design, this book favors thorough treatment of dynamic characteristics of energy converters, feedback control system theory, and their interrelations.

To illustrate and utilize the unity that exists in the analysis of machines, a two-dimensional model of an electric machine, classified as the generalized machine, is developed and its equation of motion derived and used in all the machine analyses later chapters. The technique of applying constraints to general dynamic equations is used in a detailed treatment of the dynamics of commutator machines, induction machines, and synchronous machines.

The Physics of Electricity and Magnetism


This book provides a thorough explanation of the basic theory of electricity and magnetism, treated in a rigorous manner from the viewpoint of a physicist. The author uses a modern atomic approach to describe phenomena such as metallic conduction and the production of chemical and thermal emfs. The analysis of magnetic fields starts with the Lorentz force law, and Maxwell's equations are introduced as a part of the text, with a chapter at the end on their applications. Concepts are presented one at a time, and each is developed with examples before the next is introduced.

The fully descriptive yet mathematical treatment (using vector notation and intermediate calculus) serves as a smooth transition to more advanced work in physics.

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<table>
<thead>
<tr>
<th>Vce</th>
<th>Ic</th>
<th>Pd</th>
<th>Tstg</th>
<th>Tj</th>
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</thead>
<tbody>
<tr>
<td>7.0V</td>
<td>0.15A</td>
<td>200mW</td>
<td>-65°C to 150°C</td>
<td>150°C</td>
</tr>
<tr>
<td>700mW</td>
<td>0.18A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.0V</td>
<td>0.15A</td>
<td>200mW</td>
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<td>700mW</td>
<td>0.18A</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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BOOKS

Electrical Measurement Analysis

The purpose of this book is to develop in the student the attitudes and comprehension necessary for the analytical solution of problems arising in electrical measurements. Methods, concepts, and analysis techniques are emphasized. With a minimum of qualitative material, the material has been selected to illustrate basic measurement concepts, while omitting many specific topics.

Methods of measurement are classified into two major categories: null and deflection methods. Illustrations in each category are developed in mathematical detail. Special attention is given to ideas of measurement errors and their statistical treatment. Particular attention is given to the compensation theorem. Error-analysis techniques are emphasized in the treatment of ohmmeters, potentiometers and bridges. Square-wave response of galvanometers is analyzed from both a steady-state and transient point of view.

Topics covered in detail include statistics and errors; fundamental forces and from a modern viewpoint, and the relationship between force and field equation treatment of data with emphasis on line graphs as an analysis tool; and techniques of error analysis. Problems are grouped at the end of each chapter and answers are given at the end of the book.

Electronic Digital Computers

A comprehensive picture of the basic principles embodied in the computer machines in use today is presented in this book, which provides the reader with a sound and thorough account of what electronic digital computers are and how they function.

From the treatment of the basic logic and arithmetic notions to the discussions of the circuits and devices by which the basic functions are physically realized, an
The description of the major units of a representative machine, everything important to the form and function of electronic digital computers is taken up here.

**Dictionary of Guided Missiles and Space Flight**


This dictionary defines and explains the most commonly used terms in the guided missile and space flight fields today. Reflecting the work of leading professionals, it combines their endeavors to facilitate the establishment of a common language in the selected field by offering a comprehensive vocabulary of commonly used terms.

Terms defined include current and historical guided missiles and spacecraft; major systems used for guidance and control; propulsion, armament and launching; and all related terms from aerodynamics, astrodynamics, electronics, astronomy and physics. Included are terms for types of antennas, circuits, radar systems, propellants, as well as the important laws, relationships, equations, and environments and concepts which govern utilization in design.

Illustrations and discussions are provided for important terms. A comprehensive cross-referencing plan is included.

**The Theory and Design of Magnetic Amplifiers**


This book is the first of a series on Automation and Control Engineering, which is planned to cover as comprehensively as possible this wide field in the most economical way for the control engineer. The aim of the first volume is to give an account of the theory of magnetic amplifiers and to link up the theory with the design in a way which it is hoped will be of value not only to the professional engineer, but also to the university student. Many of the theoretical aspects are supplemented by short numerical examples and, in addition, a number of complete designs are carried out in one chapter. Some typical problems to which magnetic amplifiers have been applied successfully are discussed in another chapter. A list of principal symbols is contained in the preface.
**REPORT BRIEFS**

**Radio Interference**

The purpose of this memorandum is to examine some of the consequences of radio interference for the operator. By knowing what these consequences are one can be prepared to understand the penalties for not adequately solving interference problems. The principal conclusion to be reached is that the penalties of letting an operator cope with the results of radio interference are sometimes much greater than design engineers recognize. Detection of Aircraft by Radars Subjected to Radio Interference, John D. Coakley, Dunlap and Associates, Inc., Stamford, Conn., May 57, 15pp, Microfilm $2.40, Photocopy $3.30. Order PB 135 738 from Library of Congress, Washington 25, D.C.

**Design of Shaped Response Microwave Filter**

An array of microwave filters was designed and developed to provide instantaneous frequency indication over the 8000 to 10,000-mc band. The range is covered with sinusoidal functions of frequency about their center frequencies. The bandwidth of each filter is 220 mc from zero to zero. The filter is composed of cascaded LC-coupled cavities separated by 1/4 connecting lines. Design of Shaped Response Microwave Filter, W. R. LePage and A. T. Villeneuve, Syracuse U. Research Inst., N. Y., May 31, 1956, 106 pp, Microfilm $5.70, Photocopy $16.80. Order PB 135376 from Library of Congress, Washington 25, D.C.

**A Ferrite Rod Antenna**

The radiation characteristics at X-band of a ferrite rod antenna are studied. The antenna consists of a ferrite rod supported axially in a circular waveguide which is terminated in an infinite ground plane. The rod extends out of the waveguide above the ground plane. Radiation patterns as a function of dc biasing magnetic field on the ferrite are shown for both linearly and circularly polarized energy propagating in the TE_{11} mode in a circular waveguide and continuing on the extending ferrite rod. A Ferrite Rod Antenna, A. B. Johnson and D. J. Angelakos, Electronics Research Lab., U. of California, Berkeley, 13 Aug 57, 25pp, Microfilm $2.70, Photocopy $4.80. Order PB 135 099 from Library of Congress, Washington 25, D.C.

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CIRCLE 81 ON READER-SERVICE CARD

ELECTRONIC DESIGN • June 24, 1958
Self-Adjusting Control System

Application of a self-adjusting procedure to a control system with Gaussian random inputs and subject to limiting is considered. A self-adjusting control system is defined as a feedback control system which is capable of adjusting on its own compensation (by means of an external computer) in accordance with some criterion, here assumed to be the minimization of the system mean-square error. The purpose of such adjustment is to provide partial compensation for variation in the parameters of the controlled component and for variations in the statistics of the input. Self-adjusting Control System, Robert R. Barmsfather, Instrumentation Lab., Mass. Inst. of Tech., Cambridge, May 56, 53pp, Microfilm $3.60, Photocopy $9.30. Order PB 155 698 from Library of Congress, Washington 25, D.C.

Stabilization of Computer Circuits

The objective of this study was the elimination of reduction of time dependence of output errors in continuous computers by use of special circuitry which would generate correcting factors as functions of the errors. A general theory of stabilizing circuits was formulated and applied to the functions of the harmonic oscillator and the direction cosine generator. It was proved analytically that a stabilizing circuit would bring marked improvement in the generation of these functions. The result was demonstrated experimentally in both cases. Stabilization of Computer Circuits, E. Hochfeld, University of Chicago, for Wright Air Development Center, U.S. Air Force, Nov. 1957, 39 pp, $1.00. Order PB 151255 from OTS, U.S. Dept. of Commerce, Washington 25, D.C.

Regulated Power Supply

A careful study of power supplies with the aim of developing a standard series of unitized regulated power supplies has shown that all the characteristics of a regulated power supply may be predetermined by circuit design and/or analysis. The study also showed that few present power supply designs will meet present-day general-use requirements completely. The report presents methods of analyzing and testing power supply characteristics. These methods are intended to serve as a basis for further work in the design of a family of standardized power supplies Regulated Power Supply Analysis And Design, W. Ellis, J. P. Ward and D. M. Lowe, Naval Electronics Lab., San Diego, Calif., Mar. 4, 1957, 103 pp, $2.50. Order PB 151121 from OTS, Washington 25, D.C.
You can count on Couch relays to measure up whenever the ultimate in reliability is demanded under severe environmental conditions. A unique, patented, rotary armature design, and exacting quality control procedures are but two of many reasons why the Couch family of relays meets or exceeds the requirements of MIL-R-5757, MIL-R-6106, and MIL-R-25018.

STANDARDS AND SPECS

Sherman H. Hubelbank

Nickel Oxide

NBS 673, Nickel Oxide

A new sample of nickel oxide powder is now available from the National Bureau of Standards. Analyzed and certified for nine minor and trace elements, the standard is intended for checking and calibrating spectrochemical and chemical methods employed in the analysis of high-purity nickel, particularly electronic grade and electrolytic nickel. The nickel oxide standard is packaged in bottles containing 25 grams and is available from the Standard Sample Clerk, National Bureau of Standards, Washington 25, D.C. The fee is $8.00 per bottle.

Antenna Gain

TECHNIQUES FOR ACCURATE MEASUREMENT OF ANTENNA GAIN

Methods described in this publication are primarily for use in the band of 300 to 400 mc. Copies of this 10-page bulletin are available from the Government Printing Office for 15 cents each. Request Catalog No. C134:598.

DOD Technical Documentation

PROVISIONING TECHNICAL DOCUMENTATION, DEPARTMENT OF DEFENSE SEMINARS

A collection of the keynote address, remarks, and presentations given to acquaint Department of Defense contractors with the new uniform provisioning documentation requirements established by Department of Defense Instruction 3232.7. This instruction is included at the end of the publication. Copies of the 194-page publication are available from the Government Printing Office for $1.00. Order Catalog No. D42:665.

Components

PREFERRED PRECISION INSTRUMENT COMPONENTS

Describes preferred instrument components and illustrates their major characteristics. These components were developed for the Bureau of Ordnance primarily for fire control instruments, and computing and navigational systems, as well as for missiles. Copies of this 288-page publication are available from the Government Printing Office for $4.75. Order Catalog No. D2159:1755.
Markings
MIL-STD-130A, IDENTIFICATION MARKING OF UNITED STATES MILITARY PROPERTY, 8 September, 1958

The item marking requirements for identification purposes are established by this standard. The markings are required for stocking and replacing of parts, subassemblies, assemblies, units, sets, and all other items of supply.

Canadian Standards
The 1959 issue of the CSA List of Publications has just been published. All currently available CSA standards are listed according to subject. In addition, publications of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) are listed. Copies of this list are available without charge from the Canadian Standards Association, 235 Montreal Road, Ottawa 2, Canada.

Airborne Radio
Minimum performance standards for the following were issued by the Radio Technical Commission for Aeronautics on February 10, 1959:
226-58/DO-92, AIRBORNE LOBAN A RECEIVING EQUIPMENT OPERATING WITHIN THE R-F RANGE OF 1500-2000 kc (Price 30 cents per copy)
26-59/DO-94, PORTABLE AIRCRAFT EMERGENCY COMMUNICATIONS EQUIPMENT OPERATING WITHIN THE R-F RANGE OF 118 TO 290 mc (Price 30 cents per copy)
25-59/DO-93, AIRBORNE SELECTIVE CALLING EQUIPMENT (Price 30 cents per copy)

Copies of these publications may be obtained from Radio Technical Commission for Aeronautics, Room 1072, Building 7-5, 16th & Constitution Avenue, N.W., Washington 25, D.C.

Transformers and Inductors
MIL-T-27A, TRANSFORMERS AND INDUCTORS (AUDIO, POWER, AND PULSE) AMENDMENT 2, 2 JANUARY 1959
The criteria for self-extinguishing tests for flammability are now defined. The definition for working voltage has been revised to read: The working voltage is defined as the maximum instantaneous voltage stress that may appear under the normal rated operation across the insulation being considered. This insulation may be between windings or between windings and the core or case. A higher dielectric strength test potential for individual windings may be used, if so specified by the manufacturer, to simplify testing procedures at sea level and high altitude. The high-altitude dielectric strength test potential for units rated less than 50 working volts is now specified as 100 v.
NEW LITERATURE

Connectors

The DS series of miniature electrical connectors with snap-in contacts and crimp-type terminations are described in the DS catalog. Detailed instructions on contact crimping, insertion, and removal are also covered. The Deutsch Co., 7000 Avalon Blvd., Los Angeles 3, Calif.

Transistors

Brochure G-100 describes custom quality transistors for original equipment manufacturers. It is a four-page, illustrated folder with a chart insert having tabulated specifications on the firm's most popular EIA-registered transistor types. The chart shows case style, polarity, and gives detailed data on cut-off characteristics, dc and switching characteristics, and small signal characteristics of each numbered type shown. Types are grouped by classification and identified by name in an application cross-index. General Transistor Corp., 91-27 138th Place, Jamaica 35, N.Y.

Instrument Components

Master catalog #20, 416 page catalog consolidates 41,000 components and accounts and describes more than 60,000 items, including gears, shafts, collars, coupling, speed reducers, differentials and other precision items available from stock. Also included are detailed drawings, complete specifications and prices. PIC Design Corp., Atlantic Ave., East Rockaway, L.I., N.Y.

Magnet Wire

High temperature ceramic insulated magnet wire for service up to 1000°F is described in this eight-page brochure. The brochure contains basic information on the original research as well as recent engineering data. Included in the brochure are the electrical insulation values of the various types of insulation available at elevated temperatures. The brochure contains charts and diagrams. See Metals Corp., 7 Intervale St., White Plains, N.Y.

NEW! HI-POWER COAXIAL CALORIMETRIC POWER METER

Such meters are greatly simplified Calorimeters which use water to carry the heat away, for economy of space and cost. The instrument is fully self-contained, portable, water cooled and requires only connection to the power line and water supply. It does not use any flow meters, thermometers or any other controls. There is only the "ON" and "OFF" switch for the operator to use on the front panel, when a measurement is to be made. A sensitive thermometer and microamperemeter measure the power dissipated in the load. The microamperemeter is calibrated in watts, is direct reading and can be remotely located.

The radio frequency load has a low VSWR between DC to 1000 MC. This feature makes it possible to calibrate this instrument at 60 cps against an accurate laboratory wattmeter, and then use it at any frequency up to 1000 MC. Thus an accuracy of 2% can be easily accomplished. This recalibration is necessary only when measurements are made at extreme temperatures or when wear is suspected.

This calorimeter is particularly recommended for field service where a rugged and yet accurate Power Meter is required for use by unskilled personnel.

<table>
<thead>
<tr>
<th>Model</th>
<th>Power Rating</th>
<th>Connector</th>
<th>Max. VSWR</th>
<th>Water Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>CK-5</td>
<td>5 kW</td>
<td>1-1/4&quot;</td>
<td>1.3</td>
<td>15 G.P.M.</td>
</tr>
<tr>
<td>CK-10</td>
<td>10 kW</td>
<td>1-3/8&quot;</td>
<td>1.3</td>
<td>6 G.P.M.</td>
</tr>
<tr>
<td>CK-20</td>
<td>20 kW</td>
<td>1-3/8&quot;</td>
<td>1.3</td>
<td>6 G.P.M.</td>
</tr>
<tr>
<td>CK-50</td>
<td>50 kW</td>
<td>6-1/4&quot;</td>
<td>1.3</td>
<td>15 G.P.M.</td>
</tr>
</tbody>
</table>

WRITE FOR COMPLETE INFORMATION

ELECTRO IMPULSE Laboratory

208 River Street • Red Bank, New Jersey • Phone: 544-1004

CIRCLE 95 ON READER-SERVICE CARD
Iron-Nickel Alloys

Entitled "Directory of U.S. Producers of the Iron-Nickel Alloys," this booklet is designed to help those with the responsibility of obtaining information on, or procurement of, the iron-nickel alloys where their end-use depends on special thermal expansivity, thermo-elastic or special magnetic properties. It lists compositions, manufacturers, and forms available to industry. The International Nickel Co., Inc., Readers Service Section, 67 Wall St., New York 5, N.Y.

CHP Motors

A wide range of fractional horsepower geared motors, turntables, transmissions and cup dispensers are illustrated and described in a series of bulletins being distributed in a file folder. Complete specifications and dimensional drawings are included. Merkle-Korff Gear Co., 213 North Main St., Chicago 7, III.

Square-Loop Tape Cores

These three engineering bulletins provide a complete set of data on the firm's square-loop tape cores for magnetic amplifiers and specialty transformers. Performance characteristics are given in bulletin No. DN-2000. Standard core sizes are in bulletin No. DN-2001, and magnetic characteristics of standard cores plus other technical data are given in bulletin No. DN-2002. Dynacor, Inc., 10431 Metropolitan Ave., Kensington, Md.

Inertia Switches

In four pages this catalog covers a new operating principle used in the design of the firm's inertia switches. Pictorial material, descriptive text, electrical characteristics and application information are included in the catalog. Inertia Switch, Inc., 311 West 43rd St., New York 36, N.Y.

Time Delay Relays

Bulletin AWH TD-501 describes a precision time delay relay for military applications. Included in the bulletin are illustrations, applicable military specifications, wiring diagram, and outline and mounting dimensions. The A. W. Haydon Co., Waterbury, Conn.

TYPE U general-purpose low cost power relay. Single coil construction, box-type magnetic field, movable contact springs. Contact forms from 1C to 5C. For AC or DC.

rugged power relay

sensitive

Type TQA is a compact efficient relay, ideal for DC operation at 20 to 100 milliamps. Sensitivities. Hermetic sealing available. Send for details and free Comar catalog.

MASSA METERITE

THE FIRST MODULAR 2 Channel
PORTABLE RECORDING SYSTEM

Outstanding Features

- INTERCHANGEABLE PLUG-IN PREAMPLIFIERS — Low, Medium, High Gain DC; AC; Chopper; Carrier and Servo
- EXTENDED FREQUENCY RANGE — Full Scale Amplitude to 100 cps. Reduced Amplitudes to 200 cps available
- RECTILINEAR MOTION — Free of Curvilinear Distortion
- 6 CHART SPEEDS — Covering the Range .5 to 200 mm/sec
- INK OR ELECTRIC WRITING — Ink, using hermetically sealed disposable ink cartridges. Electric, using auxiliary power supply and electric stylus
- TRANSISTORIZED DRIVER AMPLIFIERS — Differential and Single Ended
- LIGHTWEIGHT — Approximately 35 lbs.

Multi-Channel Systems Are Also Available
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CHICAGO 18, ILLINOIS

RELAYS • SOLENOIDS • COILS • SWITCHES • HERMETIC SEALING

CIRCLE 115 ON READER-SERVICE CARD
NEW LITERATURE

Control Relays 118
Bulletin 4470, four pages, describes multi-pole solenoid type HR industrial control relays. Features, applications and design features are covered. Technical data is provided in a table and dimensions of the units are given. Ward Leonard Electric Co., 115 MacQuesten Parkway South, Mount Vernon, N.Y.

Electrolytic Capacitors

Wires And Cables
The color coding of the following types of wires, cables and cords is included in publication WC-1959: asbestos, asbestos-varnished cloth and asbestos-thermoplastic insulated wires and cables; textile coverings for flexible cords; and POS1 flexible cords; rubber-insulated wires and cables. Send 80.30 to National Electrical Manufacturers Association, 155 East 44th St., New York 17, N.Y.

DC Motors
In six pages data sheet 107-1 covers the firm's line of aircraft, missile and ordnance dc motors. All electrical and physical data is provided in tabular form and pictures of the motors are included. Schematic drawings of the units and special motor designs are described. Lee Electric, Inc., Grand Rapids Div., 110 Jonathan Ave. N.W., Grand Rapids 2, Mich.

Thermocouple Wire

This catalog describes a new line of thermocouple wire. The 4-page, illustrated bulletin presents in tabular form an all new line of the most commonly used wires with respect to gauge, type, color coding, and insulation combinations available. Harco Laboratories, Inc., Olive St., New Haven, Conn.
Transistor Data 123

Voltage breakdown, the major cause of transistor failure, and leakage currents are discussed in Transistor Kinks, Vol. 1, No. 1, four pages. Five types of voltage breakdown and their effects on transistors are discussed. Three leakage currents, which are closely related to breakdown voltage are also defined and covered. Valco Instruments, Inc., 13214 Crenshaw Blvd., Gardena, Calif.

Components 124

This four-page brochure covers taphasum capacitors and micro-miniature relays. Called Easy Guide To The Selection Of GE, it lists capacitors in numerical sequence in microfarads, provides a five-step guide in the selection of relays, and includes legend, case sizes and tolerances.

Schweber Electronics, 60 Herricks Rd., Mineola, L.I., N.Y.

Resistors 125

Catalog sheet DC8 describes the firm's Multi-Range resistor line. These resistors have four separate 10 w wirewound resistors all encased in common steatite housing. The complete line comprises only five basic units, but provides 200 fixed resistance values. Pictures, prices and a tabulation of the units available are covered. International Resistance Co., 401 North Broad St., Philadelphia 8, Pa.

Differential DC Amplifier 126

Model 114A differential amplifier is discussed in this two-page data sheet. Descriptive material, operating characteristics, circuit description and the unit's specifications are included. Cohu Electronics, Inc., Kin Tel Div., Box 623, San Diego 12, Calif.

Metal Stampings 127

Lugs, clips, terminals, and hundreds of other standard parts are illustrated in sketches and plan drawings in this 58-page catalog. Small metal parts offered are hot-tinned for easy soldering. Special parts can also be hot-tinned to reduce soldering costs and insure a satisfactory bond. Zierick Mfg. Corp., 110 Beechwood Ave., New Rochelle, N.Y.

JENNINGS VACUUM RELAYS AND CAPACITORS

...when reliability counts

Jennings Vacuum Relays and Variable Capacitors play an important role in the Air Force's "Project Sideband," aimed at constant radio contact on intercontinental missions.

The high standards of reliability and performance required by the Air Force were more than met by Collins Radio Company's new 1 kw SSB system for "Project Sideband." The airborne end of the system, designated ARC-58, includes an automatically tuned antenna coupler. Jennings vacuum relay, RB3, and vacuum variable capacitor, USLS 465, are used in the coupler to match the 52 ohm impedance of the equipment with the antenna.

Jennings vacuum components were chosen for their recognized ability to withstand high voltage in limited space applications. The Type RB3 vacuum transfer relay is designed to meet peak voltages of 15 kv and rf currents to 15 amps yet it is only 3½ inches long. The relay also has an auxiliary set of low voltage contacts for control purposes designed to operate after and release before the high voltage set. The Type USLS 465 is only 5 inches long and will withstand 10 kv at its minimum capacity of 5 mmfd and 5 kv at its maximum capacity of 465 mmfd. Both units will withstand 10G vibration to 500 cycles, 30G shock, and 50 hours salt spray.

Send for catalog literature on Jennings complete line of vacuum capacitors and relays.

JENNINGS RADIO MANUFACTURING CORPORATION
970 McLaughlin Ave., P. O. Box 1278, San Jose 8, Calif.
Where only the best is good enough...you'll see

electronic instruments

In basic electronic instruments for lab or test work, less than the best may be a dangerously bad bargain. Unexpected limitations — of reliability, range, precision — can throw out weeks of work on today's jobs, and can make tomorrow's tougher jobs untouchable.

The best instrument of its type is probably a bit more expensive, but it's worth buying...because you can believe in it today, and will rely on it tomorrow. An example is the Krohn-Hite Model 440-A wide range push-button oscillator illustrated here.

Exactly because K-H instruments are good enough even for tomorrow's most critical work, they are increasingly chosen today where true reliability and precision are needed.

Oscillators — .001 cps to 520 kc, dial or push-button tuning, less than 0.1% distortion, sine wave and square wave outputs.

Power Supplies — zero to 600 volts dc, zero current to 1 ampere, regulation .001%, ripple less than 100 µv, internal impedance 0.1 ohm to 100 kc.

Power Amplifiers — 10 to 50 watts, dc to 1 mc, transformer or direct coupled, 0.005% distortion.

Tunable Electronic Filters — variable from .01 cps to 200 kc, band pass, band rejection and servo types.

Write for your free copy of the new Krohn-Hite Catalog

Krohn-Hite CORPORATION
580 Massachusetts Avenue,
Cambridge 39, Mass.

NEW LITERATURE

Midget Screw Lampholders 131

A data sheet describing Tinylite midget screw lampholders is now available. It gives full details about lamp sizes, availability of both soldered terminals and wire leads, suggested brackets for specific uses, and lampholder dimensions. Drake Mfg. Co., 1711 W. Hubbard St., Chicago 22, Ill.

Magnetic Recorder-Reproducer 132

The specifications, operational characteristics and design features of the new Mincom 7-track Video Band Magnetic Recorder/Reproducer are described in this 2-color, 4-page brochure. The bulletin includes color photographs of actual oscilloscope traces, calibrated in micro-seconds per centimeter, showing the equipment's quality reproduction of transient phenomena occurring at frequencies from 400 cycles to one megacycle. Minnesota Mining & Mfg. Co., Mincom Div., 2049 S. Barrington Ave., Los Angeles 25, Calif.

Magnetic Core Storage Products 133

Specifications for standard ferrite core and core product lines are included in the condensed illustrated catalog, SL-106. The four-page brochure describes ferrite storage and switch cores, core arrays, sequential and conversion types of core storage buffers, transistorized computer memory modules, and Data Translators designed to provide compatibility between data systems utilizing different codes and formats. Telemeter Magnetics, Inc., 2245 Pontius Avenue, Los Angeles 64, Calif.

Switch-Indicator Devices 134

"Series 2 Lighted Indicator and Pushbutton Switch Devices" is the title of Catalog 67, 20 pages. The catalog describes units which were designed for efficient control panels. Split pages allow quick selection and comparison of the operator units, indicator units and switch units in the new series. Dimensional drawings, photographs and technical information are provided. Micro Switch, Division of Minneapolis-Honeywell Regulator Co., Freeport, Ill.

Coaxial Cables, Connectors 135

Complete data on Spir-o-line coaxial cable and Spir-o-lok connectors is included in catalog 591. The catalog, which also includes related transis-
A flexible RF cable that will operate continuously at 1000°F is ready now for missile, aircraft, spacecraft and other ultra-high temperature applications. Capable of short time excursions to higher temperatures, the cable is a sealed RF transmission system complete with connectors. It is available in standard lengths up to 200 feet.

Delivery: Three to four weeks!

**DATA**

- Altitude Insensitive—Moisture Resistant
- Resistant to Shock and Vibration
- Resistant to Nuclear Radiation
- Connectors: Series N, C and SC
- Impedance: 50 Ohms
- Capacitance: 30.0 µf/ft.
- Velocity of Propagation: 69.0%
- Voltage Breakdown: 3500 Volts RMS
- Maximum Operating Voltage: 1000 VRMS
- Weight: Cable, 17.5 pounds per 100 feet
- Connectors, 2½ ounces each

**AMPHENOL CABLE & WIRE DIVISION**

South Harlem Ave. at 63rd St., Chicago 38, Illinois

- □ Send additional engineering information.
- □ Have AMPHENOL Representative contact me.

**NAME:**
**TITLE:**

**COMPANY:**
### PHYSICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>CONSTRUCTION DETAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inner Conductor</td>
<td>Stranded coated oxygen-free, high-conductivity copper wire.</td>
</tr>
<tr>
<td>Cable Core</td>
<td>Modified semi-solid silica.</td>
</tr>
<tr>
<td>Outer Conductor</td>
<td>Single braid, AWG size 32 coated oxygen-free, high-conductivity copper wire.</td>
</tr>
<tr>
<td>Jacket</td>
<td>Flexible special metal alloy. Nominal overall diameter: .525&quot;.</td>
</tr>
</tbody>
</table>

### FLEXING CHARACTERISTICS

Cable can be bent on a 10X mandrel (bend diameter = 10X diameter of cable). Cable dielectric shows no deterioration after 30,000 cycles of bending over 10X mandrel in accordance with specification MIL-C-915.

---

**ATTENUATION VS. FREQUENCY AT ROOM TEMPERATURE, 700°F AND 1000°F**

**ATTENUATION VS. TEMPERATURE AT VARIOUS FREQUENCIES**

**AMPHENOL**

CABLE & WIRE DIVISION

Chicago 38, Illinois

A Subsidiary of C. W. Elektronik Corporation
Measure to within ±0.01 C from −190 to +500 C

with L&N's Type G-2 Mueller Bridge

When used with the L&N 8163 Platinum Resistance Thermometer, this Type G-2 Mueller Bridge provides a standard of temperature throughout the range of −190 to +500 C with an accuracy in ohms equivalent to ±0.01 C.

Available in the advanced research laboratory, the G-2 facilitates the making of a variety of highly accurate temperature measurements... of specific heats; of boiling and freezing points of many chemicals; and in calorimetry, for the precise determination of heats of combustion of coals, gases, oils, etc.

LIST NO.—8069-B TYPE G-2 MUELLER BRIDGE, normally available for immediate delivery.

Measuring Arm—0 to 111.111 ohms in steps of 0.0001 ohm.

Constant Temperature Chamber—With thermostatically controlled heater; wide resistors of measuring circuit constant within ±0.01 C at about 0 C.

Melia Arms—1,000 ohms each. Adjustable in equality.

Millimeter—Range 0 to 5 ma. Indicates current in the resistance thermometer.

Limit of Error—Within a few ten thousandths of an ohm or a few parts in a hundred thousand, whichever is larger, divided bridge and resistance thermometers are calibrated in terms of same resistance unit at six-month intervals.

Case—Polished mahogany with cover; 4”(h) x 21¼”(w) x 13”(d).

Price $87.60.00 f.o.b. Phila. or North York, Pa. (subject to change without notice). Specify List No. 8069-B when ordering from L&N, 4908 Stenton Ave., Phila. 14, Pa. or nearest L&N office.

Multistylus Recorder

Bulletin A-100 describes the theory, application and specifications of the new model 3-100A Radicorder multistylus recorder. The 8-page brochure details the basic theory of fixed-styl pen recording technique and electro-sensitive chart characteristics. It shows actual applications in data systems as a quick-look monitor, high-speed digital printer, and data editor. Operating characteristics and construction details are illustrated. Radiation, Inc., Melbourne, Fla.

Recorders and Controllers

Spec. Sheets 51-1102C1 to 5 describe a line of electronic circular chart flow rate recorders and controllers. Included are operating specifications, mounting information, and performance characteristics. Fischer & Porter Co., 846 Jacksonville Road, Hatboro, Pa.

Antenna Calculator

An improved version of Gabriel's original "Antenna Calculator" has been developed to simplify computations for determining the parabolic antenna parameters for microwave antenna systems. The calculator scales include frequency, wavelength, beamwidths, gain, return loss, vswr, windloading, focal length, and other scales relating to parameters for parabolic antennas. A spectrum scale has also been included for band designation and frequency bandwidth. The calculator costs $2.00. Gabriel Electronics Div., The Gabriel Co., Dept. ED, 135 Crescent Road, Needham Heights, Mass.

Wires and Cables

In six pages this condensed catalog lists coaxial cables, military hookup wire, multi-conductor cables, appliance wire, miniature and audio wires and cables, high voltage and frequency wires, antenna loop, rvc-300 apparatus and annunciator (bell) wire, also television transmission lines—primary and secondary lead-in cable, "paralleled" and "airspaced" lead-in wire and TV rotor cable. These cables are available in a variety of conducting, insulating, jacketing, shielding and armorizing materials. Chester Cable Corp., Oakland Ave., Chester, N. Y.

Circuit Breaker Catalog

Electrical characteristics, dimensions and pictures are provided in this 8-page catalog on high rupture capacity, miniature and commercial type circuit breakers. Wood Electric Co., 244 Broad St., Lynn, Mass.
CIRCLE 144 ON READER-SERVICE CARD

STATHAM P285TC
Oil-Damped Pressure Transducer

This new, extremely rugged oil-damped miniature pressure transducer easily survives the step function pressures and blast pressures of rocket engine environments. Measures pressures from 0-50 to 0-1000 psi with the infinite resolution, accuracy and reliability of unbonded strain gage instruments. Absolute and gage models.

Write for Data File ED-603-1.

STATHAM INSTRUMENTS, INC.
12401 West Olympic Boulevard
Los Angeles 64, California

CIRCLE 499 ON READER-SERVICE CARD

STATHAM P10
Pressure Transducer

In automatic transmission pressure tests run by one of the world's leading auto manufacturers, this rugged pressure transducer has outlived engine after engine throughout more than two years of 24-hour-a-day test operation. Built to stand rough handling and mechanical overload in many applications, the P10 affords the accuracy, reliability and infinite resolution of an unbonded strain gage instrument.

Write to Dept. ED-604-1

STATHAM INSTRUMENTS, INC.
12401 West Olympic Boulevard
Los Angeles 64, California

NEW LITERATURE

Counting Units

This 4-page Bulletin, illustrates and describes Sodeco Single-Decade Counting Units. In addition to giving the usual construction and electrical data, the bulletin describes the various auxiliary contacts and executions which make possible the use of these counters in the solution of a wide variety of counting, telemetry and automation problems. Some typical schematics are given showing applications including forward counting, subtraction, predetermined counting, transmission of numbers with addition, and forward counting with zero reset. Landis & Gyr, Inc., 45 West 45th St., New York 36, N.Y.

Transistor Switching Circuity

Entitled “Notes On Transistor Switching Circuity,” this 14-page booklet contains graphs, block diagrams, and specifications of such equipment as: shift registers; binary counters; ladder networks; pulse sorters; electronic switches; amplifiers; and power supplies. Navigation Computer Corp., 1621 Snyder Ave., Philadelphia 45, Pa.

Equipment Data Sheets

Complete specifications, descriptions and pictures are included in Product Data Sheets 101-5, 102-10, 117-7, 117-8 which cover, respectively, rotary actuator 6116A-1, series 313 miniature linear actuator, series 2009C single resolver, and series 2010C triple resolver. Lear, Inc., P. O. Box 688, Grand Rapids, Mich.

Telemetry Receiving Systems

This reference bulletin has been prepared to aid engineers in planning telemetry receiving systems. The Miniature FM Telemetry Receiving Systems bulletin illustrates typical systems and describes individual building block components: receivers, subcarrier discriminators, master controls, record-monitor-mixers, and other units. Tele-Dynamics, Inc., 5000 Parkside Ave., Philadelphia 31, Pa.

Ovens, Environmental Cabinets

Bulletin ’51, four pages, two-color, illustrates and describes various types of Blue M oven and environmental cabinets. Dimensions, electrical and operating characteristics, and pictures are included. Blue M Electric Co., 138th and Chatham St., Blue Island, Ill.

TUBE PROBLEM:

When the 6AF4 tube was replaced in UHF TV tuners, servicemen sometimes got a big surprise. Reason: the tubes were not standardized, and a replacement was likely to bring in one channel where another should have been.

SONOTONE SOLVES IT:

First, Sonotone set up extremely tight controls on all materials going into the 6AF4 components. Second, Sonotone used a more thorough exhaust process.

RESULT:

The Sonotone AF4 family of reliable tubes has been accepted by the industry as standard for initial production and replacement.

Let Sonotone help solve your tube problems, too.

Sonotone

Electronic Applications Division
ELMSFORD, NEW YORK

Leading makers of fine ceramic cartridges, speakers, microphones, electronic tubes.

In Canada, contact Atlas Radio Corp., Ltd., Toronto.
Probes, Transducers, Tubes 152

Illustrated short form catalog, No. 115811, is mainly devoted to the company's line of temperature transducers, or temperature "probes," with a brief section devoted to deiced pitot-static tubes and precision pressure transducers. The catalog covers 52 items in 10 pages with pictures. Rosemount Eng. Co., 4900 W. 78th St., Minneapolis, Minn.

Cooling Packages 153

Four electronic cooling packages are described in this loose-leaf catalog folder. The cooling packages are designed for use in electronics systems requiring air-liquid coolant mediums, and are particularly adaptable to systems utilizing liquid-cooled power tubes in both airborne and ground installations. Included in each catalog page is a picture of the unit described, along with full specifications. Pesco Products Div., Borg-Warner Corp., 24700 N. Miles Road, Bedford, Ohio.

Short Form Rectifier Catalog

This 16-page catalog gives ratings, electrical characteristics and descriptive data on 405 types of silicon and selenium rectifiers and diodes. Specifications cover more than 140 types of silicon cartridge rectifiers, and more than 130 selenium rectifier and contact protector types. Write on letterhead requesting "Short Form Catalog," International Rectifier Corp., El Segundo, Calif.

Transistor Equipment, Components 154

Transistor equipment and components are covered in this 12-page, 1959, catalog. Included are: a new line of power supplies; the latest types of transistorized converters, a tiny plug-in transistorized l-f amplifier, an expanded line of miniature rectifier transformers for use in transistor power supplies, and several new types of transistor test equipment, including an alpha meter, beta meter, and noise figure meter. Ferrotran Electronics Co., Inc., 693 Broadway, New York 12, N.Y.

Cabinet Racks and Slide Assemblies 155

Catalog 59 contains 28 pages of illustrations, descriptions, technical specifications, and prices of universal cabinet racks, rack type slide assemblies, type C and type A racks, and utility desk assemblies. Complete information is supplied on accessories, fittings, and panels. This catalog is available on request. Please address inquiries to: Par-Metal Products Corp., 32-62-49 St., Long Island City 3, N.Y.
do you know...  
that proper heat dissipation of a 1003 type transistor operating at 12 watts would require a 1/8" thick aluminum heat sink the size of this 4½ x 10 at?  

IERC TRANSISTOR HEAT DISSIPATORS  
of the type shown here full size, are the thermal equivalent when mounted to a heat sink 60% smaller!  
Proven design and heat dissipating effectiveness of the IERC components by conduction, radiation and convection assure you of time, cost, space and weight savings plus reliability!  
Available in various heights, write for IERC Test Report # 114.

NEW LITERATURE

Rectifier Tubes and Circuits  158  
A chart designed to simplify the selection of a combination of a rectifier circuit and a mercury-vapor rectifier-tube type for any application requiring dc voltage up to 21 kv and direct current up to 60 amp is given in application notes AN-179.  
The note, six pages, also contains a table of the electrical quantities involved in the design of rectifier-type dc power supplies and gives the values of these quantities for the rectifier circuits shown in the chart.  
Radio Corp. of America, Commercial Engineering, Harrison, N.J.

Speed Reducers  159  
Bulletin 97 describes the firm's new series 8 and 9 miniature fixed ratio speed reducers. The units are available in over 400 fixed ratios. In four pages the bulletin covers applications, mounting data, cut-away pictures of the units, dimensional data and ordering information.  
Metron Instrument Co., 432 Lincoln St., Denver 3, Colo.

Fasteners  161  
A full range of sizes and types in A, and MS fasteners are among the many items covered in this 24-page catalog.  
More than seven thousand items and sizes in stainless steel fastenings are available and include cap screws and bolts, nut washers, machine screws, wood screws, set screws, sheet metal screws in slotted and Phillips head, rivets, cotter pins, plain hinges, pails, funnels, scoops, and screen machine products. Star Stainless Screw Co., 699 Union Blvd., Paterson 2, N.J.

Rectifier Handbook  
This 128-page engineering handbook on rectifiers is divided into four parts. The first part deals with the principles of semiconductors. The second contains application data on selenium, silicon, and germanium rectifiers. Zener voltage regulators and photocells and sun batteries are discussed in the third and fourth parts. Graphs, pictures and tables are included.  
Send $1.50 to: International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.

Missile-age ECM trouble-shooters

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offers its contractual associates  

250 MAN-YEARS  
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IN AND FREQUENCY SYSTEMS AND SUBSYSTEMS  
SPECIALISTS IN ELECTRONIC COUNTERMEASURES  

TAMAR ELECTRONICS, INC.  
LOS ANGELES • SANTA MONICA • BURBANK, CALIFORNIA  

CIRCLE 157 ON READER-SERVICE CARD

CIRCLE 158 ON READER-SERVICE CARD

ELECTRONIC DESIGN • June 24, 1954
Photosensitive Devices, CR Tubes

This 32-page illustrated catalog on the firm's photosensitive devices and cathode ray tubes presents technical data, basing diagrams and brief text descriptions of more than 130 tube types. Photographs and representative types are shown throughout the publication. Covered for the first time in this catalog are image-converter tubes; photoconductive cells, new varieties of storage tubes; new cathode-ray tubes; new camera tubes; new single-unit phototubes; and new multiplier phototubes including ultra-violet and infrared-sensitive types. For form CRP D-105A send 30¢ to Radio Corp. of America, Tube Div., Harrison, N.J.

Condenser Microphones 164

A new condenser microphone series is discussed in this 24-page Technical Review. Major advancements in measurement microphone design are described and the exact measurement of the free field corrected is covered. B & K Instruments, Inc., 3044 W. 106th St., Cleveland 11, Ohio.

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**Hi Q TOROIDAL INDUCTORS**

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Order as above for open type, varnish finish. Use prefix E for encapsulated types and M for molded types.

**Our Specialty**

Molded Toroidal, Mag Amps, Converter Toroids, Custom Job Winding.

Write, Wire, Phone for prompt quotations

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**Magnetico, Inc.**

EAST NORTHPORT, L. I., L. Y.

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**INSTRUMENT SERVO-AMPLIFIERS!**

an addition to the DIEHL family of INSTRUMENT SERVO COMPONENTS

This new line of Instrument Servo-Amplifiers, coupled to an already established family of DIEHL Instrument Servomotors, Tachometers and Gear Reducers, further expands the new DIEHL concept of furnishing high quality servo components in modular form.

These units have been designed so that a true servomotor-amplifier combination featuring faster SERVO response is at last available from a single source of supply.

DIEHL Instrument Servo-Amplifiers are supplied in ratings suitable for driving the popular 1, 5 and 10 watt motors and use printed circuitry for high reliability.

**Features**

- Standard rack mounting.
- Control adjustments for gain, phase, internal feedback, and external feedback.
- Push-pull output stage matched to motor control phase.
- A.C. or D.C. input.
- With or without integral power supply.
- Reliable, premium quality vacuum tubes.

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Electrical Division of THE SINGER MANUFACTURING COMPANY

Findene Plant, SOMERVILLE, N. J.

Other available components

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CIRCLE 165 ON READER-SERVICE CARD

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COAXIAL CABLE
the way you want it . . .
when you want it!

When it comes to coaxial cable — come to
TIMES first. You name it — we make it —
solid polyethylene and Teflon dielectric,
expanded polyethylene dielectric, semi-solid
polyethylene dielectric, semi-solid Teflon
dielectric. TIMES manufactures over 175
RG/U Type* Coaxial Cables meeting
virtually all industrial and military needs. In
addition, a customer-service stock is
maintained of over 100 RG/U Type Coaxial
Cables in most length-requirements,
providing immediate delivery.
If you’re in a hurry, or you want
the best at the right price —
check with TIMES first . . .

PHONES: Colony 9-3381
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information, or write for complete
wire and cable catalog.
TWX 370 — Wallingford, Conn.

*Meeting or surpassing
MIL-C-17 specifications

TIMES WIRE AND CABLE CO., INC.
on affiliate of The International Silver Company
WALLINGFORD, CONN.

CIRCLE 167 ON READER-SERVICE CARD

NEW LITERATURE

High Tensile Fastenings 168
Presented as an aid to the selection of appro-
priate nut and bolt combinations for high tensile
applications, this Design Manual No. 5825 is a 36-
page booklet offering high tensile fastener design
considerations; reproductions of all relevant NAS
and MS bolt specifications; three tables cross ref-
erencing 160,000 psi, 180,000 psi and 220,000 psi
bolts and other compatible elastic stop nuts; and
a complete set of high tensile self-locking fastener
standard drawings. Elastic Stop Nut Corp. of
America, 2330 Vauxhall Rd., Union, N.J.

Digital Instruments 169
This four-page, illustrated bulletin No. 19-36
describes a complete line of digital instruments.
The line includes voltmeters, ratiometers, ohmm-
ers, preamplifiers, input scanners, and a vari-
ety of accessories for driving card punches, tape
punches, and printers. Kin Tel Div., Cohu Elec-
tronics, Inc., Box 623, San Diego 12, Calif.

Microminiature Relay 170
Bulletin 160-I gives technical data on crystal
plug relay, Series 160. The tiny, 0.5 oz. relay was
designed for airborne and portable equipment. It
is hermetically sealed in compact gas-filled case
with a hot dip finish and provides a minimum of
100,000 operations. Wheelock Signals, Inc.,
Long Branch, N.J.

Pulse Transformers, Delay Lines 171
Catalog TRO19, 6-pages, provides data on pulse
transformers and delay lines. Listed in the catalog
are physical sizes on standard styles, ratios and
widths available from stock. Also given are various
transformer case styles available, blocking oscil-
lator test circuits, exciting current tests and other
data. The Gudeman Co., 340 West Huron St.,
Chicago 10, Ill.

Power Connectors 172
This illustrated bulletin gives specifications,
outline dimensions and general information on
Series 14 power connectors with closed ring entry
contacts. This series is available in 7, 9, 10, 15 and
19 contacts. The closed entry design provides in-
creased reliability and assures a low millivolt drop
under constant and uniform insertion pressure.
Solder cup, turret top or taper pin terminations
are available. Electronic Sales Div., DeJur-Amsco
Corp., 45-01 Northern Blvd., Long Island City
1, N.Y.
Selenium Rectifiers

In eight pages this catalog contains basic characteristics of selenium rectifiers with temperature derating table as well as an overload and allowable currents-under-various-forced-cooling curves. One page is devoted exclusively to general design information on rectifier circuits. The catalog also contains a code designation chart, a dc voltage chart and bracket dimensions in chart form. Shown for the first time is a practical method for computing the overall length of a selenium rectifier stack. Rectico, Inc., 963 Frelinghuysen Ave., Newark 12, N.J.

Connectors

This four-page folder has been prepared to assist buyers and engineers in the selection of Amphenol connectors. Photographs and condensed description are designed to facilitate ease of securing the correct type. Schueber Electronics, 60 Herricks Rd., Mineola, L.I., N.Y.

Power Supplies

Bulletin No. 721 describes and illustrates an integrated series of regulated transistorized power supplies. Specifications are given for over 40 different models. Two categories are covered: wide range models and narrow range models. Wide range models have a continuously variable main voltage control and a vernier control for adjusting the output to any value from 0 v to some higher limit. Narrow range models cover a range of several volts each side of a popular nominal value. Ten different voltage ranges are available. Electronic Measurements Co. of Red Bank, Eatontown, N.J.

Automatic Systems

Techniques in automatic systems such as sorting, inspection, counting, positioning and weighing are described in this four-page brochure. Pictorial material and an explanation of automation services are included. Atronic Products Inc., Industrial Equipment Div., Bala-Cynwyd, Pa.

Ceramics

Chart No. 591 provides in tabular form the properties of several types of ceramics. Among the properties listed are: volume resistivity; dielectric constant; power factor; loss factor; and thermal conductivity. Ceramics listed include: steatite, forsterite, zircon; titania, cordierite; and machineable ceramics. Graphs are included. American Lava Corp., Manufacturers Rd., Chattanooga 5, Tenn.
PRODUCTION PRODUCTS

Wire Marking Machine
Handles Teflon
Air operated model KW-7 wire marking machine is designed to mark thinner insulations and Teflon along with other types.
CIRCLE 182 ON READER-SERVICE CARD

Induction Heating Generator
For growing semiconductor material

Available at any output frequency from 200 kc to 3 mc, the model LAE-C-2 induction heating generator is adaptable to refining and growing semiconductor material and to inert atmosphere brazing of precision nuclear and electronic components. The unit has a power input of 230 or 460 v, single phase, 8 kva at full load output. Its stepless electronic power output control is continuously variable from 0.5 to 4 kw.
Reeve Electronics, Inc., Dept. ED, 609 W. Lake St., Chicago 6, Ill.
CIRCLE 183 ON READER-SERVICE CARD

Glass Diode Sealing Machine
Processes up to 1500 units an hour
Machine No. 3117 seals up to 1500 glass diodes an hour. It performs the following fully automatic sequence: loading both cat whisker wire and diode body; assembling the cat whisker with its beaded lead wire; assembling the body of the diode which contains the crystal and its lead wire; providing contact between the cat whisker wire and the diode body with precise tension and spacing; making the final seal; and unloading the finished diode. The machine handles all types of glass diodes.
Kahle Engineering Co., Dept. ED, Union City, N.J.
CIRCLE 184 ON READER-SERVICE CARD

Write for 22 page catalog on complete Adjust-A-Volt line including standard bench and panel mounted manual or motor-driven units, 50/60 or 400 cycle, high temperature; double commutator; military and special designs. Single or three phase—ratings up to 130 kva.
Stocked by leading jobbers.

STANDARD ELECTRICAL PRODUCTS COMPANY
VARIABLE TRANSFORMER DIVISION
2240 EAST THIRD STREET, DAYTON, OHIO
CIRCLE 181 ON READER-SERVICE CARD

SPECIAL RESISTOR FOR YOUR DESIGN

Stab-on terminals and a square hole make positive-lock mounting . . . typical of the special resistors available from General Electric. No matter what your needs, G-E resistors can be designed to your exact requirements. For your free resistor catalog, follow reader service instructions below. General Electric Co., Roanoke, Virginia.

Progress is Our Most Important Product

GENERAL ELECTRIC
CIRCLE 185 ON READER-SERVICE CARD

CIRCLE 183 ON READER-SERVICE CARD
ELECTRONIC DESIGN • June 24, 1962
Electric clutch performs dual function in control rod drive for nuclear reactor

Emergency is illustrated in the way Warner B-400's are applied in this control rod drive at the Alco-built packaged power reactor at Belvoir, Va. They provide both free-wheeling emergency release and automatic positioning control of reactor rods. During normal operation, clutches are constantly engaged—lowering and raising rods by means of a neutron-absorbing material to carefully regulated positions within the reactor. Motor

This measuring instrument assures accurate orientation of silicon and germanium crystals for transistors, diodes, and other semiconductor devices. Easy to operate, it permits the cutting, preparation, etching, and evaluation of a crystal in 15 min.


CIRCLE 187 ON READER-SERVICE CARD

Wave Soldering Equipment

For printed circuits

Designed for printed circuit soldering, the Adawave attachment can be installed in existing solder pots. It provides a continuously recirculating wave of solder which gives linear contact soldering with minimum distortion and delamination. It also eliminates icicles and cold joints and reduces rejects and rework.


CIRCLE 188 ON READER-SERVICE CARD

Wire Straightening Machine

Aligns and cuts transistor leads

The model AL3NS Radialead Straightener automatically straightens, cuts, and preforms transistor leads. It can align them to the proper center distance so that the components will always exactly match the holes in a printed circuit board. A simple change of head adapts the unit for different job functions.

Design Tool Corp., Electro-Machinery Div., Dept. ED, 772 Bergen St., Brooklyn 38, N.Y.

CIRCLE 189 ON READER-SERVICE CARD
Be sure the Teflon* you buy has the Qualities you need

Processing can radically change Teflon properties

Take flex life as an example. The Teflon sheet illustrated was quenched to 50% crystallinity, resulting in an excellent flex life of 60,000 cycles. However, through lack of process control, it might have been cooled more slowly, giving a 56% crystallinity and a flex life of 40,000 cycles... A LOSS OF 20,000 CYCLES OF FLEX LIFE!

You can be sure of proper processing by specifying Teflon stocks made by Garlock's Plastics Division, the United States Gasket Company. U.S.G.'s years of experience with fluorocarbon resins guarantees you the right properties every time. This, plus assurance of fast delivery anywhere, makes Garlock your prime source of Teflon sheet, rod, tape, tubing, bars, cylinders. Find out more by calling one of Garlock Packing Company's 26 sales offices and warehouses throughout the U.S. and Canada.

THE GARLOCK PACKING COMPANY, Palmyra, N.Y.

United States Gasket
Plastics Division of
Garlock

PRODUCTION PRODUCTS

Name Plate Equipment
For production quantities

Designed for mass production of Fotofoil etched anodized panels, dials, and name plates, this equipment includes an automatic Fotofoil vacuum printer, a complete processing center, and specialized fabrication equipment for shearing, rounding corners, punching holes, blanking parts, and applying adhesive to the Fotofoil.

Miller Dial & Name Plate Co., Dept. ED, 4400 N. Temple City Blvd., El Monte, Calif.
CIRCLE 192 ON READER-SERVICE CARD

Portable Power Supply
For resistance welding

A medium range capacitance-discharge power supply, the model 1034 delivers up to 160 w-sec of energy in less than 0.002 sec. It is designed to permit distortion-free welding for mechanical filters, component packaging, semiconductor construction, relays, and honeycomb and brazing foil assemblies. The unit is portable and operates from any 115 v line.

Weldmatic, Div. of Unitek Corp., Dept. ED, 380 N. Halstead Ave., Pasadena, Calif.
CIRCLE 193 ON READER-SERVICE CARD

Punching Press
Has interchangeable punches and dies

The model 1012 Unipunch precision press can be provided with 37 round punches and 74 dies which are rapidly interchangeable. In addition to punching round and shaped holes and notching corners and edges, the unit may be used for punching extruded and countersunk holes, small louvers, and lanced holes. Small die sets may be installed for making stampings, and threaded nut inserts may be pressed into sheets or parts.

Punch Products Corp., Dept. ED, 3800 Highland Ave., Niagara Falls, N.Y.
CIRCLE 194 ON READER-SERVICE CARD

Tinned sheet steel, available up to 22 gauge, has the strength of steel, and good formability in addition. The coating also serves as an excellent paint base and doesn't require a primer coat. For these reasons it is widely used in the automotive industry for air cleaners, oil filters, covers, vents and hot-air ducts.

Modern pewter is nontarnishing and nontoxic, contains no lead, and does not darken or lose its surface finish. It contains 93% tin, 6% antimony, and 1% copper. Surface finish ranges from a bright, high polish to a subdued satin texture. It can be cleaned with soap and water. Frequent polishing is not necessary.

De-icing problem? Perhaps this is the answer. Years ago a transparent electroconductive coating, containing tin, was developed for aircraft. The thin tin-oxide film is applied to glass. A low current passing through the coating generates sufficient heat to de-ice the glass, now standard equipment on most commercial and military planes.

Phosphor bronze, a tin-copper alloy containing up to 10% tin, is used in over 30 different aircraft applications. Typical uses are for bushings, bearings, springs, valves, contacts, thermostats and switches.

TIN NEWS
For a free subscription to TIN NEWS—a monthly bulletin on tin supply, prices and new uses.

The Malayan Tin Bureau
Dept. 12F, 1028 Connecticut Ave., Washington 6, D.C.
Rotary Marking Machine

Handles 1500 units an hour

Air operated from a standard plant air line of 75 psi or more, the model 9A-14 rotary marking machine has a 14 in. stroke and handles 1500 or more parts an hour. It will mark the full circumference of a 4 in. diameter part or 2/3 of the periphery of a 6 in. diameter part. It will also do serial numbering and fixed marking in alternate rotations. The machine can be adapted for marking flat parts with the substitution of a roll die for the flat die. Dimensions are 51 x 18 x 14 in.

Acromark Co., Dept. ED, 411 Morrell St., Elizabeth, N.J.

CIRCLE 197 ON READER-SERVICE CARD

Induction Soldering Machine

Seals frequency control crystals

This induction soldering machine is designed for hermetic sealing of frequency control crystals and similar electronic components. It has a two-station slide fixture so that while one station is being heated for soldering, the other can be unloaded and reloaded. Soldering time is 5 to 15 sec depending on the size and shape of the can. The unit is 21 x 30 x 21 in. and weighs about 200 lb. Power requirements are 120 or 240 v, single phase, 60 cps.

Reeve Electronics, Inc., Dept. ED, 609 W. Lake St., Chicago 6, Ill.

CIRCLE 198 ON READER-SERVICE CARD
ONLY ACOUSTICA
ULTRASONIC CLEANERS
HAVE MULTIPower!

MAJOR BREAKTHROUGH
IN ULTRASONIC TECHNOLOGY!
In determining which ultrasonic cleaner to buy, remember that all ultrasonic cleaners are not alike. There is variation in uniformity of cavitation. There is variation in the transducer — and the transducer is the heart of an ultrasonic cleaner. The Multipower transducer developed by Acoustica research, multiplies the power and efficiency of ultrasonic action. Cleaning is faster, labor costs are lower.

Acoustica ultrasonic cleaners are engineered and produced to the finest standards, unequalled in quality and value. Off-the-shelf in capacities from 1 to 75 gal. or custom built to 5000 gal. Expert Acoustica engineers can help you with your cleaning problems. Send for further information.

Acoustica Associates, Inc.
Dept. ED, Fairchild Court, Plainview, N. Y.
Send information describing advantages of Acoustica ultrasonic cleaners.

New York
Los Angeles

CIRCLE 200 ON READER-SERVICE CARD

PRODUCTION PRODUCTS

Vacuum Resistance Furnace
Operates at temperatures to 2400 C
The model 2915 vacuum resistance furnace handles production as well as laboratory work and can operate at temperatures to 2400 C. It can be used for heat treating, brazing, sintering, and testing both reactive metals and ceramics. It is completely self-contained with furnace chamber, pumping system, power supply, and controls in one cabinet and can be operated at absolute pressures of 10^{-5} mm of mercury or under inert atmospheres. Vacuum is achieved by a 30 cfm rotary gas ballast pump for roughing operation and a 6 in. high vacuum oil diffusion pump for evacuation in the high vacuum ranges.
CIRCLE 201 ON READER-SERVICE CARD

Polyurethane Foaming Machines
Deliver 0.5 to 250 lb per min
Mobile, low cost, precision foaming machines, Stafoamers automatically meter and mix rigid, semirigid, and flexible Stafoam polyurethane. This material can be used for thermal, sound, and electrical insulation; for vibration damping; and for electronic component potting. Series F, C, R, SM, and B Stafoamer models have ratio limits between 11.07 to 1 and 2 to 1; viscosity maximum ranges of 20 kc; and compressed air requirements of 80 to 100 psig. All are 70 x 38 x 32 in. Resin and catalyst flow are varied by gear changes except in SM models, which use variable drive for catalyst flow. Power requirements are 220 v ac, 60 cps, three phase in models P4OB and P8OB, single phase in all others. Foam delivery varies from 0.5 to 250 lb per min, depending upon the model.
American Latex Products Corp., Dept. ED, 3341 W. El Segundo Blvd., Hawthorne, Calif.
CIRCLE 202 ON READER-SERVICE CARD

PRECISION
ENGINEERED
Sub-Miniature
Pilot Lights
...facilitate the solution of miniaturization problems.

DIALIGHT
FOREMOST MANUFACTURERS OF Pilot Lights
CIRCLE 203 ON READER-SERVICE CARD
CIRCLE 204 ON READER-SERVICE CARD
Here's an entirely new concept in ultra-high frequency filtering—Allen-Bradley's new ceramic feed-thru filters. Their high insertion loss—up to 60 db—effectively prevents feedback and radiation from low power circuits operating in the frequency range from 50 mcs to 5000 mcs.

Astounding in performance, these new A-B filters are actually superior to the theoretical ideal capacitor over a wide frequency range. Note, in the graph at right, their effective filtering increases with frequency—and they have none of the undesirable resonance characteristics of standard tubular capacitors. In addition, A-B filter elements provide far greater effective capacitance values than practical with conventional capacitor designs. Filters are available in voltage ratings up to 500 v DC at 125°C. Send for Technical Bulletin 5410.

Allen-Bradley Co., 222 W. Greenfield Ave., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.
NEW Allen-Bradley POTENTIOMETERS for use in TEMPERATURES UP TO 150°C

This new Allen-Bradley potentiometer—the Type L—is especially designed to solve problems associated with high ambient temperatures—and space conservation. Although extremely compact—0.5 inch in diameter—the Type L control has a conservative rating of 0.5 watt when operating in an ambient temperature of 100°C. And, it provides reliable performance when operated at a temperature of 150°C—under "no load" conditions. (See graph at right.)

The new Type L control features the same solid, hot molded resistance element that has proved unequalled for long life, smooth operation, and low "noise" characteristic in Allen-Bradley's popular Type J, Type K, and Type G potentiometers. When temperature and space problems in your designs plague you, this new A-B "high temperature" potentiometer is a reliable answer. Please send for complete information, today.

ALLEN-BRADLEY Quality Electronic Components

Allen-Bradley Co., 222 W. Greenfield Ave., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ont.
what size reliable RELAYS do you need

Micro-miniature 44
SPDT and DPDT contacts rated 12 amps, 28 VDC and 115 VAC; non-inductive. Operate time, 5 ms max.; release 3 ms max.; wide choice of mountings; vibration and shock resistance to meet military specifications.

Subminiature 33
Fast acting—contact combinations to 6 arms per stack, 12 per relay. Contact ratings to 5 amps; operate sensitivity (SPDT) 250 mw, min.

Miniature 11
Contact combinations to 8 arms per stack, 16 per relay. Contact ratings to 5 amps; operate sensitivity (SPDT) 150 mw, min.

Small 22
Contact combinations to 10 arms per stack, 24 per relay. Contact ratings to 10 amps; operate sensitivity (SPDT) 100 mw, max. TIME DELAY: constant to 60 ms; release to 150 ms.

Medium 66
Contact combinations to 12 arms per stack, 24 per relay. Contact ratings to 15 amps; operate sensitivity (SPDT) 100 mw, max. TIME DELAY: constant to 60 ms; release to 150 ms.

Ultrasonic Cleaners
Multipurpose

Consisting of a generator and a matching transducerized tank, Circosonic ultrasonic cleaners may be used for cleaning gears, bearings, and instruments; removing excess solder flux, fingerprints, line waxes, and grease from parts; and many other purposes. Outputs range from 60 to 1000 w and tank capacities are 1 to 20 gal. Tuning is continuous over a wide range, and the generators are equipped with a selector switch so that two transducerized tanks may be operated from the same generator.

Circo Ultrasonic Corp., Dept. ED, 50 Terminal Ave., Clark, N.J.

CIRCLE 206 ON READER-SERVICE CARD

Multipurpose Furnace
Grows crystals

The model MF-90 furnace provides complete heat treating and experimental facilities in one apparatus. It may be used in a horizontal or vertical position at temperatures up to 1100 °C and is provided with an anticipating controller, a Variac, and an ammeter. A clock motor is mounted for growing single crystals by the Bridgman technique. The furnace cores may be replaced in two minutes with the furnace at operating temperature.

Materials Research Corp., Dept. ED, 47 Buena Vista Ave., Yonkers, N.Y.

CIRCLE 207 ON READER-SERVICE CARD

WE DON'T WANT TO CANCEL YOUR SUBSCRIPTION, BUT...

When you notify us of a change in job or in any part of your address, we are forced to cancel your subscription unless you:

- Restate in writing your qualifications to receive ELECTRONIC DESIGN, either by letter, on the Reader Service Card, or on an ordinary change of address card.
- Include your old as well as new address (even if you are only correcting an address).

Although we regret this inconvenience, the regulation is necessary because of the strict circulation requirements governing the audit of our subscribers by the Business Publications Audit of Circulation Inc.

Remember... to insure the transfer of your subscription to a new location, you must restate your qualifications.

ELECTRONIC DESIGN
a HAYDEN publication
830 Third Ave., New York 22, N.Y.
Covering all new products that might generally be specified by an electronics engineer engaged in the design of original equipment.

**New Products**

Multiturn Pots Have Film Elements

Having virtually infinite resolution because their resistive element is of the film type, the model 783 and 7810 potentiometers are three and ten turn units, respectively. Case diameter is 7/8 in, and linearity is 0.025% at any resistance value. Life expectancy is in excess of 10 million shaft revolutions at speeds over 200 rpm.

Computer Instruments Corp., Dept. ED, 90 Madison Ave., Hempstead, L.I., N.Y.

CIRCLE 209 ON READER-SERVICE CARD

**Tiny Amplifier Has Military Uses**

Measuring 0.531 in. in diameter and 0.228 in. in height, including the hermetically sealed case, the TA-12 four-stage amplifier has 12 resistors, 5 capacitors and 4 transistors. It weighs 1/16 oz, and has both industrial and military applications. Gain of the unit is from 73 to 78 db at 1 ke with a 1000 ohm load. Having a nominal input impedance of 2000 ohms, its signal to noise ratio is 42 db below 1 v. At 300 cps the frequency response is down 6±3 db; it is down 4±2 db at 3000 cps.

Centralab, Division of Globe-Union, Inc., Dept. ED, 900 East Keefe Ave., Milwaukee 1, Wis.

CIRCLE 208 ON READER-SERVICE CARD

**Drum Head Handles 64 Channels**

Track width of the model HD 14-64x metal drum head, designed to handle 64 channels, is 0.024 ±0.0005 in. Track spacing from center to center is 0.0625 in. and gap length is 0.0005 in. The maximum deviation from head to base to back of any stack is ±0.001 in, and gap scatter is ±50 μin. Specifications of this unit may be modified to suit particular requirements.

J. B. Rea Co., Inc., Dept. ED, 2202 Broadway, Santa Monica, Calif.

CIRCLE 210 ON READER-SERVICE CARD
NEW KILO-LINE RECORDING STORAGE TUBES SPECIALLY DESIGNED FOR SCAN CONVERSION

To meet the need for low-noise, high-resolution devices for frequency and scan conversion, Raytheon scientists and engineers have developed two new storage tubes: the single-gun QK-685 and the dual-gun QK-703. These tubes are now available in production quantities.

Both types incorporate a specially designed tetrode electron gun for higher resolutions — 1,000 TV lines at 50% cut-off — and better control over beam modulation than conventional triode guns. A new multiple collimating lens improves background uniformity and results in shading-to-signal ratios of less than 10%.

The ability of the dual-gun type to read and write simultaneously makes this tube particularly applicable to slow-down video and conversion from PPI to TV scan patterns for "Bright Display."

Servo systems are checked out automatically with this servo plotter. It reproduces test results in graphic form on linear plot paper and provides, among others, Bode, Nichols and Nyquist plots. The unit produces a selection of 40-point curves within 12 min.

Resistors are quickly changed. Designed for quick interchangeability on computer boards, or wherever required, the series EP encapsulated wirewound resistors have binding post terminals. The tubes are available with either silver or gold plating. Maximum resistance of the units is up to 25 meg; wattage rating is from 0.5 to 2.5 w.

You can obtain detailed application information and special development services by contacting: Microwave and Power Tube Division, Raytheon Manufacturing Company, Waltham 54, Massachusetts
NEW PRODUCTS

Panel Lights
Mount in front

Front mounted series FML lights require no rear panel access for mounting or replacement. They have a collet type body that is locked in place by a lens which acts as a compression ring. Connections are made with collet terminals, wire wrap, or soldering. The units are available with a variety of lamps and mount in 3/8 in. holes on 1/2 in. centers. The lenses, clear or colored, have molded-in diffusing rings.

Transistor Electronics Corp., Dept. ED, 3357 Republic Ave., Minneapolis 26, Minn.
CIRCLE 215 ON READER-SERVICE CARD

Tantalum Capacitors
Rated 1 to 300 pf

Type SRM and SCM capacitors are solid electrolyte, sintered tantalum anode units with capacity ratings from 1 to 330 μF and voltage ratings from 6 to 350 V. They have low dc leakage current and standard capacity tolerances of ±10 and ±20%, respectively. Type SRM units operate from -80 to +125°C, while type SCM are designed for -80 to +85°C operation and have a slightly higher dissipation factor.

Texas Instruments Inc., Semiconductor-Component Div., Dept. ED, P.O. Box 312, Dallas, Tex.
CIRCLE 216 ON READER-SERVICE CARD

Original Equipment Manufacturers:
Design and Packaging Engineers: Let us help solve your problems. The engineering, facilities, skills and experience responsible for these designs stand ready to help you grow.

L.L. Constantin & Co.
MANUFACTURING ENGINEERS

CIRCLE 214 ON READER-SERVICE CARD

These new transistor bases supplement Constantin's expanding line of semiconductor base designs now numbering well over 500 configurations.

By far the largest existing selection, many of these designs are available on open tooling.

TYPE 519

SPECIFICATIONS
.071 Pin Circle
.018 Pin Diameter
.500 Pin Below Flange
.138 Eyelet Body Diameter
.200 Eyelet Flange Diameter
.010 Kovar Mat'l
with or without ground pin or blind pin

TYPE 520

SPECIFICATIONS
.100 Pin Centers
.018 Pin Diameter
.500 Pin Below Flange
.443 Flange Diameter
.6-32NC Copper Stud
.012 Kovar Mat'l
with or without ground pin or blind pin

TYPE 521

SPECIFICATIONS
.100 Pin Circle
.018 Pin Diameter
.500 Pin Below Flange
.166 Eyelet Body Diameter
.210 Eyelet Flange Diameter
.008 Kovar Mat'l
with or without ground pin or blind pin
Sweep Generator
Provides center frequencies from 1 to 900 mc

Sweep generator model HD-1 has a dual oscillator assembly that provides a continuous spectrum of center frequencies across the 1 to 900 mc range. Sweep widths may be varied from 200 kc to 100 mc over the heterodyne range and from 0 to 6% of the center frequency for all frequencies over 400 mc. An age circuit continuously samples the sweep signal and maintains a level output flat within 5% across the entire sweep width. The rf output is 1 v peak to peak over the high range and 0.5 v peak to peak over the low. This voltage may be reduced in steps by a front panel turret attenuator. The horizontal sweep signal is 20 v peak to peak with a repetition rate equal to a 50 or 60 cps line frequency.

Teleonic Industries, Inc., Dept. ED, Beech Grove, Ind.
CIRCLE 217 ON READER-SERVICE CARD

Test Set
For diode pulse recovery

Used with a suitable square wave generator and oscilloscope, the model ND-1 standard diode pulse recovery test set measures: forward bias current from 2 to 40 ma; inverse voltage from 5 to 50 v; load resistance from 500 to 3000 ohms; load capacitance from 10 to 100 μf; and inverse enhancement current from 5 ma to 50 μa. Military designation is JAN-265. The unit has built-in test clips and interconnecting cables and is supplied with resistance and capacitance standards.

The Indikon Co., Inc., Dept. ED, 76 Coolidge Hill Rd., Watertown 72, Mass.
CIRCLE 218 ON READER-SERVICE CARD

FOR COMPLETE DETAILS
OF THE NEW Jf MODEL 803 WRITE DIRECT OR
CONTACT OUR ENGINEERING REPRESENTATIVE IN YOUR AREA.
Cabinet Size: 9 3/4 x 13 x 17 — Price: $845.00 F.O.B. Seattle factory

JOHN FLUKE MANUFACTURING CO., INC.
1111 West Nickerson — Seattle 99, Washington
CIRCLE 219 ON READER-SERVICE CARD

ELECTRONIC DESIGN • June 24, 1959
NEW PRODUCTS

**Micro-Miniature Latching Relays** by Iron Fireman

5 MS PULSE AT 300 MW:

This very short burst of power and the shock and vibration immunities shown above are features of the newest addition to the Iron Fireman line of micro-miniature relays.

The model R650 relay was designed specifically to meet requirements when operating power is at a premium and ruggedness and dependability are essential.

Conforming to and exceeding the test specifications of MIL-R-5757C, the performance and reliability of the R650 relay is assured by the use of high temperature materials and a unique permanent magnetic structure.

Complete performance data available on request. Write to the address below.

---

**Strain Gages**

Weigh 1.1 to 9.3 mg

These miniature MetalFilm strain gages are for use in rockets, space vehicles and supersonic aircraft. The model 121-R3A is a rosette gage that determines the magnitude and directions of principal strains; the 1X1-32A is a miniature gage for use in areas of very steep strain gradient; and the 341-500 is a high fatigue life unit for structures undergoing severe dynamic strains. The smallest gage is 1/32 in. wide, 5/32 in. long, and 1/1000 in. thick and the largest is 1/2 in. square and 1/1000 in. thick. The units weigh 1.1 to 9.3 mg.


CIRCLE 221 ON READER-SERVICE CARD

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**Random Access Memory**

Has 8 μsec cycle time

The model TCM random access magnetic core memory is an all transistor, coincident current, ferrite core unit with an 8 μsec cycle time. For use with the company's 3C T-Pac systems or any other type of digital system, the unit is modular and can be assembled to provide word capacities to 4096 and word lengths to 40 bits. Access time to any address is 4 μsec.

Computer Control Co., Inc., Dept. ED, 92 Broad St., Wellesley, Mass.

CIRCLE 222 ON READER-SERVICE CARD
Some Ideas

for your file of practical information on drafting and reproduction from

KEUFFEL & ESSER CO.

A year of relentless testing has produced a small library of interesting facts about HERCULENE (T.M.) Drafting Film. What follows is a consensus of drafting-room experience with HERCULENE - by K&E and its customers - with some up-to-date recommendations for using it. Take the matter of...

**Shiny Back vs. Pencil Back**

A basic question is: do you need a double-surfaced drafting film? We make HERCULENE Drafting Film both ways, of course - with a single surface (shiny back) and double surface (pencil back). It's our recommendation that you use pencil back HERCULENE only if it's your practice to make basic drawings on one side, changes on the other. For most other uses, shiny back is preferable. (At first, the double-surface film was chosen by many drafting rooms because it lay flatter on the board than shiny back. This is no longer true. K&E research labs have come up with a fully effective anti-curl treatment.) Especially in filing, shiny back HERCULENE presents fewer problems. The clean non-abrasive back won't smudge the face of the sheet underneath, even in a heavy stack of tracings. If you'd like to compare a few sheets, please let us know.

**Plastic Pencils and the HERCULENE Surface**

Not just a handy catch-phrase, when K&E puts its "exclusive 'engineered surface'" on a drafting material, the result is an exact, uniform tooth for sharp pencil drawing, inking and typing. With HERCULENE Drafting Film, however, an entirely new type of plastic (non-graphite) pencil yields especially good results. Quite a few of our customers have reported favorably on the well-known Staedtler "Duralar" brand. Duralar pencils come in five hardnesses, are non-smudging and have generally good covering power, sharpness and erasability. After about 20 prints, the Duralar lines show up consistently better than those made by a regular pencil, since graphite lines tend to lose density.

Inking over graphite pencil lines comes out best when done over light lines, drawn with a harder grade of pencil. A good way to remove excess graphite is to go over the drawing with an ABC pad. Inks vary in their usefulness on HERCULENE. We've tested several, and you're welcome to those results as well, on request.

**Wet That Eraser!**

The erasing qualities of HERCULENE Drafting Film are excellent, but (as with the pencils) we've discovered it's a new type of vinyl eraser that does the best results. Examples of these non-rubber type erasers are the Richard Best "TAD" and the Eberhard Faber "RACE KLEEN" - both available from your K&E dealer. With vinyl erasers, pencil lines whisk off. Even stubborn ink and typing can be removed easily, with no damage to the surface. Here's a tip on how to do this:

Moisten the eraser slightly. It becomes no more abrasive, but a lot more "erasive." Moistening is a must when removing Duralar lines or typing after exposure to heat. (Incidentally, don't use electric erasing machines, steel erasers or typewriter erasers.) When erasing large areas, certain chemical eradicators work fine too. Our suggestion: use Vythene or a very light application of a denatured alcohol such as Solox, both of which can be applied with a cotton swab or clean cloth.

**After Typing, Please Pounce**

Typed impressions on HERCULENE Drafting Film are crisp and sharp, but may take a while to dry because the film's surface doesn't "swallow" ink readily. A light pouncing right after typing will dry the ink and fix the lines - giving you uniform permanent contrast.

A new typewriter ribbon will produce the best impressions. At K&E we've tested a healthy variety of ribbons and we'd be pleased to send you the results on request.

**Outstanding Advantages Proved in Tests**

We're pleasantly amazed at the short time it took for HERCULENE Drafting Film to become an accepted "staple" - along with ALBANESE® Tracing Paper and PHOENIX® Tracing Cloth. Actually, it's a rare drafting room by now that has not tested HERCULENE during its first year on the market. The findings: All properties considered, HERCULENE stands up better than any other drafting film. It has great resistance to heat, aging and abuse. Its exclusive "engineered surface" plus its tough, durable Mylar® base provide superior pencil and ink take, fine erasability, remarkable dimensional stability - a combination we're proud to call unbeatable!

The K&E dealer near you has HERCULENE now. Stop in and see him.

KEUFFEL & ESSER CO., Dept. ED-4, Hoboken, N. J.

Please send further information about HERCULENE Drafting Film. I'd like samples too.

Name & Title.

Company & Address.

CIRCLE 225 ON READER-SERVICE CARD
**Three voltage ranges:**

- **0-200, 125-325, 325-525 VDC**

1.5 AMPERE MODELS *NEED ONLY 8 1/4" OF PANEL HEIGHT!*

<table>
<thead>
<tr>
<th>Model</th>
<th>Metered</th>
<th>Unmetered</th>
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<tr>
<td>C-1550M</td>
<td>0-200 VDC, 0-1500 MA</td>
<td>0.500</td>
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<tr>
<td>C-1551M</td>
<td>125-325 VDC, 0-1500 MA</td>
<td>0.500</td>
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<tr>
<td>C-1552M</td>
<td>325-525 VDC, 0-1500 MA</td>
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800 MA MODELS *NEED ONLY 7" OF PANEL HEIGHT!*

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<tbody>
<tr>
<td>C-280M</td>
<td>0-200 VDC, 0-800 MA</td>
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<tr>
<td>C-282M</td>
<td>325-525 VDC, 0-800 MA</td>
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400 MA MODELS *NEED ONLY 5 3/4" OF PANEL HEIGHT!*

<table>
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<th>Model</th>
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<td>C-482M</td>
<td>325-525 VDC, 0-400 MA</td>
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200 MA MODELS *NEED ONLY 5 3/4" OF PANEL HEIGHT!*

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<tr>
<td>C-282M</td>
<td>325-525 VDC, 0-200 MA</td>
<td>0.199</td>
</tr>
</tbody>
</table>

NEW 1959 CATALOG NOW AVAILABLE

New 36-page edition contains information and specifications on Lambda's full line of transistor-regulated and tube-regulated power supplies.

**ALL LAMBD A POWER SUPPLIES ARE GUARANTEED FOR FIVE YEARS.**

**NEW PRODUCTS**

**Servo Amplifiers**

Drive 3.5 w motors

Transistor-magnetic servo amplifier models 403-A and 403-B drive 3.5 w Mark XIV or equivalent size motors from low level ac signals. They require 115 v, 400 cps excitation. Respectively, they have input impedances of 30 and 500 k and gains of 2000 and 900 times.

ACF Industries, Inc., Avion Div., Dept. ED, 1 Park Place, Paramus, N.J.

**Power Transformer**

For voltage doubler circuits

Power transformer R-93A permits the development of voltage doubling circuits with silicon rectifier powers supplies. It provides taps on both primary and secondary windings and is rated at 110 or 120 v, 60 cps, primary and 150, 160, or 170 v at 500 ma secondary. It also supplies 6.3 v, 6 amp filament power.

Triad Transformer Corp., Dept. ED, 4055 Redwood Ave., Venice, Calif.

NEW 1959 CATALOG NOW AVAILABLE

New 36-page edition contains information and specifications on Lambda's full line of transistor-regulated and tube-regulated power supplies.

**ALL LAMBD A POWER SUPPLIES ARE GUARANTEED FOR FIVE YEARS.**

**LAMBD A ELECTRONICS CORP.**

11-11 131 Street, College Point 56, N.Y.
Impedance Meter
Direct reading

Meter model 310-B provides direct readings of impedance from 15 ohms to 100 K; phase angle in degrees; dissipation factor; and storage coefficient. Frequency range 30 cps to 40 kc. Impedance and angle accuracy are ±1% and ±2 deg, respectively, up to 20 kc.
Acton Labs, Inc., Dept. ED, 533 Main St., Acton, Mass.
CIRCLE 229 ON READER-SERVICE CARD

Germanium Transistors
For audio use
Type 2N1191 to 2N1193 transistors are low cost, germanium pnp junction units for general audio, including amplifier and switching service. They dissipate 175 mw and provide current gain ranges with 3 to 1 maximum spread.
CIRCLE 230 ON READER-SERVICE CARD

Metallized Paper Capacitors
For transistor applications
Tubular axial-lead capacitors, MOZF, are hermetically sealed metallized paper units for low voltage transistorized applications. The subminiature capacitors have operating temperature range of 0 to +85 C. Ratings are 0.047 to 8.0 pf. The smallest is 0.195 in. in diam and 11/16 in. long.
Entex Corporation, Dept. ED. 8 Grand Ave., East Newark, NJ.
CIRCLE 231 ON READER-SERVICE CARD
CIRCLE 232 ON READER-SERVICE CARD

without E-W cooling units, electronic gear in this hut would burn out in minutes!

The Ellis and Watts Model A-9 Unit that keeps this critical electronic gear cool has a cooling capacity of 9000 BTU's per hour. Without this vital cooling capacity the electronic equipment would burn itself out in a matter of minutes! Wherever electronic gear is used, it creates heat problems. And, in compact airborne huts these problems are especially serious.
Designing and building specialized units to keep electronic gear cool is our business at Ellis and Watts. Units of any capacity, configuration, control requirements or functions can be designed and built to any applicable military or commercial specifications. E-W Units will function perfectly in any climate conditions on earth.
For additional information on Ellis and Watts Model A-9 Unit for cooling electronic gear in airborne huts or similar installations, write for Bulletin #130-D.

ELLIS AND WATTS PRODUCTS, INC.
P. O. Box 33-D, Cincinnati 36, Ohio
AXIMAX® 1

Ideal for flushing tightly packed "black boxes" aboard aircraft and missiles where size and weight must be held to a minimum, where reliability is critical and where high heat loads must be dissipated with cooling air. Dimensions 1 1/2" x 1 1/2", weight 4 ounces. The Aximax 1 will deliver 23 CFM free air or 19 CFM at 1" W.G. Choice of motors for 115 or 200 VAC, 400 CPS, 1 phase or 3 phase, for either pressurized or non-pressurized applications and for sine or square wave. All flow instantly reversible by turning fan end-for-end. Meets military specifications.

NEW PRODUCTS

MULTICONDUCTOR COAXIAL CABLES.—These cables consist of 95-ohm miniaturized coaxial conductors with Teflon dielectric and vinyl jacketing arranged in three layers around a center conductor. A cable may have up to 92 conductors.

Times Wire and Cable Co., Inc., Dept. ED, Wallingford, Conn.

CIRCLE 234 ON READER-SERVICE CARD

POLARITY-SENSITIVE DELAY LINES.—Provide output polarities identical or opposite to input polarities depending on connection method. Signal inversion needs no added parts.

Deltim, Inc., Dept. ED, 608 Fayette Ave., Mamaroneck, N.Y.

CIRCLE 235 ON READER-SERVICE CARD

RESISTANCE STANDARD BRIDGE.—With aged, encapsulated resistors, accuracy of the 1 K to 110 meg-ohm model 801 has been increased to ±0.01% in the first two stages and ±0.02% in the other four.

Mid-Eastern Electronics, Inc., Dept. ED, 32 Commerce St., Springfield, N.J.

CIRCLE 236 ON READER-SERVICE CARD

RETRACTABLE CABLE.—"Spectra-Flex" has built-in spring steel coils that make it self-retracting.

Spectra-Strip Wire & Cable Corp., Dept. ED, P.O. Box 415, Garden Grove, Calif.

CIRCLE 237 ON READER-SERVICE CARD

MOUNTING ASSEMBLY.—Angle and clamp designed for quick mounting of switches and cable, filters, regulators and gages, valves, soldering apparatus, and lamps. Vibration proof.

Versa-Loc Corp., Dept. ED, Southern Blvd., Chatham, N.J.

CIRCLE 238 ON READER-SERVICE CARD

BUZZERS.—Series BD with standard voltages of 6, 12, and 24 v, others to 48 v dc. May be used for ac applications. Have dustproof cover and adjustable sound volume.

Line Electric Co., Dept. ED, 271 S. Sixth St., Newark 3, N.J.

CIRCLE 239 ON READER-SERVICE CARD

COIL AND WINDING IMPREGNANT.—One component, fast air-drying HumiSeal type 1B12 preserves original core and coil values, is solderable and humidity proof, withstands operating temperatures of -60 to +130 C.

Columbia Technical Corp., Dept. ED, 61-02 31st Ave., Woodside 77, N.Y.

CIRCLE 240 ON READER-SERVICE CARD
**Pulse Transformer**

Operates at 135°C

---

**15kw S-Band Amplifier Klystron**

has no heavy magnets

Exclusive Space-Charge Focus cuts weight to only 6½ lbs.

---

**FHP Motors**

1/35 to 1/10 hp

---

Designed for an ambient temperature of 85°C, this pulse transformer will withstand 135°C operating and 150°C nonoperating temperature. It is vacuum impregnated with silicone oil and has silicone rubber or Teflon gaskets and seals. Voltage output is 27 kv; step-up ratio, 1 to 5; primary impedance, 20 ohms; pulse duration, 0.9 μsec; pulse repetition frequency, 1300 pps; and filament supply, 3.5 amp. The unit has a case diameter of 5-1/2 in. and a case height of 5-5/8 in. It weighs 14 lb.

Stavid Engineering, Inc., Dept. ED, Plainfield, N.J.

CIRCLE 242 ON READER-SERVICE CARD

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The Classic flip motor line consists of eight standard models operating at 3600, 5000, 7500, or 10,000 rpm and rated 1/10, 1/12, 1/15, 1/18, 1/20, 1/25, and 1/35 hp. Available as universal, 115-volt, or series motors from 12 to 220-volt input. They measure 4-1/2 x 3-5/16 x 3-3/8 in. and weigh 33/4 lb. The units have large brushes, precision ball bearings, and sealed in lifetime lubrication.

Carter Motor Co., Dept. ED, 2711 W. George St., Chicago 18, Ill.

CIRCLE 243 ON READER-SERVICE CARD

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**AVAILABLE FOR IMMEDIATE DELIVERY.**

Sperry's new S-band transmitting tube is a 3-cavity pulse amplifier of high gain and extra-long service life.

**EXCLUSIVE SPERRY SPACE-CHARGE FOCUSING** design eliminates heavy, cumbersome magnetic structures—a feature of prime importance in equipment design. Although the SAS-61 weighs only 6½ lbs., its sturdy construction withstands extreme vibration and environmental conditions.

**MAIN APPLICATIONS** for the SAS-61 are as an output tube in low-power radars, or as a driver for higher-powered klystrons in radar and linear accelerator systems. Its unusually long service life, however, makes it highly desirable for any application requiring 15 kw in the S-band. The SAS-61 with its internal tunable cavities is a complete microwave unit. No external equipment is required.

**SPERRY CAN DELIVER** SAS-61 tubes in quantity at once. Write or phone your nearest Sperry district office.

---

**ELECTRONIC TUBE DIVISION, SPERRY GYROSCOPE COMPANY, GREAT NECK, NEW YORK. DIVISION OF SPERRY RAND CORPORATION**


CIRCLE 244 ON READER-SERVICE CARD
It's not easy these days to find a relay as ideally suited to fast, one-way, non-stop journeys as Morton P. Rodentia is. Morton's now-famous travels have proved conclusively that he can stand 30 g vibration to 5000 cycles while functioning, and shocks as high as 100 g do not even disturb his derby. The triumphant expression springs from his latest discovery—the Sigma Series 33 relay with vibration and shock ratings as good as his own, and a sensitivity of 200 mw to boot. As a matter of fact, this is the only switch with these specs Morton could find that also would fit into his 0.8" x 0.4" x 0.9" attaché case. When last heard from, Dr. Rodentia (hon. Ph.D., Solid State U.) was dickering over delivery schedules with the supplier.

With its prime customer taken care of, Sigma is now ready to do business with anyone interested in these Series 33 relays. Similar in appearance to the perhaps better-known Series 32 magnetic latching relay, the "33" is a non-latching DPDT relay. Switching is accomplished by a signal of the correct polarity and magnitude (Sigma Signal). Specs of major interest are as follows and are further discussed in a preliminary bulletin available on request.

### SERIES 33 RELAY

- **Vibration**: 30 g to 5000 cps with no contact opening (energized or de-energized).
- **Shock, Constant Acceleration**: 100 g does not cause damage or open contacts (energized or de-energized).
- **Sensitivity**: Operate 200 mw, release 2 mw.
- **Contact Rating**: 2 amperes at 28 VDC/120VAC, resistive load, for 100,000 operations min. at 125°C max.
- **Speed**: Operate time 2 to 20 ms, depending on overdrive; release time 2.5 ms, max.
- **Operating Temp. Range**: -65°C to +125°C.
- **Connections**: Plug-in, hook terminals or 3 leads.
- **Mounting**: Flange or stud.
- **Enclosure**: Hermetically sealed.

**SIGMA**  
SIGMA INSTRUMENTS, INC.  
91 Pearl St., So. Braintree 85, Mass.  
AN AFFILIATE OF THE FISHER-PIERCE CO. (SINCE 1890)

**NEW PRODUCTS**

**SIGNALLING CONTROLLER.**—Can be used with any transducer generating a dc signal to provide automatic industrial process control. Reacts to 1 µv changes. Calibration accuracy, ±0.25% of full scale; available ranges, 1 to 100 µv.

Thermo Electric Co., Inc., Dept. ED, Saddle Brook, N.J.  
CIRCLE 246 ON READER-SERVICE CARD

**LOW POWER CONTACTS.**—For use with company's type HR multipole relays, these interchangeable palladium alloy contacts are designed for electronic switching, grid, and instrument control circuits.

Ward Leonard Electric Co., Dept. ED, Mt. Vernon, N.Y.  
CIRCLE 247 ON READER-SERVICE CARD

**COAXIAL TERMINATIONS.**—For -450 to +440 F use, units have dc to 3 kc range, 100 to 9 ohm resistance, type N or C male or female connectors. Average power dissipation, 1 w; vswr, below 1.2 to 3 kc.

Stoddart Aircraft Radio Co., Inc., Dept. ED, 6644 Santa Monica Blvd., Hollywood 38, Calif.  
CIRCLE 248 ON READER-SERVICE CARD

**DRAFTING MACHINE.**—Portable Draftette Senior 12 folds like a jackknife, attaches to drawing board, desk or table. Has one-piece 6 x 9 in. interchangeable scale divided into 16ths or 10/50ths and 300 deg protractor. Available with or without 20 x 26 in. drawing board.

David Miller & Associates, Dept. ED, Box 572, Beverly Hills, Calif.  
CIRCLE 249 ON READER-SERVICE CARD

**VOLTAGE REFERENCE PACK.**—For printed circuit board mounting. Output voltage, 8-4 v ±5% stability, ±1 mv over ±10% line variation in all 2v supply; temperature coefficient, ±0.001% per deg C from 55 to +100 C. Encapsulated in epoxy housing 1 in. in diameter and 1-1/4 in. high.

International Rectifier Corp., Dept. ED, 1521 E. Grand Ave., El Segundo, Calif.  
CIRCLE 250 ON READER-SERVICE CARD

**MINIATURE STRAIN-CAGE SIGNAL AMPLIFIER.**—Model CA9 operates from 28 v dc, delivers 0 to 5 v dc, has self-contained balance and gain controls. Single package 3.87 x 1.87 x 1.16 in. combines power source for excitation and signal amplifier. Unit has 0 to 2 kc response, operates from -65 to +165 F, withstands 35 g vibration and 100 g shock.

Statham Instruments, Inc., Dept. ED, 12401 W. Olympic Blvd., Los Angeles 64, Calif.  
CIRCLE 251 ON READER-SERVICE CARD

**FOR...**

Slip-On Insulation
Instrument Tubing
Bundle Sheathing
Medical Tubing
Pigtails...

**USE SPAGHETTI SLEEVING**
MADE FROM TEFON*

PF Spaghetti sleeving has these important advantages:

1. Good dielectric strength (500 to 2000 volts/mil)
2. Excellent electrical properties at high temperatures (300°F) and a wide frequency range
3. Low coefficient of friction. It slips easily on long lengths of wire up to 3 ft.
4. Eliminates the need for silver coated wire
5. Zero moisture absorption
6. Unaffected by any commercial chemical
7. Stress relieved for negligible shrinkage

25 sizes, 2 wall thicknesses, 10 colors in stock, 100% inspected and controlled dimensionally are available.

Write, wire or call for full details, competent engineering assistance and information on special sizes and wall. PF Teflon® flexible tubing, heavy-walled tubing and rod stock are also available.

PENNSYLVANIA FLUOROCARBON CO., INC.  
1115 W. 28th St., Phila., Pa.  
READER-SERVICE NUMBER 6-0605

*P.Teflon® trade name for Tetrafluoroethylene-chlorotrifluoroethylene copolymer file
Power Amplifier

Provides 15 kw average output

The model QK622 Amplitron is an S band power amplifier stage rated at 3 megawatts peak and 15 kw average output. It supplies full power over an operating band of 2900 to 3100 mc at over 70% efficiency. It requires no heater power for starting or operation and lasts 1000 hr at rated power output. Pulse duration is 10 nsec; duty cycle, 0.005; pulse voltage, 50 to 55 kv; peak anode current, 65 amp; rf input, 475 kw; and weight with permanent magnet, 125 lb. The unit can be operated at reduced peak power level to serve as a driver stage. High efficiency is retained at a peak power output of 600 kw and a gain of 10 db.


CIRCLE 253 ON READER-SERVICE CARD

Timer Kits

For process control

For use in process control, life testing, pulsing, and flashing, these timer kits are available in cycle lengths from 60 sec to 1 revolution per hr. They consist of a heavy duty, 115 v, 60 eps synchronous motor that drives an adjustable split cam assembly which actuates a totally enclosed, dustproof snap action switch. Contacts are rated 15 amp at 12 v, 5 amp at 250 v ac, noninductive. Multi-range timers for repetitive cycle timings are also available.

Herbach & Rademan, Inc., Dept. ED, 1204 Arch St., Philadelphia 7, Pa.

CIRCLE 254 ON READER-SERVICE CARD

New from Fairchild

LOW STORAGE SILICON TRANSISTORS

Fairchild's 2N1252 and 2N1253 provide the guaranteed shorter total switching time necessary for direct-coupled transistor logic circuits (DCTL) in combination with the inherent reliability and power dissipation that silicon mesa construction affords.

75 microseconds is typical storage-plus-fall time at 150 ma collector current on these new devices; 150 mua. is guaranteed. For low level operation, typical storage time is 35 mua. for Ic=Ib1=Ib2=10 ma. This performance makes them usable for saturating type logic circuits and high-current-lowered switching circuits. A few of the many applications are magnetic core drivers, drum and tape write drivers, high-current pulse generators and clock-amplifiers. They also provide extra safety factor in less critical applications.

To achieve high reliability, these transistors are preaged at 300° C, a temperature that would destroy most other types. This preaging time at 300° C accomplishes a stabilization of characteristics equivalent to thousands of hours of operation at junction temperatures as high as 175° C.

For full information, write Dept. B-6.

CIRCLE 255 ON READER-SERVICE CARD
Business

The 8th definition of business, according to Webster, reads as extracted, "...to increase business by advertising." This advertisement has the sole purpose of offering the capabilities of BJ Electronics, Borg-Warner Corporation, to military suppliers for the manufacture of precision electronics. From your print specifications, this establishment will fulfill orders quickly and economically, utilizing 10 years of know-how and over 90,000 sq. ft. of new, completely equipped facilities. Consider your need, then...consider this a direct solicitation of your sub-contract electronic business.

Write for facilities brochure. BJ Electronics, Borg-Warner Corporation, 3300 Newport Boulevard, Santa Ana, California.
National Direct Dial Number 714 KI 5-5581, TWX 5291.
Inertia Switch

Operates between 0.25 and 10 g

This hermetically sealed inertia switch is set to operate at an acceleration or deceleration between 0.25 and 10 g and at a time between 0.05 and 60 sec. Built to MIL-E-27872A, it is rated 3 amp, resistive with 12 to 30 v dc operating voltage.

Walter Kidde & Co., Inc., Aviation Div., Dept. ED, Belleville, N.J.

CIRCLE 260 ON READER-SERVICE CARD

Variable Speed Drives

1/50 to 1/3 hp

Series SC-31 variable speed drives cover the 1/50 to 1/3 hp range and use no tubes. They have wide speed ranges with stepless adjustment from zero to full speed and use circuit breakers for armature protection.

Applied Technology Corp., Dept. ED, 475 Fifth Ave., New York 17, N.Y.

CIRCLE 261 ON READER-SERVICE CARD

Time Delay Relay

Delay of 0.05 to 60 sec

Model N17 is a subminiature time delay relay which uses all-silicon semiconductor devices for maximum reliability. The time delay is established by RC time constant circuitry, permitting an overall standard accuracy of ±5%. Better accuracies are available. The unit's time delay is 0.05 to 60 sec, preset at the factory. Ambient temperature (operating) ranges from -55 C to +71 C. Input voltage is 24 to 32 v dc, and current drain is 50 ma at 28 v.


CIRCLE 262 ON READER-SERVICE CARD

CIRCLE 263 ON READER-SERVICE CARD

Hudson has the answer!

Hudson offers the widest selection of standard tooling, cover assemblies with innumerable modifications and special cases and covers for unusual applications. All finishes are available for components of mumetal, nickel-silver, aluminum, brass, copper, steel and stainless steel.

Hudson facilities range from batteries of standard and special presses to a fully equipped sheet metal department capable of handling your most rigid requirements.

Hudson Tool & Die Co. Inc

18-38 Malvern St., Newark 5, N. J.

TELEPHONE: MARKET 4-1802

TELETYPE: NK 1056

Precision Metal Components for Electronics, Nucleonics, Avionics and General Industrial Applications
ELECTRONICS: In the half century since the invention of the original audion tube by De Forest, the art of electronics has expanded to a fourteen billion dollar industry that is contributing in hundreds of ways to our knowledge of the universe and our understanding of life itself. At Lockheed, for example, over half the technical staff is engaged in electronics research and development.

Significant contributions to the advancement of the state of the art in electronics have been made by Lockheed engineers and scientists in such areas as: computer development; telemetry; radar and data link; transducers and instrumentation; microwave devices; antennas and electromagnetic propagation and radiation; ferrite and MASER research; solid state electronics, including devices, electrochemistry, infrared and optics; and data reduction and analysis.

Over one-fifth of the nation's missile-borne telemetering equipment was produced by Lockheed last year. Its PAM/FM miniaturized system provides increased efficiency at one-fourth the weight of FM/FM missile-borne systems.

Advanced development work in high-energy batteries and fuel cells has resulted in a method for converting chemical energy directly into electrical power that promises a fuel utilization of almost 100% and an energy conversion efficiency of 70% or better.

Areas of special capability in computer development include the design of large scale data handling systems; development of special purpose digital computing-and analog-digital conversion devices; development of high-speed input-output equipment; and advanced research in computer technology, pattern recognition, self-organizing machines, and information retrieval.

Other major developments are: a digital flight data recorder able to record each of 24 channels every few seconds; digital telemetry conversion equipment to reduce telemetered test data to plotted form rapidly and inexpensively; advancements in the theory of sequential machines; and a high-speed digital plotter that can handle some four thousand points per second with the finished plot programmed into the data tape as a continuous curve.

Lockheed Missiles and Space Division is engaged in all fields of the art—from concept to operation. Its programs reach far into the future and deal with unknown environments. It is a rewarding future which scientists and engineers of outstanding talent and inquiring mind are invited to share. Write: Research and Development Staff, Dept. F-21, 962 W. El Camino Real, Sunnyvale, California. U.S. citizenship required.

"The organization that contributed most in the past year to the advancement of the art of missiles and astronautics."

NATIONAL MISSILE INDUSTRY CONFERENCE AWARD

Lockheed

MISSILES AND SPACE DIVISION

Weapons Systems Manager for Navy POLARIS FBM; DISCOVERER SATELLITE; Army KINGFISHER; Air Force Q-5 and X-7.

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NOW! COMPLETE FACTS ABOUT EVERY CIRCUIT...RIGHT BEFORE YOUR EYES!

DIT-MCO FAULT LOCATION CIRCUIT ANALYZER AUTOMATICALLY PLOTS TEST SEQUENCE...PINPOINTS, IDENTIFIES AND PATTERNS CIRCUIT ERRORS.

DIT-MCO’s exclusive cross-reference Matrix Chart automatically pinpoints each circuit flaw and puts clear, concise test information directly in front of the operator! Horizontal and vertical indicator lights cross-reference to the matrix square corresponding to the circuit under test. This square details type of flaw, circuit number and exact error location. Once an error is detected, the operator immediately marks it on the matrix square, resets the Universal Automatic Circuit Analyzer and continues the test.

All corrections are made directly from the Matrix Chart after the test sequence has been completed. This saves up to 90% of time consuming searches through diagrams, manuals or interpretive readout devices. Because the DIT-MCO Matrix Chart is a simple, concise representation of all test circuits, specifications, instructions and modifications, nothing is left to chance or guesswork! The comprehensive nature of the Matrix Chart system provides important data for statistical analysis and permits effective checks and balances from the drafting board to obsolence!

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ELECTRONICS DIVISION - BOX 06-20
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CIRCLE 264 ON READER-SERVICE CARD

NEW PRODUCTS

ACRYLIC CONTROL KNOB.—Has integrally molded pointer with color filled engraved hair line on under side. Fits 1/4 in. shaft and comes in variety of colors. Skirt diameter is 1 in.

Industrial Devices, Inc., Dept. ED, 982 River Rd., Edgewater, N.J.

CIRCLE 265 ON READER-SERVICE CARD

CONTROLLED ATMOSPHERE SYSTEMS.—Chambers provide under 1 ppm contamination without excess inert gas flushing, reach 5 x 10^-6 ultimate vacuum in less than 20 min. Equipped with full-view Plexiglas domes.

Scientific Engineering Labs, Dept. ED, 1510 Sixth St., Berkeley 10, Calif.

CIRCLE 266 ON READER-SERVICE CARD

DELAY-LINE ASSOCIATED CIRCUITRY.—Complete custom delay packages to fit input, output, and packaging requirements, including amplifiers, flip-flops, and logic circuits.

Deltimco, Inc., Dept. ED, 608 Fayette Ave., Mamaroneck, N.Y.

CIRCLE 267 ON READER-SERVICE CARD

MINIATURE TUBE AND TRANSISTOR SOCKETS.—Type JF-424, for JETEC type sockets, has four contacts, Teflon body, is designed for compression mounting without additional hardware.

Fluorcarbon Products Inc., Dept. ED, Camden 1, N.J.

CIRCLE 268 ON READER-SERVICE CARD

MINIATURE RECTANGULAR CAPACITOR.—Type KLU has four times the life required by MIL-C-25A, is 80% smaller than previous units. Operates to 125° C. Voltage ratings, 600 v to 50 ky.

Plastic Capacitors, Inc., Dept. ED, 2620 N. Clybourn Ave., Chicago 14, Ill.

CIRCLE 269 ON READER-SERVICE CARD

CONNECTOR TOOLS.—Models 15500, 15510, and 15520 respectively crimp, insert, and remove the company's miniature DS connectors.

Deutsch Co., Dept. ED, 7000 Avalon Blvd., Los Angeles 3, Calif.

CIRCLE 270 ON READER-SERVICE CARD

HEAT DISSIPATING COIL.—Finned aluminum coil that clamps to rotary components, increasing their operating temperature limits. Made to fit size 8, 10, 11, 15, and 18 units.

Kearytt Co., Inc., Dept. ED, 1500 Main Ave., Clifton, N.J.

CIRCLE 271 ON READER-SERVICE CARD

CIRCLE 272 ON READER-SERVICE CARD

CIRCLE 273 ON READER-SERVICE CARD
Bulkhead Mounting Filters

Low pass

Series JX bulkhead mounting, low pass filters have a variety of ac and dc voltage ratings and current ratings from 5 ma to 50 amp. Depending on the model, they are rated for maximum ambient temperatures of 85 to 125 C.


CIRCLE 273 ON READER-SERVICE CARD

Toggle Switch

Four-way operation

The type 8SB2-1 toggle switch combines the advantages of multi-circuit control, single-hole panel-mounting, and a toggle actuator, with subminiature size. It comprises eight type USM5 switches, secured in a mounting bracket, with a four-way toggle mechanism. Mounting in panels up to 1/4 in. thick, the toggle is maintained in center position and is spring-retumed from each of the four possible operate positions. Each operate position actuates two spdt switches and the eight basic switches meet MIL-S-6743. Ratings for each switch are: 2.5 amp 30 v dc inductive; 3 amp 30 v dc, resistive; 5 amp, 125/250 v ac.

The W. L. Maxson Corp., Unimax Switch Div., Dept. ED, Ives Rd., Wallingford, Conn.

CIRCLE 274 ON READER-SERVICE CARD

DC Relay

For printed circuitry

For use in printed circuitry, this miniature spdt relay has a standard operating voltage of 3 to 24 volts ac, dc resistance range to 8500 ohms, and a power requirement of 0.1 w. Contact rating is 1 amp, 50 v dc, resistive.

Sprague Electric Corp., Dept. ED, Frederick, Md.

CIRCLE 275 ON READER-SERVICE CARD

ELECTROSNAP CORPORATION
SWITCH DIVISION
4216 W. Lake Street, Chicago 24, Illinois
Telephone: VAn Buren 6-3100 • TWX No. CG-1400

Write for new technical literature and specifications on environment-free switches.
Formica perfects new Flame Retardant grade

New EP-37 Properties...

- Flame retardant
- Self-extinguishing
- Dimensional stability under both solder dipping and humidity conditions
- Million megohms IR
- Cold punch 1/16"
- 10# avg. bond strength
- 500°F. solder heat resistance for 25 secs.

The team shown above demonstrates the flame retardant, self-extinguishing properties of the newest Formica® copper clad, EP-37. Because of these unusually effective properties, the new paper-epoxy is well suited for use in computers, radio, tv, telephone and aviation electrical devices. Increased dimensional stability—30% greater than existing grades under moisture conditions—offers many other application advantages.

This basic new material offers the additional properties shown at left—so essential for dependable printed circuit performance. For complete information, send for free test sample and data information. Formica Corporation, a subsidiary of American Cyanamid, 4512 Spring Grove Ave., Cincinnati 32, Ohio.

NEW PRODUCTS

Envelope Delay Equalizer
Provides 50 delay characteristics

Multistage delay equalizer model EN-766 offers 50 delay characteristics to complement or equal envelope delay introduced by wire lines and other voice bandwidth circuits. The frequency of maximum delay is selectable in five steps from 1 to 10 kc, while the delay at each frequency is variable in 10 steps from 0.8 to 3.5 msec.

Rixon Electronics, Inc., Dept. ED, 2414 Reo Dr., Silver Spring, Md.

CIRCLE 278 ON READER-SERVICE CARD

Microwave Signal Source
Has interchangeable tuning units

Microwave signal source model KSS has a 1 to 11 kmc range and four interchangeable plug-in tuning units. Outputs are 80 to 400 mw in the lowest range and 14 to 40 mw in the highest. The tuning unit may be externally modulated and generates internal cw signals and variable 10 to 10,000 ps square wave signals. Frequency settings are accurate.

Polarad Electronics Corp., Dept. ED, 43-34th St., Long Island City 1, N.Y.

CIRCLE 279 ON READER-SERVICE CARD

Magnetostrictive Delay Line
For delays to 100 μsec

For delays to 100 μsec and digit rates to 1 m/sec, the type 5810 magnetostrictive delay line may have any number of continuously variable taps spaced at 2 μsec. Input and output impedances are made to requirements.

Ferranti Electric Inc., Electronics Div., Dept. ED, 95 Madison Ave., Hempstead, N.Y.

CIRCLE 280 ON READER-SERVICE CARD
NEW HIGH-RELIABILITY TANTALUM CAPACITOR SERIES

125°C operation • standard ±10% tolerance

Now, premium performance solid tantalum capacitors to fill your highest reliability requirements!

134 ratings from 1-330 μf, 6-35 v

Exceeding all existing MIL specs over a full range of industry-standard ratings and case sizes, the subminiature SRM series features . . . new low dc leakage limits and long operating and storage life . . . standard ± 10% tolerance . . . operation from -80°C to +125°C . . . ruggedized construction . . . reverse voltage capability . . . nominal voltage derating required at 125°C. TI's advanced processing techniques and 100% testing of pre-aged units assure SRM capacitors to the most exacting reliability standards.

*Trademark of Texas Instruments Incorporated

Contact your nearest TI sales office today for delivery information and your copy of the 12-page bulletin listing specifications of all 134 ratings.
NOW... VTVM's for all applications

... panel-mounted... small-size ELECTRONIC VOLTMETERS

SEND FOR CATALOG 10A which gives complete specifications and prices on panel-mounting, relay-rack and plug-in models.

Build accuracy into all your equipment, test and production alike, with Metronix DC and AC Electronic Voltmeters.

These Metronix instruments are no larger than conventional voltmeters, cost little more. They offer higher accuracy because they don't load the circuit. In AC applications, they respond accurately over a frequency range of 20 CPS to 100 KC.

Selective, step-ranges run from 0-10MV; to 0-300V AC, and 0-1 to 0-1000V DC. Metronix Electronic Voltmeters can be furnished in MIL-spec. rack-mounting and plug-in models.

Metronix INC
A SUBSIDIARY OF ASSEMBLY PRODUCTS, INC. Chesterland 17, Ohio
CIRCLE 283 ON READER-SERVICE CARD

FOR NARROW-BAND F.M. . . . .

... Marconi designed this premium FM/AM generator with very high stability, calibrated AM/AM controls, 3 mod. frequencies and less than 25 cps spurious FM. Range is 1.5 to 220Mc without extra equipment.

FM: 0.5, 0.15kc; also high dev. AM: 0-500, also simultaneous AM/AM, AM/AM. Output: 0.1 to 100,000 V. Stability: ±0.02% per 10 min.

Write for 4 page brochure

MARCONI INSTRUMENTS
111 CEDAR LANE • ENGLEWOOD, NEW JERSEY
CIRCLE 284 ON READER-SERVICE CARD

NEW PRODUCTS

140 KW POWER-TEMPERATURE REGULATOR.
Model SPC5009 controls power input to an electrically heated process to maintain a precise temperature. Can be used in high temperature testing of materials and structures using radiant heating lamps. Available in 50 kva air cooled or 140 kva water cooled versions.

Research, Inc., Dept. ED, 115 N. Buchanan, Hopkins, Minn.
CIRCLE 285 ON READER-SERVICE CARD

CENTRIFUGE SPEED CONTROL.—For use with the company's model RCT 1 and RCT 2 centrifuge acceleration test machines, this unit provides electronic programming, sequencing, remote control, and infinitely variable g loadings.

Rucker Co., Dept. ED, 4710 San Pablo Ave., Oakland 8, Calif.
CIRCLE 286 ON READER-SERVICE CARD


National Vulcanized Fibre Co., Dept. ED, 1059 Beech St., Wilmington 99, Del.
CIRCLE 287 ON READER-SERVICE CARD

VOLTAGE-TO-TIME CONVERTER.—Model 1230 connects directly to the company's model 1031 counter-timer to provide a 4-digit in-line readout of dc voltages. It accepts ±1 mv to ±100 v dc inputs and delivers two pulses directly proportional to input voltage. Conversion with automatic polarity is effected in 10 msec with 0.05% accuracy.

Systron Corp., Dept. ED, 950 Galindo St., Concord, Calif.
CIRCLE 288 ON READER-SERVICE CARD

LOW- TORQUE DIAL COUNTER.—Designed as position indicator for servo systems with constant torque over the entire range. Has two concentric pointers, one connected directly, the other back geared to the input shaft. Directly readable to 0.00.

D. S. Plumb Co., Inc., Dept. ED, 77 Norfolk St., Newark 3, N.J.
CIRCLE 289 ON READER-SERVICE CARD

RATE GYRO TEST TURNTABLE—Multiple fixed rate model T-893 has provision for 14 slip ring connections and a 3/8 in. pipe pneumatic connection to the 12 in. table top.

Sterling Precision Corp., Dept. ED, 17 Matinecock Ave., Port Washington, N.Y.
CIRCLE 290 ON READER-SERVICE CARD

MINIATURE TELEPHONE-TYPE DC RELAY CUTS SPACE REQUIREMENTS BY 1/4!

Available up to 4PDT, this compact telephone-type DC relay measures only 1 3/4" long x 1 1/2" wide x 13/16" high over stock. Up to 500 CPS vibration. Current ratings: up to 3 amps. Furnished with silver, palladium, or gold alloy contacts and beryllium copper contact springs. Stack insulation Type G1 Glass Melamine. Coil resistances available up to 10,000 ohms. Insulated up to +125°C. Available in open or hermetically sealed models. Type K enclosure available with either plug-in or solder terminals. Dimensions of hermetically sealed units 1 1/8" long x 1 3/4" wide x 1 3/4" high. For detailed specifications on this compact unit write for your free copy of AEMCO's newest relay catalog.

MINIATURE TELEPHONE-TYPE DC RELAY CUTS SPACE REQUIREMENTS BY 1/4!

MINIATURE TELEPHONE-TYPE DC RELAY CUTS SPACE REQUIREMENTS BY 1/4!

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MINIATURE TELEPHONE-TYPE DC RELAY CUTS SPACE REQUIREMENTS BY 1/4!
Solving switch problems fast...

your job... and Centralab's

Series 100: 1/8" diameter
Rating: 0.5 amp, at 6 VDC
100 ma at 110 VAC
Breakdown: 750 V. R.M.S.
Up to 12 positions/section

Series 20: 1/8" diameter
Rating: 2 amp, at 15 VDC;
150 ma at 110 VAC
Breakdown: 1500 V. R.M.S.
Up to 12 positions/section

Series 27S: 1/16" diameter
Rating: 2 amp, at 15 VDC;
150 ma at 110 VAC
Breakdown: 1500 V. R.M.S.
Up to 23 positions/section

Series 230: 3/16" diameter
Rating: 25 amp, at 6 VDC;
7.6 amp, at 110 VAC
Breakdown: 3000 V. R.M.S.
Up to 24 positions/section

Your switch problems can be solved quickly and efficiently at Centralab. No matter how unusual or difficult the switch, you can get samples fast, quotations fast, and production fast! This is a result of years of specialized experience and superior facilities for designing and manufacturing a wide variety of switch types.

Typical of the extensive range of units available to you are the four Centralab ceramic section switches shown here. These switches, and many others, are also available with phenolic sections, for economy applications, or where a larger number of positions is required.

**DESIGN AIDS FOR ENGINEERS**

Centralab's unique Switch Visualizer, which simulates actual switch operation, will help you simplify and speed up switch design. Used in conjunction with our detailed layout sheets (available for all Centralab switch types), they greatly facilitate your job in switch design (and ours, too). Write for them today—along with a copy of Centralab Switch Catalog 42-405.

A Division of Globe-Union Inc.
960 E. KEEFE AVE. • MILWAUKEE 1, WIS.
In Canada: 669 Bayview Ave., Toronto 17, Ont.
New ceramic compositions, and new techniques have been introduced many times by Coors. Eighteen years ago Coors met the requirements of engineers in an early atomic project by supplying both a new ceramic composition and a new isostatic technique for forming ceramic components. The result—a new, mechanically strong, completely homogenous ceramic having excellent electrical properties.

Demands for better, stronger materials have been answered by Coors throughout the 47 years of their experience. Continuous research assures future developments. For example, Coors AD-99 is only one of several ceramic materials recently developed to meet the new needs of the electronic industry.

Parallel with the development of new ceramic compositions is the research for new and better techniques. For example, a completely new department for metalizing and brazing was installed and recently enlarged. Ceramic-to-metal assemblies can be furnished where brazing temperatures go as high as 1083°C—bonds have tensile strengths as high as 9,000 to 12,000 psi.

Ceramic compositions or production techniques are of little value without precise control. You need close tolerances—you obtain them from Coors in production runs, or experimental prototypes. Customary, careful work by over 600 skilled workers permits holding tolerances of 30 millionths of an inch on production runs.

To meet increased demands, additional engineers are being assigned to the field—Coors engineers in your neighborhood give you on-the-spot ceramic design service. They need only your invitation to help you with your ceramic problems.

For information concerning our facilities and for data about Coors high alumina ceramics, please write for bulletin 858.

Coors
COORS PORCELAIN COMPANY
600 Ninth Street, Golden, Colorado

NEW PRODUCTS

5000 V Power Supply
Has dual range output

For gas proportional counters which use high voltage gases, the model HV-3C power supply has two output ranges from 1 to 2.5 and 1 to 5 kV. A 10-turn, 1000-division dial provides continuously variable output within the two ranges and also makes resetting of voltages accurate within ±5% in the high range and ±3% in the low. The unit will deliver 100 µA at up to 3 kV and has ±6% high and ±4% low range stability. Voltage regulation is ±2% high range and ±1% low range for rated 105 to 125 V line variations.

Technical Measurement Corp., Dept. ED, 441 Washington Ave., North Haven, Conn.
CIRCLE 296 ON READER-SERVICE CARD

Reaction Vibration Machine
Handles loads to 10,000 lb

The type RVH-96-10,000 reaction vibration machine vibrates loads up to 10,000 lb in both vertical and horizontal directions. It requires no special foundation to absorb reactive forces and operates from 5 to 60 cps with adjustable displacement from 0 to 0.25 in. maximum. Changes in vibration direction and displacement settings can be made in minutes with the load in position. Maximum acceleration rating is 10 g, and table size is 8 x 8 ft. The system is designed to MIL-STD-167 requirements.

L.A.B. Corp., Dept. ED, 116 Onondaga St., Skaneateles, N.Y.
CIRCLE 297 ON READER-SERVICE CARD

Display Tube
For airborne use

Designed for airborne and monitor applications, the model 7AUP4 nine-pin display tube is 7 in. in diameter and has a 7/8 in. diameter neck for decreased deflection power. It
Heavy Duty Enclosures

Modular
Using a 22-1/16 in. wide frame, these modular, heavy duty enclosures provide flush mounting 19 in. panels of any thickness. The panels may be recessed to any depth in the frame. Flush or huddle doors are available. The 1-1/2 in. wide, 14 gauge steel, box channel construction with reinforced, built-in 12 gage inter mounts and lift eye receptacles provides rugged protection and mobility in modular or single unit applications.

Amero Engineering Co., Dept. ED, 133 W. Ainslie St., Chicago 31, Ill.

Thytratrons

For grid controlled rectifier service
Xenon thytratrons VTP 7386/ 6278/5F14 are designed for grid controlled rectifier service. The first has plate current of 6.4 amp average and 100 amp peak and can be used to control current pulses to welding transformers, to control power to dc motors supplied from ac lines, or to convert ac power sources to dc supplies. The second can be used in inverters for generation of medium high frequency alternating currents from a low voltage dc source.


ESC delay lines

take off with America's talking satellite

On December 18, 1958, the world entered a new era of communications with the successful orbitalting of an Atlas ICBM—the Talking Satellite that broadcast President Dwight D. Eisenhower's Christmas message to the world. Circling the earth at a speed of more than 17,000 mph, the Talking Satellite repeated the President's message, erased it, and received and rebroadcast new messages in both voice and code.

ESC Corporation is justifiably proud that its delay lines were selected to aid in this electrifying triumph for America and her electronics industry. Especially designed by ESC, these delay lines were used in the timing sequence for propulsion, the guidance system and the telemetering system.

As America's largest manufacturer of custom built and stock delay lines, ESC has continually met the responsibility of leadership by providing virtually every type of delay line needed by defense and industry. If you have a delay line problem, let ESC's design staff suggest a custom-built answer.

WRITE TODAY FOR COMPLETE TECHNICAL DATA

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

CORPORATION 374 BERGEN BOULEVARD, PALISADES PARK, NEW JERSEY

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

... IN THE SMALLEST SPACE!

Tenney-mite STRAT environmental chamber

Altitudes to 200,000 ft., temperatures from -100° F to +350° F, in only 4 square feet of floor space. Now, any company can own a combined altitude and temperature test chamber ... without sacrificing much valuable floor space. And the investment, too, is reasonable.

Only Tenney Engineering, world's largest and most experienced creator of environmental equipment, could produce the Tenney-mite Strat. Write for further information.

Write for a descriptive catalog and complete information on Tenney's research and development, engineering consultation, and design services.
CANNON PLUGS

FOR IMMEDIATE LARGE QUANTITY DELIVERY AT FACTORY PRICES

2500

Yes! You can now order up to 2500 each of such popular Cannon Connector types as Miniature D, KO, DPD, DPA, DPX, etc. Immediate shipment at factory prices.

RELIABLE MULTI-PURPOSE "K" SERIES

K STANDARD

FOR AIRCRAFT, ELECTRONIC, INSTRUMENT, MILITARY, MISSILE, INDUSTRIAL AND COMMERCIAL APPLICATIONS Standard K and RK, in straight and angle 90° plugs with wall mounting receptacles. Conduit and clamp entry types. 1 to 110 contacts in 250 different insert arrangements. 10, 15, 30, 40, 60, 80, 115 and 200 amp. silver plated brass on copper contacts. High quality phenolic, melamine, and formica insulators. Cadmium plated aluminum alloy shells. Flashover voltages: 110 to 5000V, 60 cps ac rms.

KH-RKH

FOR USE UNDER CRITICAL PRESSURE AND LEAKAGE CONDITIONS—Hermetically sealed plugs with steel shells, steel contacts, and Canseal glass insulated for true hermetic sealing. Electro tin plating over cadmium plate over copper flash provides highly receptive surface for soldering and corrosion resistance.

RK

FOR FLUSH OR SEMI-FLUSH MOUNTING—Cannon RK Plug assemblies are equipped with an external threaded coupling nut which is the reverse of the standard K Series. Note: RK will mate only with RK's.

TBF-K

FOR CARRYING CIRCUITS THROUGH BULKHEADS Cannon TBF-K Bulkhead Plugs feature a double faced construction allowing mating at both ends. Pin inserts. Single piece shell.

RLKL-LKL

FOR TV AND OTHER PANEL SWITCHING OPERATIONS—Quick connect and disconnect RLKL Plugs are designed for one-hand fast disconnect use on TV station program switching panels and similar type operations. Feature a quick coupling means. Latch-lock secures plug to mated fitting (RLKL receptacle). Thumb pressure releases it.

FW-K FWR-K

FOR OPEN FLAME PROTECTION AGAINST HIGH TEMPERATURES—Cannon K Firewall plugs are available in straight and angle 90° shell types. Wall mounting receptacles also available. Phenolic or fireproof inserts of glass-filled materials. Crimp type contacts. Cannon originated the firewall connector and continues to be the leader in this important field.

CANNON ELECTRIC COMPANY—3208 Humboldt Street, Los Angeles 31, California. Please refer to Dept. 841.

Electronic Design • June 24, 1959

LARGEST FACILITY IN THE WORLD FOR PLUG RESEARCH-DEVELOPMENT-MANUFACTURE
General Electric
small panel meters

BIG LOOK styling of General Electric's new small panel meters adds functional beauty to your products and equipment. Distinctive design creates the illusion of bigness, yet these new meters fit into the same panel space as old style meters. You get big border-to-border scale . . . modern, clean-line design . . . your choice of seven attractive colors . . . and widest selection of scales.

Up to 28% longer scales allow accurate readings. Tough neoprene gaskets provide complete protection of internal parts and movements from dirt, dust or water. Best of all, General Electric BIG LOOK meters are competitively priced. And you can plan on fast delivery, too, from a national network of authorized stocking distributors and G-E Apparatus Sales Offices.

Let G.E.'s BIG LOOK in panel meters help you improve the appearance and reliability of your equipment at low cost. Get the full story. Just contact your G-E Apparatus Sales Engineer, or write for bulletin GEA-6678, Sect. 593-303, General Electric Co., Schenectady, N. Y.

NEW PRODUCTS

Space Environment Chamber

Simulates 100 mile altitude.

This chamber simulates environmental conditions at altitudes to 100,000 miles. It is 8 ft in diameter and 16 ft long, permitting the testing of large components, assemblies, and subassemblies. Pumping equipment capacity is sufficient to handle considerable quantities of gas such as might be experienced in combustion and ion propulsion studies. The system is track mounted, and the chamber can be opened either by rolling the removable end, or by moving the cylinder from the fixed end.

Scientific Engineering Labs, Dept. ED, 1510 Sixth St., Berkeley 10, Calif.

CIRCLE 309 ON READER-SERVICE CARD

DC Power Supplies

High voltage

These tube type and semiconductor high voltage dc power supplies are designed for such applications as hard tube radar modulators, tube and high frequency structural testing installations, wind tunnel charting supplies, and linear accelerators for atomic research. One console houses all controls, meters, and protective devices for each supply unit. Ratings are 10 to 1000 kv de and milliamperes to 250 amp.


CIRCLE 310 ON READER-SERVICE CARD

Etched Precision Resistors

In values to 200 ohms per sq in.

For use as meter shunts and attenuator pads, these etched precision resistors have resistive elements of cupro-nickel alloy and can be bonded to phenolic impregnates.

CIRCLE 311 ON READER-SERVICE CARD
paper laminate, epoxy glass laminate, metal, or silicone glass laminate. Power dissipation averages 2.5, 15, and 30 w per sq in., respectively. Obtainable tolerances are 1% from 0 to 1 ohm, 0.5% from 1 to 10 ohms, and 0.1% above 10 ohms. The units have resistances ranging from fractional values to 100 ohms per sq in. and will withstand 100% overload for short periods.

Photocircuits Corp., Dept. D, 31 Sea Cliff Ave., Glen Cove, N.Y.

CIRCLE 312 ON READER-SERVICE CARD

Subminiature Tube Shield
Removes up to 90% of heat
This heat-dissipating resilient thermal conductive elastomer called Elastaclam is designed to provide complete contact between heat transfer medium and glass envelope while protecting tubes from severe shock and vibration. Use of the material does away with dangerous hot spots and reduces bulb temperature in many cases up to 90%. Tube shield also permits continuous operation in ambient temperatures up to 200°C. Elastaclam is available for T3 flat press and T3 subminiature tube outline.


CIRCLE 313 ON READER-SERVICE CARD

Pulse Delay Network
Has 3.5 db maximum attenuation
Pulse delay network LD 228 meets MIL-E-5272 and MIL-STD-224 and has a delay of 75 ±5 nsec with taps at 38 ±3 and 47 ±5 nsec. Impedance is 330 ohms; flattening, 3.5 db; input and output rise times, 1 and 4 nsec, respectively.


CIRCLE 314 ON READER-SERVICE CARD

Shown Actual Size
These resistors meet and exceed all requirements except physical size, of MIL-R-93-B, and MIL-R-9444.

Top reliability in miniature size...
Daven wire wound resistors

For printed circuit boards, miniature plug-in packages... any tight place in which you must have a really small wire wound resistor, check Daven for the Super Davohm Miniatures that can solve your problem. For example...

1273
"Lollypop" 1274
Up to 400 K
Up to 100 K
1275
Up to 900 K

The overall reliability of Daven Miniature Resistors is possible because of an entirely new approach to subminiature production techniques. A unique spool design permits low-stress winding of fine resistance wire... obtaining 2 to 3 times the resistance value previously supplied on a miniature bobbin. This is done under the most stringent quality control and inspection.

The industry's widest range of sizes, temperature coefficients, and tolerances is available for your requirements. Write today for further information and a complete resistor catalog.

THE DAVEN CO. LIVINGSTON, NEW JERSEY

TODAY MORE THAN EVER THE DAVEN® STANDS FOR DEPENDABILITY
U.S. Hits Venus By Radar Beam; 56 Million Miles

1st Planet Contact
WESTFORD (Mass.), March 19—(UPI)—Man has made his first contact with another planet. Scientists reported tonight they detected a radar signal off Venus for a space round trip of 6.000,000 miles.

It was the first two-way contact with any celestial body beyond the moon.

President Eisenhower sent a special message congratulating scientists and engineers of the Lincoln Laboratory of the Massachusetts Institute of Technology for the achievement, one of the most spectacular of the space age.

"Congratulations to all those involved in this notable achievement," the President said."

Mode Smaller
The universe as man has been made smaller. The long, intricate contacts between Earth and Venus have been achieved.

EIMAC KLYSTRON POWERS VENUS CONTACT—100 TIMES FARTHER THAN PREVIOUS RECORD!

On February 10 and 12, 1958, a high-power radar of M.I.T.'s Lincoln Laboratory transmitted and received radar signals between Earth and Venus. A round-trip of 56,000,000 miles! This historic event was man's first radio contact with another planet. It was by far the longest man-made radio transmission on record.

The final amplifier tube of this giant radar is a super-power Eimac Klystron, the same used in missile and satellite detection and tracking. Eimac's long experience and leadership in the development and manufacture of ceramic-metal power klystrons enabled the firm to design a super klystron capable of producing tremendous amounts of RF energy at the desired frequency.

In this application, as in tropo-scatter installations throughout the world, Eimac Klystrons have won a reputation for exceptional reliability and long life. Today Eimac manufactures power amplifier klystrons for ultra high and super high frequencies.

The transmitter for Lincoln Laboratory's giant radar was built by Continental Electronics Manufacturing Company. The radar was sponsored and is supported by the Air Research and Development Command of the United States Air Force.

EITEL-McCULLOUGH, INC.
San Carlos, California

NEW PRODUCTS

Receiving Tubes
Have 100 mil heaters
Directly interchangeable with 13 mil prototypes, these radio receiving tubes employ 100 mil heaters. Type 18FW6 is a semiremote cutoff pentode for r-f application; type 18FM a dual control miniature pentagrid converter amplifier for converter applications; type 18FY6, a high mu triode; type 36AM3, a half-wave rectifier, and type 32ET5, a beam power pentode.


CIRCLE 316 ON READER-SERVICE CARD

Missile Programmer
Has 13 channels
Designed to MIL-E-5272, this missile programmer has 13 isolated channels with an operation time of 35 min and a time accuracy characteristic of ±20 msec. Current rating is 0.5 amp, 115 v, inductive and size is 2-3/8 x 3 x 6 in.

Ratigan Electronics Inc., Dept. ED, 425 W. Cypress St., Glendale 4, Calif.

CIRCLE 317 ON READER-SERVICE CARD

Ceramic Ladder Filters
Occupy less than 1 cu in.
For use in i.f. sections of superheterodyne communication systems, these ceramic ladder filters occupy less than 1 cu in. and directly replace conventional filters with up to 30 elements. Units with a 455 kc center frequency and 6 db bandwidth width from 4 to 50 kc have very low insertion loss.

Clevite Electronic Component Works, Div. of Clevite Corp., Dept. ED, 3311 Perkins Ave, Cleveland 14, Ohio.

CIRCLE 318 ON READER-SERVICE CARD

ELECTRONIC DESIGN • June 24, 1959
Total Temperature Probe

Measures while deicing heater goes

For use at flight speeds to Mach 2 and higher, the model 102-D probe provides precise total temperature measurements while deicing heat is continuously applied. It will deice within one minute when subjected to the icing conditions defined in Section 3.5, Paragraph 3 of MIL-P-25632A. By continuously removing boundary layer air from the internal flow through the probe, the temperature of the central core of the flow, and hence the indicated total temperature, is almost completely independent of the temperature of the probe housing.

Rosemount Engineering Co., Dept. ED, 4900 W, 78th St., Minneapolis 24, Minn.
CIRCLE 320 ON READER-SERVICE CARD

Electroluminescent Lamps

Last over 12 years

Glo-Scents lamps are electroluminescent panels that consume 0.1 ma per sq in., operate on 110 vac, 60 or 400 cps, and produce a brightness of 0.1 to 1 ft-L. Pale green, they range to 7 x 14 in. in size and last 50,000 hr.

Miller Dial & Name Plate Co., Dept. ED, 4400 N. Temple City Blvd., El Monte, Calif.
CIRCLE 321 ON READER-SERVICE CARD

Cathode Ray Tubes

11-1/4 and 13-3/16, in long

For portable and shallow TV sets, 17 in. type 17DHP4 and 21 in. type 21EMP4 cathode ray tubes are 11-1/4 and 3-3/16 in. long, respectively. Operated at 6.3 v, the 17DHP4 heater uses 0.45 amp and the 21EMP4 0.6 amp.

Westinghouse Electric Corp., Electronic Tube Div., Dept. ED, Box 284, Elmira, N.Y.
CIRCLE 322 ON READER-SERVICE CARD
CIRCLE 323 ON READER-SERVICE CARD

Now, from the Laboratories of CLARE,

THE MOST EXCITING RELAY DESIGN OF THE YEAR

NEW SIX-IN-LINE HG6F RELAY BRINGS BIG SAVINGS IN SPACE, POWER, AND COST

Latest in the Clare line of Mercury-wetted Contact Relays, world famous for their billions of operations*, is Type HG6F, a six-in-line flat-pack relay. This striking new design provides the most reliable, durable, maintenance-free relays ever made anywhere, plus these savings.

SAVES SPACE—
Unique packaging affords up to 50% savings in space over cylindrical multi-element mercury-wetted contact relays.

SAVES POWER—
Six switches per coil saves operating power.

SAVES COST—
Switch cost as much as 26% below cost of same number of switches in cylindrical packages.

*Mercury-wetted contact relays on test have completed over 6 billion operations with a contact load of 250 milliampere, and are still going strong.

MECHANICAL FEATURES
Flat, rectangular package makes most efficient use of chassis space. Printed circuit mounting eliminates custom internal wiring except for coil leads.

Units can be stacked in line without interaction.

No shelf deterioration; requires no maintenance.

Contacts cannot wear, get dirty, stick by locking or welding, nor chatter.

Tamper proof.

Completely protected against dust and dirt, corrosive fumes, and explosive atmospheres.

No mechanical damage when subjected to usual military shock and vibration tests.

ELECTRICAL FEATURES
Life expectancy measured in billions of operations.

No contact chatter or bounce.

Low and consistent contact resistance.

Full line of coil resistances.

Contacts rated at 5 amperes, 500 volts (d-c or r-m-s).

Product of voltage prior to opening, 250 volt-amperes.

Nominal operating time: 1 watt input, 11 milliseconds; 2 watts input, 7 milliseconds; 4 watts input, 5 milliseconds.
Release time: 4 milliseconds or less.

Maximum continuous dissipation: 5 watts at 100°F.

SEND FOR BROCHURE CPC-2
For complete information, contact C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Illinois. In Canada: C. P. Clare Canada Ltd., 2700 Jane Street, Toronto 15. Cable Address: CLARELAY

CLARE RELAYS
FIRST in the industrial field
New versatile relay
relies on Tung-Sol semiconductor

Tung-Sol semiconductors furnish the combination of sensitivity and ruggedness needed for Cutler-Hammer's new transistorized relays. The Tung-Sol units react quickly and display unfaltering electrical stability. They resist shock and vibration, and stand up under the most severe industrial service.

The cold weld seal found in all Tung-Sol power and high power transistors—an exclusive development of Tung-Sol research—contributes heavily to the long-life reliability Cutler-Hammer values. Cold welding gives a true hermetic, copper-to-copper seal and eliminates heat damage, "splash" and heat-caused moisture. The special seal stays vacuum-tight, moisture-proof even through "breathing".

If you need the power-saving, space-saving features of semiconductors...if your circuit calls for tubes—you can be assured of premium performance when you specify Tung-Sol. Tung-Sol makes both to a single high quality standard. Our applications engineers, expert in both vacuum tube and semiconductor problems, can give you an impartial recommendation for the circuit complement that most efficiently answers your design needs. Tung-Sol Electric Inc., Newark 4, New Jersey.

NEW PRODUCTS

Harness and Cable Assemblies
For extreme environments

These molded harnesses and special electric cable assemblies are produced from a variety of materials for maximum protection against specific environmental hazards. Harnesses can be made for -120 to +500 F continuous use and +600 F intermittent use. Any type and quantity of conductors, connectors and junctions can be provided.

Revere Corporation of America
Dept. ED, Wallingford, Conn.
CIRCLE 324 ON READER-SERVICE CARD

20 Amp Switch
Rain tight

Rain tight and explosion proof the 2CX3 switch is UL listed and suitable for use in Class I vapor-air mixtures, Groups C and D and in Class II dust-air mixtures, Groups E, F, and G. UL rating is 20 amp 125, 250, or 460 v ac.

Micro Switch, Div. of Minneapolis-Honeywell Regulator Co., Dept. ED, Freeport, Ill.
CIRCLE 325 ON READER-SERVICE CARD

FM Systems
For multichannel telemetry data

These fm systems multiplex various IRIG bands on a single tape recording head. They permit the recording of over 100 telemetry information channels on one multitrack tape recorder for playback in automatic data reduction equipment.

Wiancko Engineering Co., Dept. ED, 255 N. Halstead, Pasadena, Calif.
CIRCLE 326 ON READER-SERVICE CARD
CIRCLE 327 ON READER-SERVICE CARD
Precision Wirewound Resistors

Have specified temperature coefficients

In values of 10 ohms to 3 meg, these precision wirewound resistors are made with any specified temperature coefficient from −25 to +6000 ppm per deg C. They are available with solder lugs and axial, radial, or special leads.

CIRCLE 327 ON READER-SERVICE CARD

DC Power Supplies

Have 0.25% regulation

Built to MIL-T-943A requirements, these power supplies have ±150 or 300 V dc output and current ranges of 200, 400, and 1000 ma. Input is 115 V ±10% at 60 cps; regulation, 0.25% for line or load; ripple, 5 mv; and output impedance, 0.5 ohms. Output voltage is adjustable ±10%.

Lawn Electronics Co., Inc., Dept. ED, Woodward Rd., Englishtown, N.J.
CIRCLE 328 ON READER-SERVICE CARD

Preset Controllers

Have range of 0 to 180,000 counts per min

Operating from all types of sensing devices, these transistorized industrial preset controllers have instantaneous reset and glow counter tube or Nixie in-line readout. Preset range is 0 to 180,000 counts per min or 75,000 counts per sec. Two- or six digit single or dual units are available with three or more preset numbers on any model.

Dynapar Corp., Dept. ED, 5150 Church St., Skokie, Ill.
CIRCLE 329 ON READER-SERVICE CARD
CIRCLE 330 ON READER-SERVICE CARD

TRIMPOT® MODEL 220

As many as 17 of these compact units can be mounted in a space of just one cubic inch. Designed for printed circuits and modular assemblies, Trimpot Model 220 measures less than 3/16" x 5/16" x 1". Power rating is 1 watt and maximum operating temperature is 175°C. This Potentiometer meets or exceeds Mil-Specs for humidity, salt spray, fungus, sand and dust, as well as acceleration, vibration and shock. Self-locking 16-turn shaft insures sharp, stable settings...exclusive Silverweld fused-bond termination and ceramic mandrel provide extreme temperature stability. The Model 220 is available in a wide variety of resistance ranges and a choice of two terminal types—gold-plated Copperweld wire or insulated stranded leads.

Stocked by leading electronic distributors across the nation, these units are ready for immediate delivery. Write for complete technical data and list of stocking distributors. AVAILABLE AS PANEL MOUNT UNIT (illustrated at right) with same specifications.

Exclusive manufacturers of Trimpot®, Trimit®, Pioneers in potentiometer transducers for position, pressure and acceleration.
DESIGNERS SPECIFY P&B’s MR RELAY WITH CONFIDENCE

for a host of control applications

RELIABILITY coupled with low cost are two factors which place the MR series relays high on P&B's best seller list. They are being used in a multiplicity of designs—transmitters, street lighting equipment and small motor starters, to name but a few.

Both AC and DC models are available, with AC coils ranging up to 440 volts. All are adaptable for printed circuit mounting. The wide variety of contact arrangements include:

SPST-NO SPST-NO-DB DPST-NO DPST-NO-DB SPST-NC DPST-NC DPDT DPST-NC-DB DPDT-NC-DB

For more information about this medium duty, compact relay, call or write today— or get in touch with the P&B sales engineer nearest you. See our complete catalog in Sweet's Product Design File.

MR SERIES

Temperature Range:
DC —55°C to +85°C.
AC —55°C to +75°C.

Pull-in: Approx. 75% of nominal dc voltage, 78% of nominal ac voltage.

Weight: 4 oz.

Dimensions: 2½" long x 2½" wide x 2" high.

Mounting: Two ½" dia. holes. Can be adapted for printed circuits.

CONTACTS:

Arrangements: Up to 3pdt.

Material: ½" dia. silver. (Others available.)

Load: 8 amps @115 volts, 60 cycle, resistive.

COIL:

Max. Resistance: 34,500 ohms.

Power: 1.5 watts dc, 3.25 volt-amps ac.

Will withstand up to 6 watts at 25°C.

Voltage: Up to 110 volts dc, up to 440 volts 60 cycle ac.

GENERAL SPECIFICATIONS:

Breakdown: 1500 volts, 60 cycle rms between all elements.

P&B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL ELECTRONIC PARTS DISTRIBUTOR

NEW PRODUCTS

Vibration Exciter

5 to 2500 cps range

Vibration exciter model C125 can be used for sine wave testing or for random or complex motion testing. It has a five ton vector force output and a 5 to 2500 cps frequency range. Weight of the moving element is 100 lb.

MB Mfg. Co., Dept. ED, P.O. Box 1825, New Haven 8, Conn.

CIRCLE 231 ON READER-SERVICE CARD

Double Pulse Generator

High speed

Available in seven ranges from 1 cps to 10 me, the model B-5-2 pulse generator produces two identical pulse trains. Output pulse widths are adjustable from 20 usec to 12.5 usec with rise and fall times of 8 usec. Both pulses may be delayed individually up to 500 usec.

Rutherford Electronics Co., Dept. ED, 8944 Lindblade St., Culver City, Calif.

CIRCLE 332 ON READER-SERVICE CARD

Servo Mounting Potentiometer

Stands 500 cps, 24 g vibration

Available for standard bushing or servo mounting, model 55 wound precision potentiometer withstands vibration of 24 g at 500 cps or 10 g at 1000 cps. Maximum resistance is 100 K ±5% on standard units of ±1% on special type. Rated 2 w at 65 C, the unit operates from —55 to +105 C and survives 5 million revolutions.

New England Instrument Co., Dept. ED, 320 Main St., Westwood, R.I.

CIRCLE 333 ON READER-SERVICE CARD

POTTER & BRUMFIELD INC.

PRINCETON, INDIANA • SUBSIDIARY OF AMERICAN MACHINE & FOUNDRY COMPANY

IN CANADA: POTTER & BRUMFIELD CANADA LTD., GUELPH, ONTARIO

CIRCLE 334 ON READER-SERVICE CARD
Crosley has been named prime contractor for the B-47 and B-48, according to Air Force officials. Among the systems being evaluated are those for the B-47 and B-48, including fire control systems for bombers. The systems will be evaluated by the Strategic Air Command.

In the months and years immediately ahead, many new and ingenious improvements will be made in bomber defense that will be reflected in the bomber defense systems of the future.

For the present, Crosley's extensive experience and technical capability have made it the first name in fire control systems.
NEW PRODUCTS

Coaxial Switch

Has under 0.4 db insertion loss

For use with RG117/U and similar cables, the type YL coaxial switch can be supplied with a wide range of rf connectors, including LT, LN, 7.8 in., and TRU. At 4 kmc, vswr is under 1.4, insertion loss is under 0.4 db, and crosstalk is over 30 db. Characteristics improve at higher frequencies. The unit has 9 in. wide, weighs 3 lb, and covers frequencies to 11 kmc.

Tramco Products, Inc., Dept. ED, 12210 Nebraska Ave., Los Angeles 25, Calif.

CIRCLE 340 ON READER-SERVICE CARD

Recording Oscillograph

Handles up to 50 channels

The model 603 oscillograph records up to 50 channels of test data on paper 12 in. wide. It provides variable record speeds between 0.05 and 170 ips and presents data ready for study in seconds. The record drive is both forward and reverse, and response is flat to 6000 cps.

Midwestern Instruments, Dept. ED, P.O. Box 7186, Tulsa, Okla.

CIRCLE 341 ON READER-SERVICE CARD

Variable Attenuator

Microwave

The VAMP variable attenuator covers its full 0 to 30 db attenuation range with less than 180 deg of drive shaft revolution. It has a capacity of 10 w average power and is available in ranges of 2 to 4, 4 to 7, and 7 to 11 kmc. It weighs about 2.1/2 lb.

Antenna & Radome Research Associates, Dept. ED, 1 Bond St., Westbury, N.Y.

CIRCLE 342 ON READER-SERVICE CARD

Silicon Rectifier

Pill size

Designed to replace bulky selenium rectifiers in TV sets, radios, tape recorders and electronic instruments, the 40E5 silicon rectifier is slightly larger than an aspirin. It has a 400 piv rating and handles 750 ma with a resistive load, 500 ma with a capacitive load. It is rugged and withstands high temperatures.


CIRCLE 343 ON READER-SERVICE CARD

Metered Autotransformers

Measure voltage, current, or power directly

Equipped with meters in the output or load circuit, Variac autotransformer models W5MT3A and W5MT3W provide direct volt and ampere readings and direct volt and watt readings, respectively. They have dual scales from 1 to 5 amp or 150 to 750 w and afford 3% full scale accuracy. The portable units are 9-15/16 x 6-3/4 x 6-3/8 in.


CIRCLE 344 ON READER-SERVICE CARD

Servo Analyzers

Have 0.0008 or 0.25 to 100 cps range

Model 100-A and 100-B servo analyzers have 1% stability and respective ranges of 0.25 to 100 cps and 0.0008 to 100 cps. They generate 20 v peak-to-peak sine and square waves, 30 v modulated sine waves and 5 v trigger pulses for external sweep. The units have a 100 to 1 attenuator, accept 50 to 5000 cps carrier frequencies, and measure phase from 0 to ±180 deg.

Aetna Electronics Corp., Dept. ED, Readington Rd., North Branch, N.J.

CIRCLE 345 ON READER-SERVICE CARD

dressen-barnes

250 NORTH VINEOO AVENUE
PASADENA, CALIFORNIA

TWX PASA CAL 84199
Register Tube

Cold cathode

The Digitron CR 10 G cold cathode register tube may be used to display the count of either hard tube counting circuits or cold cathode load tube decades. It has a 160 deg viewing angle and 1-1/2 in. numerals that are easily read from 50 ft. Maximum cathode current is 9 ma and operating voltage is 180 v.


CIRCLE 346 ON READER-SERVICE CARD

Brake Motors

High torque to size ratio

Type FC brake motors, for start-stop operations in drives and positioning systems, are hysteresis-synchronous or induction units wound for 115 or 200 v ac, 60 or 400 cps. Intermittent torques to 12 oz-in. are attainable, and the brake coil can be wound for any voltage to 100 v dc. Brake holding force is 10 oz-in.; engagement time, 40 to 50 msec; diameter, 1.675 in.; length, 3.75 in.; weight, 17 oz.


CIRCLE 347 ON READER-SERVICE CARD

Static Inverter

Three-phase

This three-phase dc to ac static inverter has output ranges to 3 kva and load unbalance of 100%. Frequency stability is 0.5 to 0.002%; output voltage regulation, ±3%; harmonic content, under 5%. The unit operates with 22 to 30 v input variation and withstands 300% overloads. It may be hermetically sealed and can be used at temperatures to 250 F. Of modular design, it incorporates a control oscillator, logic system, power section, and voltage regulator.


CIRCLE 348 ON READER-SERVICE CARD

Falcon missiles travel “first class” in containers secured by LINK-LOCK

Before they take to the skies, Falcon air-to-air guided missiles are shipped or stored in containers sealed pressure-tight by Simmons LINK-LOCK fasteners.

These precisely engineered fabricated aluminum cases are produced to Hughes Aircraft Company specifications by the following companies: Vendorlator Manufacturing Co., Fresno, California; Allison Steel Manufacturing Co., Phoenix, Arizona; Avco Corporation, Crosley Division, Richmond, Indiana.

Features like these make the LINK-LOCK ideal for use on military cases made to rigid specifications as well as on inexpensive commercial containers:

- Impact and drop resistant.
- Positive-locking without springs.
- High preloading and high load carrying capacity.
- Compact design—lies flat open or secured.
- 3 sizes, for heavy, medium, light duty.
- Flexible engagement latch design...can be varied to suit different applications.

Write for Catalog #1257. Contains complete details of LINK-LOCK and other Simmons Fasteners with unlimited money-saving applications. Samples and engineering service available on request.

CIRCLE 349 ON READER-SERVICE CARD
**NEW PRODUCTS**

**Explosive Circuit Tester**

Miniature

About the size of a pack of cigarettes, this tester provides a safe means of testing bridge-wire fuses and explosive circuits without actuating or firing the explosives. It can be used to check ejector circuits, guided missile circuit continuity, bomb fuses, and remote control detonators. The unit, which needs no battery and derives its power from light, can be powered by a match.

McLean Development Labs, Inc., Dept. ED, 230 Park Ave., New York, N.Y.

CIRCLE 352 ON READER-SERVICE CARD

**Carrier Modulation Analyzer**

Phase sensitive

This visual phase sensitive detector is designed to evaluate the performance of ac servo systems and similar devices using carrier modulation. Used with any oscilloscope, it provides a visual demodulation of the carrier with no phase shift or time delay. Phase and amplitude distortion are zero regardless of carrier frequency. Quadrature and harmonic rejection are 100 to 1.

Boonshaft and Fuchs, Inc., Dept. ED, Huntington Valley, Pa.

CIRCLE 353 ON READER-SERVICE CARD

**Semiconductor Power Supply**

Continuously variable

Incorporating a magnetic line voltage regulator and a transistorized regulator circuit, the model ME36-5EM semiconductor power supply provides a continuously variable, 0 to 36 v dc output with vernier control at 0 to 5 amp. Recovery time is under 50 μsec and overshoot is less than 1% of the voltage setting. Ripple is under 1 mv rms; line regulation is 0.05% for 105 to 125 v ac changes; and load regulation is 0.1% from no to full load. The unit is 7 in. high and fits standard 19 in. racks.

Mid-Eastern Electronics, Inc., Dept. ED, 32 Commerce St., Springfield, N.J.

CIRCLE 354 ON READER-SERVICE CARD

**LOUD, CLEAR SIGNAL FROM 1760 MILES...**

in the 215 mc to 260 mc telemetering band

**THE MODEL REL-10 R-F POWER AMPLIFIER**, with outputs from 1 to 100 watts, dramatically increases the range of missile and aircraft telemetering systems... teams up with presently available FM transmitters... withstands adverse space environments as demonstrated during the full range of the 1760-mile Thor shot; as part of the 75,000-mile Lunar Probe; and on the Atlas Project Score satellite. For full specs, write for Data File ED-725-2

**RHEEM MANUFACTURING COMPANY**

DEFENSE AND TECHNICAL PRODUCTS DIVISION

11711 Woodruff Avenue, Downey, California

CIRCLE 355 ON READER-SERVICE CARD
Miniature Relays
20 to 100 mw sensitivities

Type TQA miniature relays are designed for dc operation at sensitivities from 20 to 100 mw. Contact rating at 28 v dc, resistive is 3 amp for silver and 0.5 amp for palladium or gold alloy. The units withstand 100,000 operations; -55 to +100 C; 50 g shock; and 10 g, 10 to 500 cps vibration. Type TQAH is a hermetically sealed version.

Comar Electric Co., Dept. ED, 3349 W. Addison St., Chicago 18, Ill.

CIRCLE 356 ON READER-SERVICE CARD

Precision Gaussmeter

Measures 300 to 20,000 gauss

Model G-501 is a precision nuclear magnetic resonance gaussmeter for determining magnetic field strength and homogeneity of stable or slowly changing magnetic fields. It permits measurements from 300 to 20,000 gauss with standard probes.


CIRCLE 357 ON READER-SERVICE CARD

Preventive Maintenance Check Panels

For computers

Preventive maintenance check panels 20.174 and 20.175 quickly verify the accuracy of fully expanded 16-31R and 16-131R PACE systems as well as smaller and non-standard systems. They do not require any computer setup modification except the throwing of the function switches.


CIRCLE 358 ON READER-SERVICE CARD

250 MW Package...
Fast Switching and General Purpose Types
Featuring...

- MECHANICAL RELIABILITY — Rugged, hermetically sealed, subminiature packages. Designed to meet both military and commercial requirements.
- ELECTRICAL SUPERIORITY — Excellent high temperature operation... thermally stable... high forward conductance... efficient rectification.
- PRODUCT UNIFORMITY — Tight manufacturing controls.

For details, write for Bulletin B217A-1 B217A-2

CLEVITE
TRANSISTOR PRODUCTS
241 CRESCENT ST., WALTHAM 54, MASS.
TWinbrook 4-9330

CIRCLE 359 ON READER-SERVICE CARD

TECHNICAL DATA

Type | Max. DC Inver. Oper. Voltage | Forward Current @ Specified Voltage | Max. Inverse Current @ 25°C | @ 150°C | Test Volts
--- | --- | --- | --- | --- | ---
IN457 | 60 V | 20 ma @ 1.0 V | 0.025 µA | 5.0 µA | 60 V
IN458 | 125 V | 7 ma @ 1.0 V | 0.025 µA | 5.0 µA | 125 V
IN459 | 175 V | 3 ma @ 1.0 V | 0.025 µA | 5.0 µA | 175 V
IN662 | 90 V | 10 ma @ 1.0 V | 20 µA | 100 µA @ 100°C | 50 V
IN663 | 90 V | 100 ma @ 1.0 V | 5.0 µA | 50 µA @ 100°C | 75 V
IN778 | 100 V | 10 ma @ 1.0 V | 0.5 µA | 30 µA @ 125°C | 100 V
IN779 | 175 V | 10 ma @ 1.0 V | 0.5 µA | 30 µA @ 125°C | 175 V

OTHER CLEVITE DIVISIONS:
Cleveland Graphite Bronze • Brush Instruments
Clevite Electronic Components • Clevite Harris Products
Clevite Ltd. • Clevite Ordnance • Texas Division
Clevite Research Center • Intermetall G.m.b.H.
NEW PRODUCTS

**HV Power Supply**

For specialized tubes

A dc power source for photomultipliers, klystrons, ionization counters, traveling wave tubes, and backward wave oscillators, the model 222A power supply has a 500 to 5000 V range. Its 0 to 10 ma rating permits operation of several photomultipliers at once. The unit features positive or negative polarity, continuously metered current, and 10 mv peak-to-peak maximum ripple. Two selector switches and a linear vernier control permit accurate adjustments. Voltage may be reset to within 0.05%.

Alfred Electronics, Dept. ED, 897 Commercial St., Palo Alto, Calif.

**Miniature Wirewound Variable Resistors**

5 w capacity

Series WW and WN Radiohms are 5 w, variable wirewound resistors in long or short shaft styles and resistance values from 1 ohm to 100 K. They are 1-3/32 in. in diameter and 9/16 in. deep and have a minimum life of 10,000 cycles.

Centralab, Dept. ED, 900 E. Keefe Ave., Milwaukee 1, Wis.

**Gyro**

Has inner gimbal

This split rotor, solid bar inner gyro is designed for small, short range missiles and drones. The spring wound, two-axis unit resists shock to 100 g, acceleration to 30 g, and vibration to 10 g while maintaining 0.1 deg per sec drift accuracy. Maximum time to speed and uncage is 0.1 sec and running time is 4 min with 8 min rundown time.

Clary Corp., Clary Dynamics Div., Dept. ED, 408 Junipero St., San Gabriel, Calif.

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

Any time your problem is magnet wire, consult Phelps Dodge for the quickest, surest...
Magnet Wires that pace the Industry come from Phelps Dodge!

-IDEREZE® (solderable); FORMVAR (square and rectangular)
-INDZE® (self-bonding); S-Y BONDEZE® (solderable self-bonding)
-IP-EZE® (solderable self-gripping)

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

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

CLASS H
-DAGLAS® H (flexible glass)

PHELPS DODGE COPPER PRODUCTS CORPORATION

Inca Manufacturing Division

Fort Wayne, Indiana

CIRCLE 363 ON READER-SERVICE CARD

Thermal Analog Tube
For system evaluation

The Thermion thermal analog tube is a tool for reliability design before prototype stages. It is physically and thermally identical to any vacuum tube of the same size class, an accurate thermal analog of an electron tube under study. The unit permits optimum thermal component layout in system breadboarding and evaluation stages and also the selection of thermally efficient hardware, mountings, and enclosures.

Research Council, Inc., Dept. ED, 1062 Main St., Waltham 54, Mass.

CIRCLE 364 ON READER-SERVICE CARD

Slip Ring and Brush Assemblies
For thermocouple and strain gage circuits

These slip ring and brush assemblies are designed for transmitting signals from rotating strain gages and thermocouples to fixed recorders or control stations. In sealed housings, they have individually adjustable brushes. Contacts and rings are of compatible material to avoid spurious emf effects.

Rotary Devices Corp., Dept. ED, 30 Jay St., Englewood, N.J.

CIRCLE 365 ON READER-SERVICE CARD

Relays
Withstand 30 g vibration

Made to MS-24250 requirements, type B relay is a crystal case unit rated 2 amp, 28 v dc or 115 v ac for a life of 100,000 cycles. It is also available as type BR with internally mounted silicon rectifiers for use at 400 cps or higher. Both units withstand 30 g, 50 to 2000 cps vibration.

Hi-G, Inc., Dept. ED, Bradley Field, Windsor Locks, Conn.

CIRCLE 366 ON READER-SERVICE CARD
NEW PRODUCTS

Half-Wave Magnetic Triggers
For silicon controlled rectifiers

Series 408 half-wave magnetic triggers are designed for use with C35 or equivalent silicon controlled rectifiers. Their operating range extends from 50 to 400 cps, and their output presents a steep wave front to the gate circuit of the rectifier, allowing precise determination of firing angle. The units are insensitive to line transients, commutator noise, and capacitance to ground. In combination with silicon controlled rectifiers, they provide high power amplification. They are 11.6 cu. in. and weigh 15 oz.

ACF Industries, Inc., Avion Div., Dept. ED, 11 Park Place, Paramus, N.J.

CIRCLE 369 ON READER-SERVICE CARD

Self-Balancing Potentiometers
For flight testing

Series EMP-NS2 Autopots are self-balancing potentiometers that accept outputs from thermocouples or other transducers in flight test programs. The direct reading, plug-in units include pyrometers in 25 ranges and millivoltmeters in 14. Power requirement is 0.15 amp, 115 v, 400 cps; resolution 0.25% of full scale; minimum readable input charge, 30 µv.

Daystrom Pacific, Dept. ED, 9320 Lincoln Blvd., Los Angeles 45, Calif.

CIRCLE 370 ON READER-SERVICE CARD

Transistor Oscillators
400 cps to 500 kc range

Series LTO transistor oscillators have a 400 cps to 500 kc range, up to 1 ppm frequency stability, ±0.002% calibration accuracy, and 15 min warmup time.

Monitor Products Co., Dept. ED, S15 Fremont Ave. S., South Pasadena, Calif.

CIRCLE 371 ON READER-SERVICE CARD

Film Resistors
7 to 150 w sizes

Type RD high power, high frequency resistors exceed MIL-R-11804C requirements and can be cycled from near absolute zero to almost red heat without electrical property loss. They can be supplied in values from 10 ohms to 3 k and in standard sizes from 7 to 150 w. Standard tolerances are ±2 and ±5% and standard temperature coefficients are under 0.03%/°C. Spiralled resistors in the same sizes can be furnished with resistances to several megohms. All units derate to zero at 235 °C.

Filmohm Corp., Dept. ED, 48 W. 25th St., New York 10, N.Y.

CIRCLE 372 ON READER-SERVICE CARD

Servo Motor
Size 8

Built to BuOrd Mark 23, Mod 1, the type 5002-04 size 8 servo motor has a 0.35 oz-in. stall torque and a 24,700 rad/sec² torque to inertia ratio. No load speed is 6200 rpm and rotor moment of inertia is 10 g cm².

John Oster Mfg. Co., Avionic Div., Dept. ED, 1 Main St., Racine, Wis.

CIRCLE 371 ON READER-SERVICE CARD
Now you can get quadrupled sensitivity and unprecedented design flexibility with the new subminiature TI 1N2175 Photo-Device.

Easily activated, the 1N2175 switches from a low dark current of only 0.5 μa to a high light current of 1200 μa at 1200 ft-candles — within 2 μsecs. Rated at 250 mw at 25°C, the 1N2175 operates over a range of 1-50 volts, and derates linearly to 125°C. Minimum operating temperature is -55°C.

Specify the TI 1N2175 today and get immediate off-the-shelf delivery in 1-999 quantities from all authorized TI distributors and production quantities through TI sales offices.
BONDED STRAIN GAGE construction makes the TELEDYNE practically insensitive to vibration or shock... keeps it on the job long after other transducers have failed. The resolution of the Teledyne is INFINITE for the precise measurement of gaseous or liquid pressures. Handles extremely corrosive alka-lies and acids including fuming NITRIC ACID. Pressure Cavity can easily be cleaned-out. Repeatability 0.1%, Linearity 0.25%, Hysteresis 0.5%, Ambient Temperature -65° F. to +250° F. (18° C. to 121° C.), 1 Millisecond Response. Eleven Pressure Ranges 0 - 10,000 PSIG.

Write for Literature and Prices

TABER INSTRUMENT CORPORATION
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North Tonawanda, N. Y.
Phone: LuIdow 8900  TWX - TON 277

INQUIRIES ARE INVITED regarding preforming these metals to your specification.

THE CONSOLIDATED MINING AND SMELTING COMPANY OF CANADA LIMITED
Metal Sales Division: 215 St. James Street W., Montreal 1, Quebec, Canada — Phone Avenue 8-3103

NEW PRODUCTS

Sweeping Oscillator
Covers 200 cps to 11 mc

The Ligna-Sweep model SKV sweeping oscillator covers 200 cps to 11 mc and provides sweep widths from 20 kc to 10 mc on its variable bands and 2 to 20 kc on its fixed bands. Sweep rates are 0.3 to 30 cps in three ranges, 30 cps, and line lock.
Kay Electric Co., Dept. ED, Maple Ave., Pine Brook, N.J.
CIRCLE 379 ON READER-SERVICE CARD

Digital Interval Timer
Measures to the nearest 0.1 msec

Portable model 2202TL digital interval timer meets MIL-T-945A and MIL-E-4970 and measures intervals to the nearest 0.1 msec for a total indicated time of 9.9 or 99.9 msec. Longer intervals can be provided. The unit has indicator lights that show the sequence of two events.
Erie-Pacific, Div. of Erie Resistor Corp., Dept.
ED, 12932 S. Weber Way, Hawthorne, Calif.
CIRCLE 380 ON READER-SERVICE CARD

Ferrite Components
Need no external magnet

Using a compact magnetic field unit in place of heavy external magnets to control transmission characteristics, these ferrite components are 1/2 the weight and volume of older components. The magnetic field unit is small enough to fit inside the coaxial envelope of ferrite isolators. For the 400 to 11,000 mc frequency bands, the components can be used in radars, countermeasures, communications, missiles, and special test equipment.
Sperry Microwave Electronics Co., Div. of
Sperry Rand Corp., Dept. ED, Clearwater, Fla.
CIRCLE 381 ON READER-SERVICE CARD
Guided Missile Beacon
Decoder type

Guided missile beacon model SRTS-2003CH is designed for radars using coders such as the KY-94/GPA. It has a 2700 to 2900 mc receiver and transmitter frequency, 50 db minimum image rejection, −65 dbm minimum triggering sensitivity, and two- or three-pulse code selection.

Telerad Mfg. Corp., Dept. ED, Flemington, N.J.
CIRCLE 382 ON READER-SERVICE CARD

Silicon NPNP Switch
Inratings to 400 piv

The Trinistor triode is a three-terminal, multi-junction silicon npnp switch that can replace thyratrons and be used as a converter, inverter, frequency changer, variable frequency generator, motor controller, and voltage regulator. Its breakdown voltage can be controlled by the base current. The device will block the rated voltage in the reverse direction and also in the forward direction when there is no input signal to the base terminal. When a base signal of 2 to 5 v is applied, the unit will switch from a blocking to a conducting condition. The base signal draws 25 to 150 ma. In ratings to 400 piv, the Trinistor is designed for circuits with voltage to 400 v and currents to 50 amp.

Westinghouse Electric Corp., Dept. ED, P.O. Box 2099, Pittsburgh 30, Pa.
CIRCLE 383 ON READER-SERVICE CARD

Pushbutton Switch
Rated 10 amp, 125 v ac

This small, open blade pushbutton switch is a dpdt unit with gold flashed contacts rated at 10 amp, 125 v ac. It is also available with palladium contacts.

Hubershaw-Fulton Controls Co., Dept. ED, P.O. Box 449, Columbus 16, Ohio.
CIRCLE 384 ON READER-SERVICE CARD

BENDIX SR RACK AND PANEL CONNECTOR
with outstanding resistance to vibration

The Bendix type SR rack and panel electrical connector provides exceptional resistance to vibration. The low engagement force gives it a decided advantage over existing connectors of this type.

Adding to the efficiency of this rack and panel connector is the performance-proven Bendix "clip-type" closed entry socket. Insert patterns are available to mate with existing equipment in the field.

Available in general duty, pressurized or potted types, each with temperature range of −67°F to +257°F.

Here, indeed, is another outstanding Bendix product that should be your first choice in rack and panel connectors.

SCINTILLA DIVISION
SYDNEY, NEW YORK

Export Sales and Service: Bendix International Div., 205 E. 42nd St., New York 17, N. Y.
Canadian Affiliates: Aviation Electric Ltd., 200 Laurentian Blvd., Montreal 9, Quebec.
Factory Branch Offices: Burbank, Calif.; Orlando, Florida; Chicago, Illinois; Teaneck, New Jersey; Dallas, Texas; Seattle, Washington; Washington, D. C.
CIRCLE 385 ON READER-SERVICE CARD

Reliable! Dependable! Available!

For high-performance slip rings, brushes, commutators and switches
the name to remember is

POLY-SCIENTIFIC CORPORATION
BLACKSBURG, VIRGINIA

CIRCLE 386 ON READER-SERVICE CARD

MEDALIST* meters
Combine increased readability with attractive color styling. ASA/MIL 113½, 213½ and 313½ mounting. Up to 50% longer scale in some sizes as conventional types. Standard and special colors. Bulletin on request. Marion Instrument Division, Monaca-Honeywell, Milton, Mass., D. C.
CIRCLE 387 ON READER-SERVICE CARD
when you specify . . . ELCO'S new Series 8100 MICRO-MINIATURE VARICON CONNECTORS

Elco's 8100 Series Micro Miniature Varicon Connectors are designed for applications where highest contact density and reliability are a necessity. Contacts are of the forklike mating Varicon principle, thereby assuring lowest contact resistance at all typical environmental conditions during the entire life of the equipment.

The connector can be supplied in three different variations:

- **8101 Series** — Up to 14 contacts in one row at .100" spacing.
- **8102 Series** — The same connector with brackets for p.c. mounting with up to 12 contacts in one row at .100" spacing. (Type 1 and 2.) Brackets for chassis mounting on request.
- **8103 Series** — The same connector with 2, 3 or 4 tiers of up to 14 contacts at .100" spacing per row, bonded together at various patterns.

The width of one tier is .140", the height 3/8" without contact tail.

The height of a mated pair is 17.32".

The pictures shown above depict only a few of the possible variations of this connector. Limitless other combinations are possible. For further information and full specifications, please write for Bulletin 114 on your company letterhead.

**GENERAL SPECIFICATIONS FOR 8100 SERIES**

<table>
<thead>
<tr>
<th>CURRENT RATING</th>
<th>1 AMPERES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WITHSTANDING VOLTAGE AT</strong></td>
<td><strong>SEA LEVEL:</strong> 1000 VOLS, AC, RMS</td>
</tr>
<tr>
<td><strong>WITHSTANDING VOLTAGE AT</strong></td>
<td><strong>3.6&quot; Ng:</strong> 100 VOLS, AC, RMS</td>
</tr>
<tr>
<td>CONTACT RESISTANCE</td>
<td>0.005 MAXIMUM</td>
</tr>
<tr>
<td><strong>INSULATION RESISTANCE:</strong></td>
<td>1000 MEGOHMS, MINIMUM</td>
</tr>
<tr>
<td><strong>INSULATRIX:</strong></td>
<td>DIALYL PHTHALATE—Glass-filled</td>
</tr>
<tr>
<td><strong>CONTACT MATERIAL:</strong></td>
<td>Standard—Phosphor Bronze</td>
</tr>
<tr>
<td><strong>0.0002 Nickel Plate plus 10 to 15 millionths gold.</strong></td>
<td></td>
</tr>
</tbody>
</table>

**NEW PRODUCTS**

**Trimmer Potentiometer**

Has 1/2 in. diameter

Printed circuit trimmer potentiometer model 50-M7 is 1.2 in. in diameter and available with resistances from 25 ohms to 10 K. It is light and sealed and built for rugged environments. No shaft locking device is necessary. The unit is designed to MIL-R-19A, MIL-E-5272A, MIL-R-19518, MIL-R-12904B, and NAS 710. One terminal is polarized for quick assembly.

Maury Instrument Corp., Dept. ED, 7924 S. Exchange Ave., Chicago 17, Ill.

CIRCLE 389 ON READER-SERVICE CARD

**Pilot Light**

Mounts in seconds

Supplied with a nut that permits it to be mounted in seconds through any 1/2 in. hole and any panel thickness, the Jiffi-Lite pilot light has a built-in NE-51 neon lamp and wired resistor. Voltage range is 80 to 160 v.


CIRCLE 390 ON READER-SERVICE CARD

**DC Power Supply**

400 cps

A high efficiency laboratory power supply, the model M-1201 has ±10% regulation no load to full load and recovers to 1% of the output voltage setting in under 0.1 sec. Input is 115 or 200 to 120 or 220 v ac; output, 24.32 v dc at 25 amp; ripple, 0.05 v rms.

Perkin Engineering Corp., Dept. ED, 345 Kansas St., El Segundo, Calif.

CIRCLE 391 ON READER-SERVICE CARD
**Multicylinder Tuner**

10 to 200 µF range

This tuner consists of five high dielectric glass cylinders coaxially tuned by invar pistons attached to a common adjustment plate. It has a 10 to 200 µF range, low loss, low inductance, good vibration resistance, and no derating to 125°C. A staggered piston tuning arrangement bends the tuning curve to an arbitrary function. Curves for linear or logarithmic frequency tuning may also be obtained.

JFD Electronics Corp., Dept. ED, 6101 16th Ave., Brooklyn 4, N.Y.

CIRCLE 392 ON READER-SERVICE CARD

**Telemetry Multicoders**

Low level and mixed

Designed for missile environments, these low level multicoders are available in any standard IRIG switching configuration for pam and pdm systems. A mixed high and low level system is available for 90 channels. Power requirements are 25 to 30 v dc, 2.5 w for the low level and 4 w for the mixed system. Maximum sensitivity is 10 mv for full scale output and common mode signal rejection is ±50 v dc to ±10 v at 1 kc for 1% of full scale error.

Applied Electronics Corp., Dept. ED, P.O. Box 43, Metuchen, N.J.

CIRCLE 393 ON READER-SERVICE CARD

**Silicon Rectifier**

High power

The type 300 high power silicon rectifier is available with 50 to 500 piv ratings. The hermetically sealed cells weigh under 3 oz, provide up to 9 amp forward direct current, and operate at up to 180°C junction. Maximum reverse current is 30 ma at rated piv.

Westinghouse Electric Corp., Dept. ED, P.O. Box 2088, Pittsburgh 30, Pa.

CIRCLE 394 ON READER-SERVICE CARD

**FALCON MISSILE**

Playing follow-the-leader at 50 millisecond intervals, three Super Falcon missiles rocket ahead of their diamond-shaped supersonic shock waves. Homing in on radar, these deadly air-to-air missiles locate, track, and destroy their prey, with the same killer instinct of the birds they’re named after.

Hughes Aircraft, the developer and manufacturer of these missiles and the Armament Control System that triggers them, specified Hitemp magnet and Teflon® wire for their missile, and Teflon wire for its control system.

Hitemp Wires, Inc., the leading specialist in high temperature insulated wires and cables, proudly answers roll call with those developers and manufacturers enlisted in defending our American birthright—Freedom.

**HITEMP WIRES, INC.**

1200 SHAMES DRIVE, WESTBURY, NEW YORK

*Registered trademark for DuPont fluorocarbon resins.

CIRCLE 395 ON READER-SERVICE CARD
NEW PRODUCTS

Stabilization Cavity
For 8500 to 9600 mc frequencies

Stabilization cavity model VA-1299 can be tuned at any fixed frequency from 8500 to 9600 mc with ±15 mc trim. Stabilization factor is 20; insertion loss, 10 db; unloaded Q, 20,000; and temperature coefficient, less than 5 kc per deg C. The unit is hermetically sealed and weighs 1 lb.


CIRCLE 396 ON READER-SERVICE CARD

Logic Module Tester
Automatic

This automatic tester evaluates logic circuitry printed on computer cards on a go-no-go basis. Speed and degree of response as well as continuity of the circuitry are measured. The unit has its own power supplies, pulse generators, and voltage sources and can perform up to nine tests or test programs on each circuit.

Atronic Products, Inc., Dept. ED, 1 Bala Ave., Bala-Cynwyd, Pa.

CIRCLE 397 ON READER-SERVICE CARD

DC Servo Amplifier
Modular

Industrial dc servo amplifier model SA-2002-P is designed for electrohydraulic control systems and features modular construction. It has adjustments for gain, zero, balance, dither, and feedback potentiometer excitation. Inertial gain is over 60 ma per v; quiescent current for the differential output is 15 ma for loads to 3 K; and dither output is 350 cps.

Plug-In Instruments, Inc., Dept. ED, 1416 Lebanon Rd., Nashville, Tenn.

CIRCLE 398 ON READER-SERVICE CARD

Design better products with

SILASTIC
RTV
SILICONE RUBBER

...seals and cushions delicate circuits

Sensitive electronic components are sealed against moisture and cushioned against vibration with a coating of Silastic® RTV, the Dow Corning silicone rubber. Silastic RTV forms a rubbery silicone solid in 24 hours at room temperature. Stays resilient from -70 to 260°C. This “do-it-yourself” material is used for a wide range of encapsulating, potting and caulking applications. Write for free sample and complete information.

If you consider ALL the properties of a silicone rubber, you’ll specify SILASTIC.

CIRCLE 600 ON READER-SERVICE CARD

Dow Corning CORPORATION
MIDLAND, MICHIGAN

ELECTRONIC DESIGN • June 24, 195
MINIATURE CHOPPERS

60 or 400 cps

These general purpose miniature choppers are spdt or dpdt, 60 or 400 cps units in both make-before-break and break-before-make designs. They are hermetically sealed and dry gas filled for operation in any climate. Maximum noise is 450 µ across 1 meg at 400 cps.

Collins Electronics Mfg. Corp., Dept. ED, Stevensville, Md.
CIRCLE 399 ON READER-SERVICE CARD

TERMINALS, RECEPTACLES, CONNECTORS

In chains

For use with automatic insertion machines, these miniature tubular terminals, Wrap-A-Wire terminals, receptacles, and connectors are supplied in chain form. They are designed for printed circuits and many other electronic uses.

Malco Mfg. Co., Dept. ED, 4025 W. Lake St., Chicago 24, Ill.
CIRCLE 400 ON READER-SERVICE CARD

PORTABLE TUBE TESTER

Checks transistors and diodes

Portable model 800 dynamic mutual conductance tube tester is a low cost unit that incorporates a transistor and diode check. It checks leakage between tube elements up to 10 meg and tests special tubes such as 117N7 types. The meter directly indicates 0 to 3000, 6000, and 15,000 µhos. The unit has sockets for 4, 5, 6, and 7 pin; octal; local; noval; and 7 pin miniature types.

Hickok Electrical Instrument Co., Dept. ED, 10525 Dupont Ave., Cleveland 8, Ohio.
CIRCLE 401 ON READER-SERVICE CARD

SILICONE GLASS LAMINATES INCREASE LIFE AND DEPENDABILITY

Laminates made by bonding glass cloth with Dow Corning silicone resins have high arc resistance, low loss factor, low moisture absorption, excellent retention of dielectric properties at high temperatures. Strong, lightweight—produced by leading laminators.

CIRCLE 601 ON READER-SERVICE CARD

SILICONE FLUIDS PROTECT ASSEMBLIES FROM MOISTURE

A protective film of Dow Corning 200 Fluid spray coated on electronic assemblies protects terminals, clips, switches and other exposed connections from the harmful effects of condensation. Glass and ceramic insulators coated with silicone fluid have low current leakage and a high degree of surface resistivity, even under very humid conditions.

CIRCLE 602 ON READER-SERVICE CARD

SILICONE COMPOUND PREVENTS ARCS, GROUNDS, SHORTS

Nonmelting, nongumming Dow Corning 3 Compound stays in place... provides an effective, moisture-proof dielectric seal for all types of electronic equipment. As a potting or filling material for electronic components and assemblies, silicone compounds flow into place with gentle pressure... have a serviceable temperature range of -40 to 205 C. Free sample available.

CIRCLE 603 ON READER-SERVICE CARD

further information on these products write Dept. 1618

STROMBERG-CARLSON TELEPHONE SWITCH INSULATOR

Southwestern Industrial Electronics seismographs

AN CONNECTOR TERMINALS, NAVY HELICOPTER

FURTHER INFORMATION ON THESE PRODUCTS WRITE DEPT. 1618

ELECTRONIC DESIGN • June 24, 1959
How Sylvania rates semiconductors

Now in operation at Sylvania's Semiconductor Division is a new Digital Automatic Tester and Classifier. Designed and developed by engineers of the Division, it automatically subjects semiconductors to 16 separate tests and classifies them into as many as 256 different categories at a speed of 1500 per hour.

The new computer rates each semiconductor on each test. It compares the final test results with predetermined standards and then places each unit in its proper category. Replaceable plug-in test modules enable the device to test for an almost infinite variety of electrical and mechanical characteristics and parameters.

For the circuit designer... the new classifier means new uniformity and higher quality in semiconductors. It eliminates damage due to excessive handling and reduces human error to a minimum, assuring duplicate performance from unit to unit. Continuous operation has proved test accuracy within a tight 0.5 percent limit for all parameters. The end result is a new standard of excellence in semiconductor devices.

At Sylvania, technological achievements like the Digital Automatic Tester and Classifier are in progress every day. Always, the objective is to produce the best possible semiconductor at the lowest possible cost.

SYLVANIA

Subsidiary of

GENERAL TELEPHONE & ELECTRONICS

Semiconductor Division

100 Sylvan Rd., Woburn, Mass.

Adapters Increase Meter's Versatility

You can now convert Simpson multimeters, models 260 and 270, into many different test instruments by plugging any one of seven compact adapters (described below) into either of the meters. Called Add-A-Testers, the recently developed adapters are self-contained and self-powered, like the meters.

The seven adapters—made by Simpson Electric Co., 5207 W. Kinzie St., Chicago 44, Ill.—are about half the size of meters, as shown in the photograph. Designations, model numbers, and specifications of the adapters are:

Transistor Tester, model 650. The full scale beta ranges of this adapter are from 0 to 10, 50 and 250. Beta accuracy is a nominal ±5%. The I<sub>e</sub> range is from 0 to 100 μA with an accuracy of ±1%, full scale.

DC VTVM, model 651. Voltage ranges that can be measured are from 0 to 0.5, 1, 2.5, 5, 10, 25, 50, 100, 250, and 300 v. Accuracy is ±1%, full scale, and the input impedance is greater than 10 meg ohm on all ranges.

Temperature Tester, model 652. Temperature ranges for this unit are from —50 to +100 F, and +100 to +250 F. Three lead positions are provided and the sensing element used is a thermistor.

Ac Ammeter, model 653. Ranges that can be covered with this adapter are from 0 to 0.25, 1, 2.5, 4.5, 12.5, and 25 amp; accuracy is ±1%. Frequency range handled is from 50 to 3000 cps.

Audio Wattmeter, model 654. Load ranges for this adapter are 4, 8, 16, and 600 ohms. The unit can be used to continuously indicate up to 25 w (8, 600 ohms), and 50 w (4, 16 ohms). Or, on an intermittent basis, it can register up to 50 w (8, 600 ohms), and 100 w (4, 16 ohms). Accuracy is...
Any one of seven adapters may be plugged into the
meter to increase its usefulness. The adapters are self-
contained and self-powered.

±5%. The adapter has a direct reading scale that
extends from 17 μF to 100 μF.

Microvolt Attenuator, model 655. Range for this
adapter is from 2.5 to 250,000 μF; it is continuous-
ly variable in decade steps. Frequency is from
10 to 20 kHz and accuracy is ±1 db.

Battery Tester, model 656. This unit checks all
radio and hearing aid batteries up to 90 V at the
manufacturers’ recommended load, or any external
load.

Multimeter Modifications

In some cases, depending on the particular
adapter used, it is necessary to modify the multi-
meter. The multimeter modification has to be made
prior to use. Afterwards the meter can be used
directly with any adapter.

For more information on these adapters, turn
to the Reader-Service card and circle number 104.

Prevent this inductive surge voltage
with a Thyrite® Varistor Assembly

When an inductive circuit is suddenly opened, this is
what happens: a heavy overvoltage is induced, and if no
protection is provided, the insulation of the equip-
ment is in danger of breaking down.

This equipment can be protected in several ways.
Linear resistors could be used, but they consume exces-

sive power. Or a discharge resistor might be used inter-
mitently when interruptions occur, but this requires
additional expensive circuitry. A more effective method
of protection is to use General Electric Thyrite varistors.

Protection with General Electric Thyrite Varistors. Thyrite
is a unique non-linear resistance material that reduces
surge voltages and arcing to safe limits by offer-
ing low resistance at peak current. As current decays,
Thyrite immediately offers higher resistance, reducing
current drain to a minimal amount.

General Electric Thyrite varistors are particularly
suited to protect highly inductive coils such as chokes,
reactors, D-C motor fields and transformers.

New Medium Voltage Units. New 3-inch diameter medium
voltage assemblies, two of which are shown above, are
engineered for 1 kV to 10 kV systems. They are part of
a complete line of Thyrite rods, discs and assemblies
available for components rated from 6 to 10,000 volts.

For more technical information on Thyrite varistors
and assemblies — or for the assistance of a G-E engineer
— call or write: Magnetic Materials Section, General
**Want a billion-position switch?**

Magnetic amplifier manufacturers turn to Orthonol® tape cores for precise proportioning control or switching action

Orthonol is a switching material that can be turned all the way on—or part way on—with vast precision.

The rectangular B-H loop of the 50% nickel, grain-oriented alloy provides an amplifier output which is linear and directly proportional to control (reset) current. This response is so linear that the amplifier acts as a valve with an infinite (at least a billion) number of steps from full off to full on.

Full off and full on can be achieved with snap action, because the horizontal saturation characteristic of the B-H curve means a very low saturated impedance. Thus, when the amplifier is on, it is on; when it is off, it is off. On-to-off impedance ratios of at least 1000 to 1 provide complete assurance of this absolute characteristic.

Should your manufacturing facilities prevent the use of Orthonol in tape wound core form, you can still take advantage of this excellent material in laminations. An Orthonol laminated core has characteristics almost identical to those in toroidal form.


---

**Internal bracing is secret of...**

**High-Value Ceramic Capacitors**

HIGH-VALUE ceramic capacitors are now possible because of a unique method of construction. Using a triangular type of internal bracing, these capacitors can be made with very thin walls, necessary to get low capacitance. In announcing their patent application on this form of construction, Packard Bell Electronics Corp., 12333 W. Olympia Blvd., Los Angeles 64, Calif., points out that the units are expected to replace paper capacitors in the 0.01 to 0.25 μf range. They also are expected to replace mica units in no-drift capacities of 300 μf to 0.01 μf.

Some of their advantages include long life, operation at high temperatures, lack of pinholing and eliminating of lead inductance. Less mounting area is required permitting greater ease of mounting at less cost.

Two forms of ceramic capacitors will be made—extruded and molded. The extruded type is relatively easy to manufacture. But it has to be solder-dipped at the ends after metal clips have been added.

Molded capacitors are to be produced and installed in equipment with no hand labor. Internal plate connections are made by the configuration of the capacitor itself. Installation of the unit in a printed circuit board would require only that a machine drop it into a clip—the outer plate making contact with the circuit—and the electrode attached to the inside plate dip-soldered. For high-temperature uses, no solder is needed. A clip of...
Triangular bracing of thin walls of ceramic capacitors makes possible rugged high-value units.

A screw-in arrangement for the inner electrode should be adequate.

Molded units are made by firing and plating the hardened ceramic with copper, then tin plating over the copper for ease of soldering. Ceramics used for the capacitors range from NPO (zero drift) to N7000 dielectric. Paper capacitor dielectric constants run on the order of 6 to 10.

When the molded capacitor is installed in a metal chassis with one plate of the capacitor going to the chassis, the outer plate serves as a shield for eliminating radiation which appears on the inner plate. The arrangement reduces undesirable coupling problems from one portion of the circuit to another.

Uses anticipated by the designer, Harold F. Rieth, Packard Bell Senior Staff Engineer, include military applications where life, reliability and high temperature capability are at a premium and commercial equipment where cost savings, size and safety are important.

A-c-dc radios are often grounded to the chassis through a paper capacitor. If it ruptures, there is considerable danger from shock. Rieth conceives the ceramic capacitor to be a good solution to this problem. He hopes, too, to see an automobile ignition system capacitor that will never have to be replaced.

For further information on these ceramic replacements for paper capacitors, turn to the Reader-Service Card and circle 105.

While we're the first to admit that pallbearers have a definite place ... we're last to agree that their place is in industry.

Certainly, when time is of the essence, old-fashioned repair and servicing techniques are about as efficient as horse-drawn carriages. Progressive manufacturers are dispensing with equipment-carrying pallbearers... turning instead to efficient Grant Slides.

If you've been plagued by down-time, or have been engaged in weight-lifting exercises ... why not investigate Grant Slides? It's true, we're putting industrial pallbearers out of business ... but we may help put your company back into business.

The nation's first and leading manufacturer of slides

GRANT INDUSTRIAL SLIDES

GRANT PULLEY AND HARDWARE CORPORATION / 21 High Street, West Nyack, New York
944 Long Beach Avenue, Los Angeles 21, Cal.
STACK-TYPE MOTORS
These newly designed motors have such maintenance saving features as: sectional housing . . . wick-type lubrication . . . printed circuits . . . ball bearings . . . shock absorbers . . . alignment keying rings. Any major part replaceable in two minutes.

OIL-SEALED MOTORS
These field-proven motors feature self-lubrication, have shock absorbers, are totally enclosed and oil sealed.

MILITARY MOTORS
These are oil-sealed-type motors, modified to comply with MIL-M-17059. Housing is treated as specified in MIL-C-5541, and leads are fungus resistant as per MIL-V-173.

... All motors are available in two phase and synchronous models

SPECIFICATIONS (applicable to all motors described above)

<table>
<thead>
<tr>
<th>Two Phase Induction Motor</th>
<th>Synchronous</th>
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<tbody>
<tr>
<td>330</td>
<td>4:1</td>
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<tr>
<td>144</td>
<td>10:1</td>
</tr>
<tr>
<td>48</td>
<td>30:1</td>
</tr>
<tr>
<td>23</td>
<td>60:1</td>
</tr>
</tbody>
</table>

*11, B less at 50 cycles
I Field winding 11.0 watts, balance in amplifier winding
Note: Some speeds available at 25 cycles


Honeywell
First in Control

CIRCLE 406 ON READER-SERVICE CARD
Understandably **unwelcome** in King Cold's domain...

**Heating Blankets and other Woven Heating Elements by SAFEWAY can make your problems OLD problems!**

Be it the frigid altitudes at which manned aircraft fly, the cold, trackless space domain of missile and satellite, or the icy arctic wastes of DEW Line installations — it's always "winter" somewhere.

Environmental temperature problems common to this kind of "winter" beset fuels and lubricants and hamper the operation of many types of sensitive equipment.

But SAFEWAY dispels such problems by packaging **controlled heat** for application everywhere. Among the wide variety of heating blankets and woven-wire heating elements which have been engineered by SAFEWAY to meet exacting specifications are:

- heating elements for launching equipment and for airborne gyros, cameras, computers, servos and batteries — for missiles or aircraft
- de-icing units for airfoil surfaces
- heating elements for all types of ground support equipment
- de-frosting units for industrial and commercial refrigeration
- heating blankets for honeycomb and metal-to-metal bonding

For your copy of a fact-filled folder, please write: **Safeway**

**SAFEWAY HEAT ELEMENTS INC.**

680 Newfield Street - Middletown, Connecticut

CIRCLE 407 ON READER-SERVICE CARD
MINIATURIZED - WITHSTAND HIGH SHOCK - LIGHTWEIGHT

For the highest possible reliability under the most severe environmental conditions, Bomac's complete line of beacon magnets are designed to withstand 20,000 g's and have survived centrifuge tests where the applied acceleration was in the order of 20,000 g's, and have operated satisfactorily when subjected to vibrations at a 30-g level from 50 to 2000 cps.

**Table:**

<table>
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<tr>
<th>Tube</th>
<th>Eff Watts</th>
<th>If Amp</th>
<th>Peak Anode Voltage</th>
<th>Peak Anode Current Amps</th>
<th>Peak Power Watts</th>
<th>Frequency Max</th>
<th>Output Make Take</th>
<th>Weight</th>
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<td>5000-5000</td>
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<td>10 oz</td>
<td>X</td>
</tr>
</tbody>
</table>

Leaders in the design, development and manufacture of TR, ATR, Pre-TR tubes; shutters; reference circuits; crystal protectors; silicon diodes; magnetrons; klystrons; duplexer; pulsing windows; nose source tubes; high frequency tube oscillators; surge protectors.

Bomac Laboratories, Inc.
Salem Road, Beverly, Massachusetts

**Write today for full information**
Electro Instruments  
Model A12  
D.C. Amplifier  

FULLY TWO YEARS AHEAD of the FIELD!

Totally transistorized—dissipates only 7 watts.
Long term drift less than 2 microvolts.
0.01% linearity and stability.
100 megohms input impedance—40 milliohms output impedance.
1 db DC to 10 KC.
Noise less than 10 microvolts wideband.
Single ended or differential input.
Operates to specifications from 0° to 50° C.
Self-contained power supply—operates on any line frequency from 50-400 cps.
Mil-type chopper gives unmatched reliability for the life of the instrument.
7" x 19" panel accommodates 8 instruments.

Plug-in attenuators of the A12 provide convenience, flexibility and economy. Special variations, gain settings, etc., can be tailored to your system at no extra cost.

The only wideband DC amplifier to meet rugged military environmental tests for altitude, temperature, shock, humidity and electro interference.
Remarkable Cathode Advance...

vacuum-melted

N-132 CATHODE BASE MATERIAL brings you greater TUBE RELIABILITY

N-132 cathode base material, produced by a vacuum-melting process...an RCA development...is a new and extraordinary base composition for cathodes. N-132 makes possible substantial improvements in cathode uniformity, contributing significantly to the reliability and performance of Electron Tubes.

Vacuum-melting reduces the level of contaminants such as copper and sulphur. It also permits rigid controls to be placed on the presence of essential elements such as carbon, magnesium, manganese, silicon, and titanium. As a result, this process yields exceptional uniformity from one melt to another, therefore holding cathode characteristics within strict limits. In addition, the "process" reduces the deoxidizing agents usually employed in processing nickel "batches". This minimizes the possibility of gaseous contamination as the cathode material heats and ages, assuring long term, reliable performance in high impedance circuits.

RCA Tubes utilizing N-132 Cathode material can add a greater element of reliability to your circuits. Ask your RCA Representative—he'll be glad to prove the point.