In sealing, potting and encapsulation—

Epon Resins

give excellent electrical, thermal and mechanical properties, plus—

- excellent dimensional stability
- high mechanical strength
- outstanding adhesion to metal, glass, plastics
- exceptional dielectric properties

Although relatively new, the Epon resins have won an important place in electronic and electrical manufacture. Their applications are manifold—...in printed circuit laminates, transformer and motor sealing compounds, potting compounds for components and subassemblies, protective enamels, adhesives, tool and die materials.

For potting and encapsulating—the excellent dimensional stability of Epon resins, which can, for example, withstand bath temperatures without ill effect, and their outstanding adhesion to metals and glass assures airtight enclosure of delicate components and vacuum tubes.

As adhesives—solvent-free Epon resin formulations cure at room temperature with contact pressure alone; form powerful bonds between glass, metal, wood or plastic.

As sealing compounds—varnishes and enamels based on Epon resins provide excellent moisture sealing plus outstanding resistance to solvents and chemicals, even at elevated temperatures.

For laminating—Epon resins laid up with inert fibrous fillers produce base laminates that have superior dielectric properties and can be sheared, punched, drilled and bath soldered.

Write for information on the use of Epon resins in electrical and electronic applications.
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**Specify POTTER**

FOR YOUR DIGITAL DATA-HANDLING Equipment

As the nation's No. 1 producer of precision equipment for digital data recording and playback, Potter can provide individual components or complete systems. The following are typical:

**Digital Tape Handler**

A Potter Model 905 can give you, among many other desirable features, dual tape speeds up to 75 inches per second with 3 millisecond starts and stops. Tape tension is maintained at a low value by high-performance proportional servo systems. Tape width from 1/4" to 1 1/2" for 2 to 16 channel recording are available. Other features include high-speed rewinding, automatic threading, end-of-tape sensing and tape break sensing — to name a few.

**Record-Playback Head Assemblies**

All Potter record-playback heads feature phosphor bronze construction for high dimensional stability and freedom from oxide dropouts caused by oxide pickup. Precise track alignment permits tapes recorded on one machine to be played back on another.

**Record-Playback Amplifiers**

Record and playback amplifiers are available as optional plug-in units or as complete systems for recording and playing back any desired number of channels. Various input and output requirements can be accommodated. Return-to-zero or non-return-to-zero recording is optional. Translatorized models are also available.

**Custom Design for Your Instrumentation Program** — the Potter Instrument Company is fully equipped to furnish complete systems, heads and amplifiers, storage systems, high-speed printers and other digital data-processing accessories to meet specific data-handling requirements.

Please feel free to discuss your data-handling problems and requirements with your Potter representative. Potter engineers are ready, willing, and able to assist you.
A new and important

RELIABLE SUBMINIATURE TWIN TRIODE

CK6832

The FIRST SUBMINIATURE TUBE designed for precision D.C. Amplifier and Computer Service

The Raytheon CK6832 is a subminiature version of the popular and brilliantly successful CK5755. In addition to the reliability and ruggedness for which Raytheon Subminiatures are famous, this expertly designed, precision produced tube features:

LOW MICROPHONICS

Vibration output at 40cps, 15G...10 mV

Extreme ELECTRICAL STABILITY

E1b - E2b; E1c 6.3V to 5.9V...0.3V

Extreme MECHANICAL STABILITY

E1b - E2b after 400 to 600G shock...0.5V

LOW GRID CURRENT

3 x 10^-4 A

FINE BALANCE

between sections plate current balance...0.15 mA

All of the above are maximum ratings

Raytheon

SPECIAL TUBE DIVISION

RELIABLE MINIATURE AND SUBMINIATURE TUBES - VOLTAGE REFERENCE TUBES VOLTAGE REGULATOR TUBES - PENCIL TUBES - NUCLEONIC TUBES

CIRCLE 3 ON READER-SERVICE CARD FOR MORE INFORMATION

Editorial

Mica Status Needs Clarifying

One of our basic electronic materials may be in short supply in case of war—or maybe not! We refer to mica. Its status is confusing.

Recently advised that a “hot mica potato” is simmering close to boil with political intrigue and international overtones, we decided to “see for ourselves.” After talking to many people concerned with all aspects of the high-quality mica situation we aren’t certain whether we have a roaring bull by the tail or not. It seems to be quite tame, in fact—fortunately.

Mica has been such an important insulating material for electronic and electrical equipment that its shortage is reliably reported to have been a factor in the defeat of Germany and Japan in World War II. Since over 90 per cent of U.S. electrical-grade mica now comes from India, it would appear on the surface that its loss would prevent us from getting off the ground in case of an attack. But, would it?

Faced with a mica shortage in wartime since World War I, our government has tackled the problem to an extent at least, partially in cooperation with industry. In any event, it has been spending $20 million developing U.S. mica mines (which are mighty expensive to mine) and in stockpiling a “3-years’ supply” of high-grade electrical mica. Just now it is getting ready to spend $4,000,000 to advance research on reconstituted (large sheet) synthetic mica, with early success expected. Synthetic mica now is suitable to replace over 90 per cent of electrical-grade natural mica. It can stand much higher temperatures and is practically pure. The only “bug in the ointment” is its much higher cost than India’s mica. With India mica unavailable, it would be much more attractive.

The truth seems to be this: Natural mica is critical, existing workable mines are rapidly being depleted somewhat unnecessarily because of old-fashioned mining and grading methods and resistance of the British, French and U.S. mining and importing interests to technological improvements. India’s Ruby muscovite is of sufficient quality and cheaper as long as we can get it. But, when we can’t get it, we can supply 90 per cent or more of our requirements for high-grade mica from synthetic sources (Synthetic Mica Corp. of America, Brush Beryllium Co., etc.) within a year or so. The government stockpile should carry us until then.

The evidence points to the fact that we won’t get caught flat-footed next time. We wonder, though, if anyone really knows for sure! If he does, will he please step forward and relieve our case of jitters? ETE
Engineering Review

For more information on developments described in “Engineering Review,” write directly to the address given in the individual item.

9.7 Billion Electronic Giant

Electronics became a $9.7 billion industry in 1955, nine times bigger than it was at the end of World War II, according to the second edition of RETMA’s “The Electronics Industry Fact Book.” Moreover, it is destined to double its present size over the decade ahead.

Demand for automation is seen as pushing sales of industrial electronics to more than $1.2 billion by 1960 and to $2 billion by 1965. This would be up from $700 million in sales last year.

Deliveries of military electronics equipment are expected to run for several years at the 1954-55 rate of $2.4 billion. According to RETMA’s statistical report, actual deliveries increased from $500 million in 1951, to $1.5 billion in 1951, to $2.5 billion in 1952 and to a record $2.8 billion in 1953.

Missiles and rockets will replace piloted aircraft in 50% of strategic missions and 30% of tactical missions, according to the RETMA study. It was noted that expenditures in this field had increased 50 fold—from $21 million in ‘51 to nearly $1 billion last year.

Production of TV, radio and phonograph sets continues to break records. In 1955, for the third consecutive year, there were more than 7 billion TV sets manufactured. Last year’s production was 7.5 million sets factory valued at $1.1 billion. Radio set production last year was at its highest point since 1950, with output of auto radios exceeding 6 million for the first time.

RETMA’s Fact Book contains a number of the electronic industry’s growth, including statistics on retail outlets, and exports.

Copies of the “Fact Book” are available to non RETMA members and the general public for 50 cents a copy from Radio-Electronics-Television Manufacturers Association, 777 - 14th St. N.W. Washington 5, D.C.

Portable Air-Inflated Radar Antenna

A light-weight mobile radar set with an unusual giant balloon antenna has been developed by Westinghouse Electric Corp. Electronics Div. for the Air Research and Development Command.

Resembling a giant lollypop, the Paraballoon antenna stands more than 30 ft high. The fiberglass-clot balloon is preshaped so that when inflated it forms a double parabolic reflector coated on one inside surface with vaporized aluminum to reflect radar waves.

The new radar antenna weighs only 1690 lb compared to 10,000 lb for equivalent existing metal antennas and their support structures. The lightweight unit can be disassembled in minutes and packed into airlift containers weighing only 200 lb each. The entire radar set can then be air-dropped into tactical areas for detection of hostile aircraft.

The original idea was conceived by Westinghouse engineer Coleman Miller. Development was carried out under a contract with ARDC’s Rome Air Development Center, Griffith Air Force Base, Rome, N.Y.

The Paraballoon, when deflated, can be unzipped into sections. The magnesium supporting structure also is collapsible. While such a radar set can be packed into only a few boxes about 21 cubic feet each, antennas of comparable range require three to five 2-1/2 ton cargo trucks.

When erected in the field, the Paraballoon will be protected from high winds, rain and snow by an air-supported radome, similar to some now in service at fixed radar sites. The radome in this case however, is extremely lightweight, sectionized and designed for mounting directly on the ground. The radome serves to protect the complete radar system from the elements, including antenna, electronics equipment, and operating personnel.

Westinghouse engineers explained that neither the Paraballoon antenna nor the radome are easy prey to deflation by gunfire. More than fifty 20 mm projectiles can pierce the radome and antenna without affecting normal operations. This is because a constant stream of air is sent into Paraballoon and radome to maintain their low-pressure (less than 0.02 lb per square inch for the Paraballoon).

Paraballoon antenna radar units are now being manufactured by Westinghouse for the Air Force and the U.S. Marine Corps.
**MICROWAVE SIGNAL GENERATORS**

**950 to 11,500 mc**

![UNI-DIAL](image)

**JUST ONE POLARAD MICROWAVE SIGNAL GENERATOR CAN MAKE ALL THESE MEASUREMENTS**

Each Polarad Microwave Signal Generator (4 models cover 950-11,500 mc) is equipped with the unusually simple UNI-DIAL control that tracks reflector voltages automatically while tuning continuously. Frequency, accurate to ±1%, is read directly on the single frequency dial. There are no mode charts, no slide rule interpolations necessary.

But, most significant are the built-in features that enable use of these rugged instruments for so many applications: internal modulation, pulse and FM; internal square wave modulation; synchronization outputs, delayed and undelayed; provision for multi-pulse modulation input; provision for external modulation and synchronization; variable attenuator calibrated directly in -dbm, engineered ventilation to insure performance over long operating periods.

Contact your local Polarad representative or write directly to the factory for the latest detailed specifications.

**SPECIFICATIONS (all models unless indicated)**

<table>
<thead>
<tr>
<th>Model</th>
<th>Frequency Range</th>
<th>Power Output</th>
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</thead>
<tbody>
<tr>
<td>MSG-1</td>
<td>950 - 2400 mc</td>
<td>-</td>
</tr>
<tr>
<td>MSG-2</td>
<td>2150 - 4600 mc</td>
<td>-</td>
</tr>
<tr>
<td>MSG-3</td>
<td>4500 - 8000 mc</td>
<td>-</td>
</tr>
<tr>
<td>MSG-4</td>
<td>6950 - 10,800 mc</td>
<td>-</td>
</tr>
<tr>
<td>MSG-5A</td>
<td>6950 - 11,500 mc</td>
<td>-</td>
</tr>
</tbody>
</table>

- **Frequency Accuracy:** ± 1%
- **Power Output:**
  - MSG-1 & 2: 1 mm
  - MSG-3, 4 & 4A: 0.3 mm
- **Attenuator Range:** 120 db
- **Attenuator Accuracy:** ± 2 db
- **Output Impedance:** 50 ohms nominal

**External Pulse Modulation**

<table>
<thead>
<tr>
<th>Mode</th>
<th>Pulse Width</th>
<th>Rate</th>
<th>Power</th>
<th>Frequency Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSG-1 &amp; 2</td>
<td>0.5 to 5 micro-seconds</td>
<td>4 to 4000 pps</td>
<td>Positive or negative</td>
<td>2000 to 8000 mc</td>
</tr>
<tr>
<td>MSG-3, 4 &amp; 4A</td>
<td>5 to 1000 micro-seconds</td>
<td>5 to 2000 pps</td>
<td>Positive or negative</td>
<td>8000 to 10000 mc</td>
</tr>
</tbody>
</table>

**Internal Pulse Modulation**

<table>
<thead>
<tr>
<th>Mode</th>
<th>Pulse Width</th>
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<td>5 to 2000 pps</td>
<td>Positive or negative</td>
<td>8000 to 10000 mc</td>
</tr>
</tbody>
</table>

**Available on Equipment Lease Plan**

**FIELD MAINTENANCE SERVICE AVAILABLE THROUGHOUT THE COUNTRY**

**POLARAD ELECTRONICS CORPORATION**

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


CIRCLE 4 ON READER-SERVICE CARD FOR MORE INFORMATION

---

**“Sidewinder” Missile Joins Fleet**

“Sidewinder,” a lightweight, but extremely deadly air-to-air guided missile, is now part of the Navy's arsenal. The name, “Sidewinder,” is derived from a term used in the Southwest for vicious rattle snakes. Small and light enough to be carried in quantity by single-seat interceptor planes, the missile may be fired single or in salvos. “Sidewinder” requires no complex launching equipment but is fully maneuverable at supersonic speeds. It has an unusually high single-shot “kill” reliability.

Although details on the missile's guidance system have not been disclosed, the Navy revealed that “Sidewinder” requires no special pilot training. It has been implied that electronic components are fewer than what ordinarily appear in a radio. It may be launched well beyond reach of an enemy aircraft's defense.

Philo's Government and Industrial Division, Philadelphia, which assisted the Naval Ordnance Test Station, China Lake, California in the research and development program of Sidewinder, is now manufacturing the missile and has begun scheduled deliveries. Other companies working on the Sidewinder project include: G. E., Avion Div. of ACF, Eastman Kodak, and Bulova.

“Sidewinder” is classified as a guided missile in that it can change its course to account for tactical movements of an enemy target. Although the time of interception is very short, the missile displayed extreme deadliness during recent field tests.

**Narrow-Band A Must For Mobile Transmitters**

To utilize more fully the 152-162 mc band, the FCC has ruled that within 7 years all mobile transmitters in this range must use only narrow-band equipment (15 or 30 kc). By October 1958, all equipment being manufactured will be capable of satisfying the requirement so that taxicabs, railroads, trucks, utilities, police and fire-fighting agencies should anticipate little difficulty in complying with the ruling.

It is expected that the technical standards to be set up will be discussed in a forthcoming report by the FCC. Mobile radio users will be urged to leave the 25-50 mc band and go to the higher frequencies.
Jets Get New Boost From Hi-Temp Alloy

Westinghouse soon will begin full scale tests on a new combination of high-temperature alloys that may increase the efficiency of jet engines more than 15 per cent. Described as a possible key to a major advance in the field of jet engines and gas turbines, the development involves the sandwiching of one high-temperature alloy around another to take advantage of the heat resisting qualities of each.

Current high-temperature alloys restrict maximum turbine inlet temperatures to about 1600 degrees F. While these alloys are somewhat better than those of 10 years ago, they are still essentially of the same composition. However, with the use of Inconel-clad molybdenum, inlet temperatures of between 1800 and 1900 degrees will be possible. At the present stage of progress on jet engines and gas turbines, an increase in temperature boosts efficiency on an almost directly proportional basis.

The qualities of the alloys were demonstrated by subjecting three specimens to stresses at high temperatures. Inconel alone broke when the temperature hit between 1350 and 1450 degrees. Molybdenum did not break even at 1850 degrees, but did begin smoking at about 1300. This is due to oxidation which would rapidly burn up the metal if this were allowed to continue. However, when heat was applied to "clad moly," the specimen neither burned nor broke even at 1850 to 1950 degrees, due to the oxidation resistance of the outer layer of Inconel and the strength of the molybdenum.

Current tests are being conducted at the Westinghouse aviation gas turbine division in Kansas City.

Materials Study Urged

The study of the science of materials should become a part of an electrical engineer's training, says W. W. Mullins of Westinghouse Electric Corp., Pittsburgh, Pa.

"There is need for more top quality engineers in materials research and development because the electrical engineer has an intimate knowledge of the demands of electrical technology for special materials, and can judge the practical performance characteristics a material must have to be acceptable," Mullins noted.

He also feels that training in materials science would attract more electrical engineers to the fields of research and development.

Guaranteed Printed Wiring

Reliability of printed wiring is no longer of concern to Dumont since they have announced a 5-year guarantee with their new "400" line of instruments. Perfection of the art on a production basis has come a long way since the early trials were first initiated in the laboratory.

New 1 KVA Perkin
Tubeless magnetic amplifier

AC Line Regulator

features ±0.25%
regulation accuracy

FOR ANY COMBINATION OF LINE OR LOAD

Model MLR-1000

SPECIFICATIONS:

Maximum load: 1.0 KVA
Ambient temp. range: Up to 45° C
Dimensions: 19½" wide x 11½" high x 11½" deep (Cabinet)
19½" wide x 10½" x 12½" deep (rack panel)
Mounting: Cabinet or 19" rack panel
Finish: Gray hammer tone
Weight: 85 lbs.

Also available—3 KVA Model MLR-3000, same specifications except: output current 25.5 amps. Dimensions 19" wide, 14¾" deep x 12¼" high (rack) or 19½" wide x 16¼" deep x 12¾" high (cabinet). Weight 170 lbs.
WHERE ELECTRONICS MEETS THE EYE

MARION MEDALIST METERS bring color harmony and functional beauty to panel design. Crystal clear, high temperature Plexiglas** fronts are available in many standard colors with harmonizing or contrasting dials.

Custom case and dial colors can also be supplied.

Models include standard 1 1/2, 2 1/2 and 3 1/2 inch sizes, interchangeable with ASA/MIL type mounting, and all standard DC ranges of microamperes, milliamperes, amperes, millivolts, volts, kilovolts, and AC rectifier types including VU and DB meters. The 1 1/2" Medalists are also available as self-contained DC ammeters, rectifier-type AC voltmeters and VU meters.

**Reg. T.M. Rohm & Haas Co.

Modern equipment styling directs attention to that critical area, the indicator — where electronics meets the eye of the user. Now, Marion Medalist* meters in your equipment will provide added eye appeal and sales appeal by successfully combining accuracy and reliability with color harmony and distinctive styling.

Marion Medalists have another important advantage — increased readability. In the same panel space, a Medalist provides up to 50% more scale length — longer pointer — larger numerals — and greater natural dial illumination, than a standard round or square meter of the same size.

These are the reasons that Marion Medalist Meters are setting new standards of appearance and readability, where electronics meets the eye.

MARION ELECTRICAL INSTRUMENT COMPANY
GRENIER FIELD, MANCHESTER, NEW HAMPSHIRE

Copyright © 1956 Marion

Engineering Scholarships
Four-year scholarships, valued at $2200 each, have been established at the University of Tennessee by the Filton Syphon Division of Robertshaw-Fulton Controls. In inaugurating the scholarship program, the company announced that it wished to encourage students to enter the field of engineering.

The scholarships will be awarded on a competitive basis, two being given to children of employees and the other to a Knox County High School graduate.

Radar For Private Aircraft
A fifty-pound radar, the smallest and lightest of its type ever developed, will soon be available for private and business aircraft. The system (AVQ-50) developed by RCA Custom Aviation Equipment, Camden, N.J. will enable pilots to “see” and avoid storms up to fifty miles ahead.

High Temperature Electron Tubes
Several high temperature glass electron tubes are presently being manufactured in production quantities by Sylvania. Types 6049 and 1063A are hard-glass, high-temperature tubes and are the forerunners of a group rated at 300 C, instead of the present maximum of 220 C.

A pilot line of the tubes has been completed under a manufacturing methods contract by the Sylvania Electric Co., Emporium, Pa. The joint services requirements have been estimated at 100,000 tubes a month. The use of improved production techniques instead of laboratory methods has substantially reduced the cost of the tubes. They are designed for use on devices such as missiles, which require high-temperature ratings.

Nickel Oxide Standards Available
Two new nickel oxide powder samples, intended for checking and calibrating spectrochemical and chemical analysis of nickel, particularly cathode-grade material, are available from the National Bureau of Standards in 25 gm. containers. The sample standards are analyzed and certified for nine minor and trace elements.

© CIRCLE 6 ON READER-SERVICE CARD
Camera Marker Withstands 100 G’s
A virtually “G immune” timing generator which can be designed to pulse at any rate from 1 to 3000 times per second will be used to establish a time base on the film of airborne data recording cameras.

Sandwich construction is achieved by placing subminiature tubes between fiberglass boards which bear the printed circuitry. In its present application, the units have a pulsed 150 v dc output which actuates a neon bulb. An “optical probe” conducts the light to the film and makes possible a sharply-defined timing mark.

Manufactured by the Electromation Co., 116 So. Hollywood Way, Burbank, Calif., the device can withstand loads in excess of 100 G’s, high vibration levels, high altitudes, and temperature variations from —65 F to +185 F. Weighing 2-1/4 ounces it can be installed as an integral part of a recording camera.

Vanguard Essay Contest
An essay contest for college seniors and graduate students, with ten prizes totaling $12,000 plus duplicate prizes for the colleges, is being conducted by the Glen L. Martin Co.

Contestants may use any approach they wish, so long as their thoughts bear on some problem associated with the design, manufacture or use of orbital vehicles. Equally acceptable are papers on the non-technical aspects of satellite vehicles.

The purpose of the contest is twofold: to stimulate interest among engineering students in the comparatively new field of rocketry and its application to upper atmosphere research, and to point out the fact that the Martin Co. is interested in this phase of aviation and offers opportunities to outstanding engineering graduates.

FM Air to Ground TV
An experimental model of a uhf air-to-ground military television system was displayed by the Admiral Corp. 3800 Courtland St., Chicago 47, Ill. at the Army Association meeting in Washington D.C. Feature of the system is that frequency modulation is employed for picture transmission rather than conventional amplitude modulation.
Nobel Physics Prize Awarded

For their development of the transistor, the 1956 Nobel Physics prize has been awarded to Dr. William Shockley, Dr. John Bardeen and Dr. Walter H. Brattain. The three men, who worked together at Bell Telephone Laboratories, will share an award of about $38,600 made under the will of Alfred Nobel, Swedish inventor of dynamite.

Dr. Shockley joined Bell Labs in 1936 as director of transistor physics. He resigned last year to become director of the Shockley Laboratory of Beckman Instruments, Inc.

Dr. John Bardeen, winner of many awards for his work in physics, was assistant professor of physics at the University of Minnesota from 1938 to 1941. He was principal physicist for the Naval Ordnance Laboratory from 1941 to 1945 when he joined Bell Labs.

Dr. Walter Brattain was born in Amoy, China in 1902 where his father taught in a private school. He joined Bell Laboratories in 1929. During World War II he worked with the National Defense Research Committee at Columbia University where he studied magnetic detection of submarines.

Computers Aid Heart Research

High speed electronic computers are working to defeat heart disease.

The computers, located at the Lockheed Missile Systems division, spend their spare moments between missile calculations in a fantastically detailed new study of the human heart's activity.

The heart studies are a cooperative effort by the missile division and Dr. Travis Winsor, eminent Los Angeles cardiologist, director of the Nash Cardiovascular Foundation.

The electronic computer makes it possible for the first time to analyze rapidly and accurately the human heartbeat in terms of contractions, flutters, valve actions and other motions.

Dr. Winsor said the use of such electronic equipment is the first major advancement in the accurate compilation of heart data in 50 years. The Nash-Lockheed program is one of the few cooperative industry-medical heart studies in the nation.
INDUSTRIAL AND AIRCRAFT snap-action switches are our business ... our only business.

Electro-Snap's specialized engineers and precision manufacturing facilities are devoted entirely to combining the many facets of good switch design and production into the best switch for specified purposes ... and at minimum cost.

Autopilot Mockup

The automatic flight control system that controls and assists the nation's top-production supersonic jet fighter was shown for the first time in working model form at the Aircraft Electrical Society show in Los Angeles.

This "MB-3" system, which is manufactured by the Aeronautical Division of Minneapolis-Honeywell Regulator Company, is the first designed and manufactured for North American Aviation's F-100 Super Sabre.

Besides offering the usual stabilizing and pilot-assisting characteristics of an autopilot, the Honeywell system is integrated with a special navigational and weapon systems for the jet fighter.

Color TV Still A Question

Two conflicting statements by the leading receiver manufacturers have made the color TV receiver picture cloudier than ever.

It all began with GE President Ralph Cordier's statement that color TV was not yet ready for the market (ELECTRONIC Week; Oct. 22). The statement brought a prompt and heated response from RCA Chairman David Sarnoff.

"Anyone," said Sarnoff, "who wants to wait until the wagon is rolling and then get on for a free ride should have the courtesy to remain silent."

While RCA keeps plugging away at its theme that now is the time for color TV, there is widespread disagreement in the industry as to just when color receivers will dominate the mass market.

Automatic Telephone Dialing

Automatic dialing of telephone numbers can now be done by an electro-mechanical device the size of a standard handset telephone. The device, known as a Dialaphone, is a product of the Automatic Electric Company, 1033 W. Van Buren St., Chicago, Ill. Up to 850 names and numbers can be placed on a coded tape-like "directory" operated by a small hand crank.

To make a call, the tape is turned to place the desired name in a viewing frame. When a button is pressed, the number is automatically dialed.
remote control circuits
packaged to your specifications with
OAK rotary solenoids*

application-engineered and produced to meet your requirements

1. as simple solenoids
2. as rotary selectors
3. as complete remote control sub-chassis

rugged, compact units that meet the most stringent MIL specs

instant, positive HIGH TORQUE OUTPUT from LOW POWER INPUT

OAK rotary solenoids give you exceptionally high torque ... instantly on application of power. Whether your installation requires a simple solenoid, rotary selectors with switch sections, or a complete remote control sub-chassis unit, OAK will completely engineer and manufacture to meet your individual requirements.

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1260 clybourn ave. · chicago 10, ill.
Four modern plants manufacturing switches, vibrators, tuners, choppers and rotary solenoids.

World's Smallest Radar
Development of the world's smallest known radar set, with a maximum range of 6000 yards, has been announced by the Dept. of the Army.

The lightweight, portable set, built by the Sperry Gyroscope Co., Great Neck, N.Y., provides mobile Army forces with local battle area surveillance of enemy movements despite smoke, darkness or fog.

Lightness and ruggedness is attained by eliminating a cathode-ray tube and substituting audible signals.

Upper Atmosphere Research
Stanford Research Institute, Menlo Park, Calif., has been awarded a USAF contract to gather information about the effects of irregularities in the upper atmosphere on VHF and UHF radio transmission.

First phase of the program is being carried out in the hills immediately to the west of the Stanford campus. Observations and findings are expected to be utilized in the second portion of the program which will be continued in conjunction with the Geophysical Institute, University of Alaska, near Fairbanks.

Radio signal scattering and reflection by meteor trails in the 100 to 400 mc range and reflection of radio waves by the ionization associated with the Aurora Borealis will also be studied.

Earth Satellite Launching Vehicle
Critical tolerances constitute the outstanding manufacturing feature of the Vanguard launching vehicle which will attempt to place the world's first man-made satellite in its orbit 300 miles above the surface of the earth. When fueled for take-off, Vanguard will weigh approximately 11 tons.

Every pound of structural dead weight eliminated in a rocket yields an increase in the vehicle's attainable velocity. The vital importance of weight saving with a consequent velocity gain is apparent when it is considered that if the launching vehicle fails to attain the required initial altitude of 300 miles and a velocity of approximately 25,000 ft per second (about 18,000 miles per hour) the satellite will fail to orbit, and will spiral down to earth.

Send for descriptive brochure with layout sheets

OAK rotary solenoids manufactured under license of G. H. Leland, Inc.

* Solenoids manufactured
Temperature up on Semi-Conductors

Semiconductors whose junction temperatures are limited to 150°C should soon be a "thing of the past." Recent work by United States Dynamics Corporation, Boston, Mass., has resulted in semiconductors having a storage temperature of 500°C and a conservatively rated operating junction temperature of 375°C. Up to now, announced maximum temperatures have been around 200°C storage and 150°C operating. Need for the use of relatively low-temperature solders has been largely responsible for the temperature limitation.

It is understood that the higher temperatures have been made possible not only by refinements in the manufacturing process but also by forming an environmental surface barrier around the junction area.

Recent announcements of 300°C power rectifier developments by Automatic Manufacturing of Newark, N.J., a Division of General Instrument Company, further accentuates the scientific advance heralded here. Higher-power silicon transistors and diodes are assured, and are coming none too soon for many critical applications.

It should be emphasized that the 300°C temperature units reported are still somewhat in the laboratory stage, yet, there is every reason to believe that in a few months limited production quantities will be available.

Non-Degaussable Magnet

A permanent magnet, which is difficult if not impossible to demagnetize, is now in the laboratory stage. The process, developed at General Electric, consists of encasing ferromagnetic cobalt in an anti-ferromagnetic case of cobaltous oxide. This shifts the hysteresis loop completely to the left of the zero axis in the second and third quadrants.

So far the tests have been made at below room temperature (the temperature of liquid nitrogen); but it is expected in time to be entirely practical at ordinarily encountered temperatures. The cause of this effect between the ferromagnetic and anti-ferromagnetic materials is known as "exchange anisotropy."

General Electric Antennas Are Engineered to Give Your Radar System Top Reliability and Accuracy

Backed by more than two decades of experience and proven reliability, General Electric antennas are thoroughly engineered to your specific needs.

Whether your radar system calls for extensive research and development—for component manufacturing—or simply for production of your antenna design, General Electric engineering can answer them. Simply contact your local G-E Apparatus Sales Office. An antenna specialist will be glad to give you specific information. General Electric Co., Section 223-6 Schenectady, N.Y.

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Your own tests will prove why so many critical buyers specify Leach relays

Test any Leach relay against any comparable relay on the market. You'll learn in your own laboratory why the aircraft, missile and avionic industries have learned to look for the Leach label when they're looking for:
- Resistance to greater shock and vibration
- Dependability at higher temperatures
- Space-saving design
- Outstanding reliability

That's why you find designers depending more and more on Leach when system reliability is vital and components must not fail!

Leach's family of relays...offering the important advantages emphasized above

**Letters to the Editor**

**Reflex Circuit**

Dear Sir:

My colleague, W. A. Higinbotham, and I were highly amused with the article on page 36 in the October (1) issue of Electronic Design, entitled "Pentode Does Two Jobs." We are afraid we must really be getting old when the reflex circuit can be resurrected without being recognized. If memory serves me it was 1925 when it was the rage.

J.B.H. Kuper
Brookhaven National Lab.

Dear Sir:

The article in the October 1, 1956 issue of Electronic Design, "Pentode Does Two Jobs," leaves me wondering how the application described differs in principle from the "reflex" radio receivers of the early 1920's. In these receivers, tubes in the rf stages were used jointly as audio amplifiers. A short discussion of reflex amplifiers appears in "Radiotron Designer's Handbook," third edition, chap. 21, published in 1941. The circuit discussed in this chapter uses a pentode and is essentially similar to that described in the article referred to above.

Fred West
Bell Telephone Labs.

Messrs. Kuper and West are right. The "reflex circuit" is so old it had been all but forgotten. However, as far as we know this is the first application to commercially available television receivers. Where a large segment of our readership may be interested in a practical circuit application but unfamiliar with its availability, we feel we are rendering a useful service by publishing the information in Electronic Design.

**Derivations**

Dear Sir:

Regarding Mr. Lange and derivations (Oct. 1), it seems to me a logical solution is to offer, upon request to your office, duplicated sheets with derivations relating to the particular article. This would preclude the use of important ED space and yet satisfy those who want the full analysis. Many books employ a system of "appending" material of a derivative nature (although in this case, probably more for continuity than anything). Adopting this system should satisfy most readers.

Kenneth G. Leib
Sylvania Electric Products Inc.
Washington Report
Herbert H. Rosen

In and around Washington
Four national meetings held in the Washington Area during the month of October.

Association of the U.S. Army: The AUSA theme was the FUTUR-ARMY. Gen. Medaris emphasized the direction the Army was going in the missile field. It looks like the range will be at least 1500 miles in the immediate future.

Wehrner Von Braun envisioned manned space satellites circling the globe at about 1700 miles within the next 4 or 5 years. He saw missiles being guided and controlled to their targets by crews perched in their satellites far above the earth.

Edward Teller, master-mind of the H-Bomb, predicted small independent units fighting the next war. Each unit would be self-sufficient and equipped with nuclear weapons and several varieties of launchers.

Symposium on Electron Devices: This IRE Professional Group had more than 1000 people present to hear more than 60-odd papers. Dr. William Shockley predicted that 1962 would see the 25 cent transistor. Other predictions from other speakers included production of 40 million transistors next year and frequency cut-off in excess of 1000 mc. Also discussed was a new 24 hour regenerative type storage tube which could be read out indefinitely with no fading.

Symposium on the Physics of Semiconductors: The meeting sponsored by NBS and NRC groups drew some 200 engineers and physicists to hear some 22 papers. The topics covered mostly the theoretical aspects of semiconductors and the results of the experiments (where they were conducted) of the application of these theories.

Aero and Navigational Electronics: Feature of the meeting was a talk by Assistant Secretary of the Air Force Richard E. Horner. He emphasized the qualitative superiority the Air Force is hoping to attain through a careful selective process in its R&D Programs. What this means is that a penetrating scrutiny will precede each stage of a program before it is allowed to continue. At any time a program may be stopped if progress to date does not show that future work will allow it to fit into the overall scheme of the Air Force's mission. Many basic research programs, therefore, will survive for some time as long as they show promise and cost a little more than salaries. But when the activity passes through applied research and into development—and therefore a more costly phase—selectivity will be applied where necessary.

Now you can have resistors with all these advantages . . .

1. 120° C. operation with 100% power, derating to 200° C. 2. Same size as deposited carbons 3. Wide resistance range 4. Economical cost

To help you solve the problem of small space and high ambient temperature Corning has developed these Type S resistors.

These are not ordinary film-type resistors. They are integral units made by bonding a metallic oxide to a Pyrex glass rod at red heat. They're non-inductive and completely impervious to moisture.

Three sizes are now available in production quantities:
S-20—½-watt at 120° C. (or 1-watt at 40° C.). Range from 10 ohms to 100,000 ohms.
S-25—1-watt at 120° C. (or 2-watts at 40° C.). Resistance range from 10 ohms to 400,000 ohms.
S-30—2-watts at 120° C. (or 4-watts at 40° C.). Resistance range from 30 ohms to 1 megohm.

Corning Type S resistors have an average change in resistance of less than 1.5% after 1,000 hours at rated power.
Tolerances of 1%, 2%, 5% and 10% are available to meet your exact applications.

And how does a volume price of 25¢ each for the S-20 ± 1% tolerance sound to you?

Write for detailed descriptive bulletin.

Ask for information on these other Corning resistors:
Type LP—Low-cost, low-power. In 3-, 4-, 5-, and 7-watt sizes.
Type R—Power resistor to MIL-R-11804B. Tolerances of 7 to 115 watts
Type H—High-frequency 2% or 5% tolerance. Standard ranges from 10 to 1,000,000 ohms and ratings from 7 to 140 watts.

Type HP—High-power resistors. 17, 30, 70, and 150 watts. Tolerances of 2% or 5%. 20 to 500,000 ohms.

Type WC-S—Water-cooled. Range—35 to 300 ohms. Versatile and adaptable.

Type N—Accurate grade. Made to meet all requirements of MIL-R-10509B.

Other products for Electronics by Corning Components Department: Fixed Glass Capacitors*, Transmitting Capacitors, Canned High-Capacitance Capacitors, Subminiature Tab-Lead Capacitors, Special Combination Capacitors, Direct-Traverse and Midget-Rotary Capacitors*, Metallized Glass Inductances, Attenuator Plates.

* Distributed by Erie Resistor Corporation

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Corning means research in Glass

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**The expert choice**

for

**medium power, high fidelity equipment**

### EL84

British high fidelity experts know that for medium powered equipment there is no finer tube than the EL84. A pair of these tubes provide a power output of 10W at a distortion level of less than 1%, while their transconductance value of 11.300 mhos results in exceptional sensitivity. The EL84 may also be used for higher powers. For example, two tubes in push-pull will provide outputs of up to 17W at an overall distortion of 4%.

A single EL84 has a maximum plate dissipation of 12W. It provides an output of 5-6W for an input signal of less than 5V r.m.s. at plate and screen voltages of 250V.

Supplies of the EL84 for replacement in British equipments are available from the companies listed.

#### Principal Ratings

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<table>
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<tbody>
<tr>
<td>Heater</td>
<td>6.3V 0.76A</td>
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<tr>
<td>Max. plate voltage</td>
<td>300V</td>
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<tr>
<td>Max. plate dissipation</td>
<td>12W</td>
</tr>
<tr>
<td>Max. screen voltage</td>
<td>300V</td>
</tr>
<tr>
<td>Max. screen dissipation (max. signal)</td>
<td>4W</td>
</tr>
<tr>
<td>Max. cathode current</td>
<td>65mA</td>
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**Base**

Small button noval 9-pin

**Supplies available from:**

**In the U.S.A.**

International Electronics Corporation, Dept., E12, 81 Spring Street, N.Y. 12, New York, U.S.A.

**In Canada**

Rogers Majestic Electronics Limited, Dept. 1.0., 11-19 Bremtcliffe Road, Toronto 17, Ontario, Canada.

---

### Meetings

**Dec. 3-4: Second Midwest Symposium on Circuit Theory.**

Michigan State University. Symposium will consist of four sessions: Topology and Circuit Theory, System Analysis and Synthesis, Circuit Theory and Applications, and the Place of Circuit Theory in Education. A talk on “Engineering Education for the Future” will be given by Dr. J. D. Ryder on Monday evening. Papers will also be presented by engineers in the education field. Contact for further information, IRE, 1 West 79th St., N. Y., N. Y.

**Dec. 5-7: Second IRE Instrumentation Conference.**

Biltmore Hotel, Atlanta, Ga. Sponsored by the Professional Group on Instrumentation and the Atlanta Section of the IRE. Sessions will be devoted to industrial applications, missile range instrumentation, and the application of solid state devices. For further information, contact the IRE, 1 E. 79th St., New York, N. Y.

**Dec. 10-12: Eastern Joint Computer Conference.**

Hotel New Yorker, New York, N. Y. Sponsored by the IRE, AIEE, Association for Computing Machinery. “New Developments in Computers” is the theme of the meeting. In addition to an extensive program of technical papers, the meeting will feature exhibits by many manufacturers in the computing field. For information, contact Al Forman, Room 639, 480 Lexington Ave., New York 17, N. Y.

**Dec. 12: Information Theory and the Written Word.**

New York Academy of Science, New York, N. Y. Lecture discussion by J. R. Pierce. Sponsored by the New York Chapter of Technical Writers and Editors. For more information, write to J. A. Lippke, ELECTRONIC DESIGN, 19 E. 62nd St., New York 21, N. Y.
Bovard Hall, University of Southern California, Los Angeles, Calif. Sessions on Mechanical Reliability, Information Feedback, Component Evaluation Usage will be presented. "Failure Feedback--Is It Effective" is highlight of the meeting. Registration in advance is $3.00. Further information received from RETMA Engineering Office, Room 650, 11 West 42nd St., New York 36, N.Y.

Statler Hotel, New York, N. Y. General theme of program on the Aids for Environmental Control. Various discussions will be held. For further information contact the American Association for the Advancement of Science, 1515 Massachusetts Ave., N.W., Washington 5, D. C.

Boston University, Boston, Mass. Sponsored by the Air Force Cambridge Research Center and Boston University. For information, contact Miss Alice Cahill, Air Force Cambridge Research Center, Air Research and Development Command, Laurence G. Hanscom Field, Bedford, Mass.

Hotel Statler, Washington, D. C. Sponsored jointly by the IRE Professional Group on Reliability and Quality Control, the American Society for Quality Control, the American Institute of Electrical Engineers, and RETMA. For information, write to IRE, 1 E. 79th St., New York 21, N. Y.

Sheraton-Jefferson Hotel, St. Louis, Mo. Sixty-eight advanced technical papers will be presented. For further information contact Jas. R. Davidson, Executive Secretary, Society of Plastics Engineers, Inc., Suite 118-19, 34 East Putnam Ave., Greenwich Conn.

Hotel Statler, Sheraton McAlpin New York, N.Y. Information to be available at a later date.

6 new Dressen-Barnes power supplies
—designed to speed laboratory work and for use in original equipment

- Designed for Precision Measurements

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
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<tbody>
<tr>
<td>4K-100B</td>
<td>High Voltage, Excellent Regulation</td>
</tr>
<tr>
<td>.5-1MB</td>
<td>Low Voltage, High Current, Fast Response</td>
</tr>
<tr>
<td>D1-100B</td>
<td>For Precision Measurements</td>
</tr>
<tr>
<td>300XA</td>
<td>A Compact Adjustable Unit-Regulated</td>
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<tr>
<td>28SMX</td>
<td>28 V.D.C. — 5 Amps — Adjustable</td>
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<tr>
<td>28SMXR</td>
<td>28 V.D.C. — 5 Amps — Regulated by Mag. Amp</td>
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</tbody>
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Each unit features simplified design, highest quality components, easy-to-trace wiring, and ample working room under the chassis. Components are derated to run cool and last longer. Write for literature on any or all models.
FUSITE introduces "torture-proof" solid glass headers with V-24 glass

* greater resistance to mechanical shock and vibration
* greater resistance to heat shock

Here is the ruggedness you need in glass-to-metal terminals to make production handling simple. These headers come to you without cracks or leaks—but more importantly, they stay that way without "babying" them through your soldering operation and normal handling.

An interfusion of the glass and metal at the ring and every pin together with firm but carefully controlled compression makes handling less critical.

Available in four basic flange types in a wide variety of sizes and electrode styles and arrangements.

A bulletin on this complete new line is just off the press. It gives full technical information, sizes, pin layouts, electrode treatments and ratings.

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THE FUSITE CORPORATION

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CIRCLE 15 ON READER-SERVICE CARD FOR MORE INFORMATION

NBS Boulder Laboratories, Boulder, Colo. Co-sponsored by the Denver-Boulder chapter of the IRE PGAP and the Boulder Laboratories, National Bureau of Standards. The program is titled "Theoretical and Experimental Results in the Propagation and Radiation of Very-Low-Frequency Electromagnetic Waves (less than about 100 kc)." Authors are being requested to submit summaries for appraisal as soon as possible to Dr. J. R. Wait, Chairman, Denver-Boulder PGAP Chapter, National Bureau of Standards, Boulder, Colo. For further information, contact U. S. Dept. of Commerce, NBS, Boulder Laboratories, Boulder, Colo.

February 5-7: Twelfth Reinforced Plastics Division Conference.
Edgewater Beach Hotel, Chicago, Ill. Latest developments in both technical and practical aspects of reinforced plastics. Subject matter will range from reports on research and testing to product design to production methods to marketing techniques. A complete program, listing papers and speakers, registration forms for the three day Conference and hotel reservation blanks will be available after December 26. Those interested should write now to The Society of the Plastics Industry, Inc., 250 Park Ave., New York 17, N. Y.

Feb. 7: Annual Symposium of the New York Section of the ISA.
Garden City Hotel, Garden City, N. Y. Short papers on "Practical Accuracy of Measurement" will be presented followed by a discussion. Afternoon session will be on "Data Handling." For further information contact G. Newberg, Publicity Chairman, Fairchild Engine Division, Fairchild Engine & Airplane Corp., Deer Park, L. I., N. Y.


Statler Hotel, Los Angeles, Calif. The Conference is under the joint sponsorship of the IRE, AIEE, and ACM. Theme of the meetings will be “Techniques For Reliability.” For further information contact S. Dean Wanlass, Aeronutronic Systems, Inc., 13729 Victory Blvd., Van Nuys, Calif.

March 11-15: The 1957 Nuclear Congress

Hotel Biltmore, Los Angeles, Calif., sponsored by the Society of the Plastics Industry, Inc. Sessions will cover plastics in the fields of electronics, aircraft and defense, building, and processing. Exposition will be held at the Shrine Exposition Hall. Further information may be obtained from the Society of the Plastics Industry, Inc., 250 Park Ave., New York, N. Y.

April 8-11, 1957: Fourth National Electrical Industries Show.

April 11-13, 1957: Southwestern IRE Conference and Electronics Show.
Houston, Texas. Sponsored by the Houston Section of the IRE. This conference will be augmented by the National Simulation Conference which will be sponsored by the IRE Professional Group on Electronic Computers. For information, write to Ninth Southwestern IRE Conference and Electronics Show, P. O. Box 1234, Houston 1, Texas.

May 16-18: Eighth Annual Conference and Convention, American Institute of Industrial Engineers.
New York City, Hotel Statler. For information write to AIIE, P.O. Box 8, Substation 135, The Bronx 53, New York.

For high-speed switching

CBS
HIGH-FREQUENCY TRANSISTORS
2N182
2N183
2N184

These transistors are especially designed for high-speed switching . . . control . . . analog and digital computer applications. They are:
1. NPN Symmetrical . . . for better frequency response and reversible collector and emitter, permitting unusual applications.
2. Alloy-Junction . . . for greater uniformity, higher voltage and current, flatter gain, and more dependable performance.

Note the many desirable features. Write for Bulletin E-268 giving complete data and helpful application notes.

Reliable products
through Advanced-Engineering.

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CBS-HYTROX
A DIVISION OF COLUMBIA BROADCASTING SYSTEM, INC.

CIRCLE 16 ON READER-SERVICE CARD FOR MORE INFORMATION
THE method described here for the measurement of thermal resistance of power transistors lends itself to rapid determinations. It excludes the need for prior transistor calibrations which are often very time consuming. This type of measurement is also applicable to silicon devices with monor modification.

It is necessary to know the junction temperature while the unit dissipates power so that reliability on the basis of manufacturers' data is assured. In addition, this information is needed when the transistor is encased in a final package for accurate analysis. Estimation of junction temperatures based on initial saturation and collector cut-off currents are made.

Considering a triode junction transistor operating with normal bias, the dc base current can be considered in terms of two currents, the collector cut-off current, \( I_{C0} \), and the normal base current, \( (1-a) I_E \) as,

\[
I_B = (1-a) I_E - I_{C0}
\]

Considering the above equation, when \( I_E \) equals zero, the base current consists of the \( I_{C0} \) component only. Utilizing this information, it is then possible to measure the value of the "hot" \( I_{C0} \). This is done primarily by taking the transistor and mounting it on a hollow copper block through which water, at a controlled temperature, is circulated. This places the case or stud at some fixed temperature. A block diagram of the system is shown in Fig. 1.

If we assume that \( I_{C0} \) consists of two components, namely, a saturation component and a leakage component, in accordance with the following equation:

\[
I_{C0} = I_B + I_L
\]

It is known from experimental work that the saturation component of \( I_{C0} \) varies approximately 9% per degree C and from previous work done by the author, it has been found that the leakage component for germanium devices does not vary with temperature for the practical purposes of this measurement. From this data, it is then possible to estimate the junction temperature value for the thermal resistance measurement. For example, let us assume that the value of \( I_{C0} \) at 28 v is 0.5 ma. Let us assume further, that the saturation component of \( I_{C0} \) as measured at a collector to base voltage of 2 v is 0.9 ma. This makes the leakage component of \( I_{C0} \) 0.41 ma. Let us assume for simplicity that this measurement was made at 25 C, and that for the thermal resistance measurements we will operate at a junction temperature of 70 C. The saturation component of \( I_{C0} \) will increase by a factor of approximately 16, yielding a saturation component at 70 C of 1.44 ma and a total value of \( I_{C0} \) at 70 C of 1.85 ma. Thus, it is possible to go ahead and raise the junction to this value of approximately 70 C with a resultant \( I_{C0} \) of 1.85 ma.

The circuit for measuring junction temperature is shown in Fig. 2. It consists of a constant voltage supply in the collector circuit which is in the form of a battery supply. It has been the experience that at 28 v is a convenient operating voltage in the collector circuit. A measuring resistance is inserted in the base circuit across which a cathode ray oscilloscope displays the appropriate wave forms. It has been the experience that a 200 ohm resistance is sufficient for measurement purposes and that a Tektronix Scope #531 or equivalent is used for displaying the base current wave form. The collector voltage and collector current are monitored during the measure-

Bernard Reich
Signal Corps Engineering Lab
Fort Monmouth, N. J.

Fig. 1 Block Diagram of Thermal Measurement System

Fig. 2 Thermal Resistance Measuring Circuit
ment period to determine the transistor power. In the emitter circuit, it is noted that we include an emitter supply in the form of batteries, and a Western Electric relay, Type 276, which is hooked up in the manner shown in Figure 2. The relay is on for approximately 15 milliseconds and off for 3 milliseconds, as this latter time is the break time of the relay.

Returning to the transistor mounted on the copper dissipator, through which water is flowing at 25°C, we now raise the junction temperature to 70°C by increasing the emitter current and producing resultant collector power. The amount of emitter current is increased until an \( I_{C0} \) of 1.85 ma multiplied by 200 ohms in the base circuit, or 370 mv appears across the 200 ohm, measuring resistor. This establishes one point on the transistor derating curve shown in Fig. 3.

The temperature of the water is now increased to a higher temperature. Let us say, 45°C by either using another vessel or heating the fluid in the existing vessel. Again power is dissipated in the transistor until we again read 370 mv across the measuring resistor. This establishes the second point on the derating curve. If it is assumed that it was necessary to inject \( X \) watts at the 25°C dissipator temperature to raise the junction to 70°C and \( Y \) watts at 45°C dissipator temperature for the same junction temperature, then the value of thermal resistance is

\[
\frac{(45 - 25)^\circ C}{(X - Y) \text{ watts}} \quad \text{or} \quad \frac{20}{X - Y} \text{ degrees } ^\circ \text{C per watt}
\]

The resultant method has been applied mainly to germanium power transistors and has yielded excellent results. The range of thermal resistances measured has been between 0.3 to 8°C per watt. The method lends itself to rapid thermal measurements and could also be used to determine the thermal time constant of the junction. Several companies have adopted this technique with success and it is suggested that the industry in general examine this method as a possible standard for thermal resistance determination.
Let the facts speak for themselves! ACE Sub-Miniature Precision Wire-Wound Potentiometers and Potentiometer Trimmers are the result of 4 years development and over a year of successful use by leading electronic equipment manufacturers. Users have conclusively proved that ACEPOTS and ACETRIMS meet requirements for space and weight saving compactness, while at the same time meeting MIL specs' most stringent qualifications for performance and dependability. Why invite trouble with untested components when you can protect your reputation with ACEPOT and ACETRIM . . . the subminiature potentiometers and trimmers proved in actual use.

Condensed Engineering Data

| Resistance Range | 200 to 250K ± 2% | 10 to 150K ± 3% |
| Linearity | ±3% | ±3% |
| Resolution | extremely high | excellent |
| Ambient Temperature | - 55° C to 125° C | - 55° C to 125° C |
| Torque | low or high | low or high |

The above specifications are standard — other values on special order.
Available in threaded bushing, servo, flush tapped hole or flange mounting, and ganged units. All units sealed, moistureproofed, and anti-fungus treated. Meet applicable portions of JAN specs and MIL-E-5272A standards.

*New X-500 ACEPOT operates to a new high of 150° C.

Contrasted to the ball and disk types now commercially available, this floating ring integrator can be controlled from a minute force acting through a small distance. The force required to actuate the control yoke on the ring is less than 0.5 grams. Forces of this magnitude are directly available from standard instrument type pressure spirals and filled thermometer elements. In many applications it eliminates the need for electronic amplifiers and servo mechanisms because of its low control power requirements and its mechanical power amplifying characteristics.

The integrator, designed and developed by the Optimum Engineering Co., 2017 Willow Street, Grand Prairie, Texas, operates by moving the control yoke, which causes the ring to tilt about the axis of the drum, as would occur when the measured variable changed. The ring will then move along the drum and on the face of the disc until it is aligned under the controlled point of the yoke, and is perpendicular to the axis of the drum. This alignment is automatic. The output speed of the drum shaft relative to the input speed of the disc varies in direct proportion to the ring's position from the center of the disc. Since the ring rotation would be zero at the center, it would be difficult to move it from that position. Excessive wear would also occur on both the disc and the ring. To prevent the ring from moving to the center of the disc, a physical stop is employed which limits the travel of the ring. Normally, the ring may be positioned within .01 of the disc's center.

The relation existing between the input shaft speed and the output shaft speed may be expressed by the following formula:

\[ \theta = (\theta_1)(d)(k) \]

where: \( \theta \) is the angular travel of the output shaft, \( \theta_1 \) is the angular travel of the input shaft, \( d \) is the distance from the center of the disc to the point of contact with the ring and \( k \) is a constant.

Evaluation of the constant \( k \) is as follows:

\[ k = \frac{2D_2}{D_1D_3} \]

where: \( D_1 \) is the diameter of the drum, \( D_2 \) is the inside diameter of the ring, and \( D_3 \) is the outside diameter of the ring.

The integrator can operate in any position. Normally, however, the integrator runs...
This new bulletin gives you the facts... and complete how-to-do-it instructions for wiring your product with Panel Channel® raceways. All steps are fully illustrated. Panel Channel does the wiring job with one-third the work... and even greater reductions in cost. Panel Channel is relatively new... but it is already the standard wiring method used by hundreds of leading electrical and electronic equipment manufacturers for their products. You Should Have the Facts. Send for your copy of Bulletin S-301, today.

![Diagram of Floating Ring Integrator](image)

Pictorial diagram of Floating Ring Integrator. Motion is imparted by the disc to the drum through the ring, which makes only point contact with the disc, and is held between the disc and the drum by spring loading of the disc.

in an oil bath which is contained in the lower half of the cover, and the unit should be mounted horizontally to take advantage of the oil bath lubrication which assures longer life.

The rate at which the ring will reposition itself varies as its distance from the center of the disc and the speed of the disc itself vary. The degree of tilt of the ring, and the direction it is moving relative to the center of the disc also affect the repositioning rate. Generally the time required for repositioning is under one second, except for very low disc speeds.

A standard model of the Floating Ring Integrator is available with a constant $k$ of 2.830. The unit is 6 in. x 4 in. x 3 in. including shaft extensions. By varying the design ring, integrators can be built with constants ranging from less than 0.1 up. Output torque is 3-in. oz max. More spring loading can be added if necessary.

For more data about this product, fill Reader’s Service Card and circle 19.

Here's your guide... to better wiring with one-third the work.

![Reader Service Card](image)

Alternate methods of Ring Control.

Panel Channel®

STAHLIN BROTHERS, INC. • 101 MAPLE STREET
Belding, Michigan

CIRCLE 20 ON READER-SERVICE CARD FOR MORE INFORMATION
SIMPLE, accurate phase shifting is made possible by this electro-mechanical device of unlimited life and stability. It can rotate the time phase of any single fixed frequency over 360 degrees and display it upon a dial to an overall accuracy of 12 min. of arc. This makes it particularly applicable to ac Servo synthesis problems.
Using no active components, the PG-2 phase generator, made by the Theta Instrument Corp., 204 Market St., East Paterson, N.J., has only three basic parts: an inductive synchro-resolver, a 90 degree time-phase shift network, and a geared dial. The input voltage is passed through the phase-shift network to excite the stator (instead of the rotor) of the synchro-resolver, thereby increasing the phase-shift accuracy. The output voltage is taken off the rotor by the usual brush and slip-ring assembly. Due to low current output and low speed, brush life is practically unlimited.

The phase generator can be applied in the design of ac Servo systems where input, feedback, and reference signals must be accurately phased. In this case the required phase shift is read on the dial and a fixed network can be designed accordingly. It can also be applied to measure the phase of an unknown voltage, by using a bridge transformer and a null-reading VTVM. If used in conjunction with a phase-sensitive detector where the phase reference is not readily available, the phase generator, excited by a fixed voltage source, can be set to any desired phase and used as a reference.

The output voltage is constant, as the attenuation between input and output is a fixed parameter which does not vary with the phase rotation. Since the input frequency is rather critical for any given unit, an adjustment is provided to compensate for any small variations in frequency. Standard models are designed for carriers of 60 cps and 400 cps, but special units can be produced to operate at any one frequency between 30 cps and 150 kc.

No calibration or alignment procedure is required prior to use. Since all the elements within the assembly are passive, the unit is rugged, stable, and long-lived.

For further information about this product, front Reader's Service Card and circle 22.

Unretouched oscillogram demonstrates the wide spectrum and random nature of vibrations inherent in Sylvania's new "white noise" vibration test. Its approximation of flight conditions to which guided missiles are subjected is an important contribution to tube reliability.

The "white noise" test rack is compact and simple to operate. It provides direct noise output readings from both an R.M.S. and a peak-to-peak voltmeter across a wide frequency spectrum.

"White Noise"
puts wings on a test rack, advances tube reliability

By providing a more realistic tube vibration test which can be adapted to large-scale production techniques, the "white noise" vibration test is contributing to greater tube reliability.

Developed by Sylvania engineers in conjunction with Naval contracts, the "white noise" vibration test meets important requirements for testing tubes used in guided missiles and other vehicular applications.

First, it simulates environmental conditions by presenting a wide range of vibrational frequencies. Secondly, it presents these frequencies at random g-levels. Thirdly, it provides specification limits through direct meter readings.

If you are interested in additional analysis of the "white noise" vibration test, write on your company letterhead. Please address Department M22P.

SYLVANIA

LIGHTING - RADIO - TELEVISION - ELECTRONICS - ATOMIC ENERGY
QUICK RECOVERY Silicon Junction Diodes by Hughes

DESIGN ENGINEERS—Hughes Semiconductors now offers a new family of silicon junction diodes—especially designed to provide you with a device having significantly faster recovery characteristics than even germanium computer diodes and, in addition, capable of operating at high voltages and high temperatures. For the first time, this particular combination of characteristics—(high speed + high temperature + high voltage)—is available in a semiconductor.

Excellent high-frequency characteristics of the new diodes enable you to use them instead of vacuum or germanium diodes in such applications as: FLIP-FLOP CIRCUITS . . . MODULATORS AND DEMODULATORS . . . DISCRIMINATOR CIRCUITS . . . CLAMPING AND GATING CIRCUITS . . . DETECTORS. So, whenever you need a diode for pulse or computer circuitry to perform under conditions that are marginal for vacuum or germanium diodes, use the new QUICK RECOVERY Silicon Junction Diodes—by HUGHES!

RECOVERY. All types recover to 400K ohms in one μsec when switched from 30mA forward to 35V reverse. Special types with faster recovery are available if required.

WORKING INVERSE VOLTAGE. From 30 to 200 volts.

OPERATING TEMPERATURE RANGE. —55°C to +135°C.

ACTUAL SIZE. Diode Glass Body. Length: 0.265-inch, max. Diameter: 0.105-inch, max.

TYPES NOW AVAILABLE. IN625, IN626, IN627, IN628, IN629.

With a wide variety of germanium and silicon diode types available for computer and other fast switching applications, we are in a position impartially to recommend the best type for your particular requirements. Our field sales engineers near you are ready to assist you in making the best possible selection. For further details, or for specifications covering the new Quick Recovery Silicon Junction Diodes, write: HUGHES PRODUCTS • SEMICONDUCTORS

International Airport Station, Los Angeles 45, California

CAPABLE of being tripped by a single pulse in less than 70 milliseconds, this four-arm waveguide switch for microwave relay service can be applied to standby operations, or used for switching the direction of transmission.

Covering the frequency range between 5900 and 8200 mc, the NRK No. 28900 rotary switch has been developed for use with the RG-50/U waveguide by the N. R. K. Mfg. & Engineering Co., 4601 W. Addison St., Chicago 41, Ill.

When used for standby service, two arms can be connected to signal inputs, a third arm connected to the antenna, and the fourth arm terminated in a polyiron load. Either of two signals can then be switched to the antenna while the other signal is switched to the polyiron load. For application in reversing direction of transmission, two antennas can be connected to two opposite arms of the switch, and two channels connected to the other two opposite arms. Four polyiron loads are supplied with the switch to cover the full frequency range. The maximum voltage standing-wave ratio for a standby arm terminated in any one of the loads is 1.15, while the maximum VSWR from either signal arm into the antenna is 1.10. Crosstalk is greater than 40 db.
Rotary Waveguide Switch

Constructed of aluminum, the four-pound switch requires an actuating voltage of 80 to 110 dc or it can operate on ac with additional selenium rectifiers. A selector switch is mounted on the waveguide switch shaft for remote indication of switch position.

For further information about this product fill out the Reader's Service Card and circle No. 25.

Constantin's pre-testing assures quality glass-to-metal seals that stand up under climatic extremes ... and any one of the thousands of different Constantin seals will improve your present project, no matter what your particular requirement may be.

Constantin has long been noted in the electrical and electronic industries for its rigid inspection of all parts, from start to finish. They have pioneered in unique and difficult designs in such diversified items as multi-headers, all-in-one assemblies, transistor mounts, single terminals, end seals, crystal mounts, and other superior fabrications.

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CIRCLE 26 ON READER-SERVICE CARD FOR MORE INFORMATION
Insulation Resistance of Capacitors

George Mystic
Director of Research
Condenser Products Co.
Division of New Haven Clock & Watch Co.
New Haven, Conn.

This article shows the common methods by which leakage resistance of capacitors is measured, and gives applications to show where a knowledge of this factor will aid the circuit designer in overcoming shortcomings of circuit operation.

The insulation or leakage resistance of a capacitor (IR) is the applied voltage divided by the effective leakage current flowing through the dielectric. The applied voltage can be constant, transient or sinusoidal. However, for IR values, voltages are applied for a certain length of time. The resulting IR (megohms) is multiplied by the capacitance (microfarads). This yields a quality factor—megohms times microfarads. Usually capacitor manufacturers designate capacitance values of 0.01 μF and greater in Meg μF and in megohms for capacitance values below 0.01 μF. All ratings are at room temperature. In this way capacitor IRs can be directly compared.

Capacitor Equivalent Circuit

The capacitor equivalent circuit has not only a capacitance shunted by a constant resistance value but is also shunted by a complex impedance which includes effects of ion migration, dielectric polarization, voltage, time, self inductance, etc. For practical use, one can gain a working knowledge of IR by observing the common factors which affect it and methods of its measurement.

Insulation Resistance and Circuit Operation

The most common troubles of circuitry are related to poor insulation resistance of capacitors. The effects of external influences such as radiation from radio active sources, humidity, dust, etc., can be alleviated through shielding, desiccating and air conditioning the surroundings. However, the major cause of low leakage resistance is directly related to the type of dielectric used, as will be shown. The remaining factors—such as dielectric absorption, dissipation factor and frequency—although seemingly bearing no relationship to IR, do affect IR but are usually separately measured.

Methods of IR Measurement

1. Basically, resistance can be determined from calculation of the leakage current and applied voltage (Fig. 1). It is, therefore, only necessary for the instrument to determine this leakage current in terms of the voltage drop across a precision resistor at any time during which the voltage is applied. Instruments using this principle are marketed as Megohmmeters, Ultra-Ohmeters, etc., and incorporate dc amplifiers, self-contained de voltage sources and indicating meters which give direct ohm readings to 10^15 ohms with a maximum

Fig. 1. Megohmmeter Circuit

Fig. 2. Comparison Method. Wheatstone Bridge.

Fig. 3. Self Time Constant Method.

Fig. 4. Rate of Change Method Using Electrometer.
Error of Plus or minus 5%.

Another type of apparatus using a comparison method incorporates a null detector indicating a balance arrangement (Fig. 2). With this method, resistance values of 100 ohms can be detected with a self-time constant method employed in instances where a constant time is required to hold a reference voltage for several thousand hours. In this method, the resistance is calculated as the same as when using the Maximum error calculated is from the basic transient equation.

Error of Plus or minus 5%.

The self-time constant method is employed in instances where a constant current is required to hold a reference voltage for a length of time sufficient to ensure that the circuit is in an equilibrium state. In this method, the resistance is calculated as the same as when using the Maximum error calculated is from the basic transient equation.

Error of Plus or minus 5%.

The self-time constant method is employed in instances where a constant current is required to hold a reference voltage for a length of time sufficient to ensure that the circuit is in an equilibrium state. In this method, the resistance is calculated as the same as when using the Maximum error calculated is from the basic transient equation.
High-speed control for high-speed missiles

Nowadays, target, aircraft, and missile speeds are too fast for human reactions. Automatic equipment makes ready, radar eyes take aim and a computer pulls the trigger.

Replacing men with machines on the firing line gives us a better chance for an interceptor kill or successful missile shot. And, today, we can’t afford to miss. That’s why reliability of every component is so important in modern fire control gear. And reliability is the main reason engineers—like those designing Northrop Aircraft’s Snark missile (above)—so often pick Bristol's® Syncroverter® High-Speed relays (or the very similar Syncroverter chopper).

These high-speed relays have a normal life of billions of operations in dry circuit applications. They’re available in SPDT and DPDT models with the typical characteristics listed below and in many variations.

And, of course, many critical applications other than fire control—such as air-to-ground telemetering, analog and digital computers, aircraft or missile navigation equipment, carrier current switching—can benefit from the outstanding reliability of Bristol’s Syncroverter line. Write for complete technical data today. The Bristol Company, 151 Bristol Road, Waterbury 20, Conn.

### TYPICAL CHARACTERISTICS

- **Temperature range:** -55°C to 100°C
- **Operating shock:** 30G; 11 milliseconds duration
- **Vibration:** 10-55 cps (see below, Mounting); 10 G
- **Contact ratings:** up to 35V, 45 microamperes
- **Stray contact capacitance:** less than 15 mmf
- **Pull-in time (including bounce):**
  - as low as 200 microseconds
  - Life: Billions of operations
- **Mounting:** Octal tube socket; others available, including types for vibration to 2000 cps.

---

**Table 1.**

<table>
<thead>
<tr>
<th>Dielectric and Container</th>
<th>2 min</th>
<th>10 min</th>
<th>20 min</th>
<th>60 min</th>
<th>300 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teflon—dry</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Teflon in Silicone</td>
<td>2.0</td>
<td>2.7</td>
<td>3.0</td>
<td>3.4</td>
<td>3.5</td>
</tr>
<tr>
<td>Polystyrene</td>
<td>1.0</td>
<td>1.2</td>
<td>1.5</td>
<td>2.9</td>
<td>3.7</td>
</tr>
<tr>
<td>Cellulose Acetate—dry</td>
<td>1.4</td>
<td>1.8</td>
<td>2.3</td>
<td>2.7</td>
<td>3.0</td>
</tr>
<tr>
<td>Cellulose Acetate in Silicone</td>
<td>2.0</td>
<td>2.8</td>
<td>3.4</td>
<td>3.9</td>
<td>4.6</td>
</tr>
<tr>
<td>Polystyrene</td>
<td>0.01</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Paper—mineral oil impregnated</td>
<td>4.5</td>
<td>5.5</td>
<td>7.2</td>
<td>8.2</td>
<td>8.0</td>
</tr>
<tr>
<td>Paper—chlorinated di-phenyl impregnated</td>
<td>12.0</td>
<td>11.0</td>
<td>9.0</td>
<td>7.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Mica—transmitting</td>
<td>3.7</td>
<td>4.7</td>
<td>5.1</td>
<td>5.0</td>
<td>6.0</td>
</tr>
</tbody>
</table>

**Table 2.**

<table>
<thead>
<tr>
<th>Dielectric and Container</th>
<th>2 min</th>
<th>10 min</th>
<th>20 min</th>
<th>60 min</th>
<th>300 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teflon—glass tube</td>
<td>1.2 x 10⁴</td>
<td>1.9 x 10⁴</td>
<td>2.4 x 10⁴</td>
<td>2.0 x 10⁴</td>
<td></td>
</tr>
<tr>
<td>Teflon—metal shell and glass bead terminals</td>
<td>3.5 x 10⁴</td>
<td>5.0 x 10⁴</td>
<td>1.0 x 10⁵</td>
<td>1.4 x 10⁵</td>
<td></td>
</tr>
<tr>
<td>Teflon in Silicone fluid metal shell</td>
<td>1.0 x 10⁵</td>
<td>5.0 x 10⁴</td>
<td>1.4 x 10⁵</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mylar—uncased</td>
<td>2.3 x 10⁵</td>
<td>4.0 x 10⁴</td>
<td>1.0 x 10⁵</td>
<td>1.5 x 10⁵</td>
<td></td>
</tr>
<tr>
<td>Mylar—metal shell and glass bead terminals</td>
<td>1.1 x 10⁴</td>
<td>1.1 x 10⁴</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mylar on Teflon—glass tube</td>
<td>2.1 x 10⁴</td>
<td>4.4 x 10⁴</td>
<td>1.0 x 10⁵</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mylar on Teflon in Silicone—glass tube</td>
<td>3.3 x 10⁴</td>
<td>4.5 x 10⁴</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polystyrene—glass tube</td>
<td>2.0 x 10⁴</td>
<td>1.0 x 10⁴</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polyethylene in Silicone—glass tube</td>
<td>2.1 x 10⁴</td>
<td>4.4 x 10⁴</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cellulose Acetate Dry—glass tube</td>
<td>3.3 x 10⁴</td>
<td>4.5 x 10⁴</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cellulose Acetate in Silicone—glass tube</td>
<td>2.3 x 10⁵</td>
<td>4.0 x 10⁴</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper—oil impregnated—card board case</td>
<td>2.0 x 10⁴</td>
<td>1.0 x 10⁴</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transmitting Mica—ceramic case</td>
<td>5.0 x 10⁵</td>
<td>7.0 x 10⁴</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metallized Paper—metal shell</td>
<td>8.0 x 10⁴</td>
<td>2.0 x 10⁴</td>
<td>1.0 x 10⁴</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Table 3.**

Comparison of Methods of Insulation Resistance Measurements of Dielectrics at 25 C, 100 v dc

**Fig. 5.** Insulation Resistance vs Time of Voltage Application for Several Dielectrics*. Charging voltage, 250 dc, at 25 C.

* T—Teflon dry
  M—Mylar dry
  C—Ceramic
  MT—Series Mylar Teflon
  CA—Cellulose Acetate dry
  AS—Cellulose Acetate siliconed
  P—Polystyrene dry
  KM—Paper-Mineral Oiled

**Fig. 6.** Insulation Resistance vs Temperature for Several Dielectrics*. after 2 min charge to 250 v dc.
chance of not discharging and discharging tends to increase the IR of a dielectric.

If dissimilar dry dielectric films are placed in series between the capacitor foil electrodes the result on the IR will depend upon the chemical composition of the dielectric and the amount of dielectric absorption contributed by each film type. For instance, from Table 3, if non-polar Teflon (2 minute IR 1 x 10$^8$ meg x μf) is wound in series between foil electrodes with Mylar (1 x 10$^5$ meg x μf) the new double layer dielectric will have an increased two minute IR of 2.3 x 10$^5$ meg x μf. An advantage of plastic films is that the dielectric can be tailored to meet IR requirements.

Environmental Conditions. Excluding temperature, which was previously mentioned, the outstanding conditions under which the capacitor IR is affected are humidity, acid fumes, dust, conductive lint, salt spray, and high-energy radiation.

If the capacitor is plastic embedded, or hermetically enclosed, high humidity, dust, etc., will not affect IR. In the majority of instances this is not the case. A thin surface layer of moisture can increase surface leakage over insulating terminals, bushings and container.

The effects of these surface contaminants are usually decreased but never eliminated by such methods as convolutions of the insulating terminal and various baked silicone treatments.

High resistivity plastic containers of Polystyrene, Teflon and Polyethylene retain surface and volume charge due to molding by the manufacturer. This charge tends to precipitate dust, lint, etc., upon the plastic surface causing an increase in surface leakage currents. Sharp discontinuities of the plastic case will alleviate the effects of these conducting surface films in some instances.

Capacitors used on high voltages will exhibit leakage due to corona discharge due to conductive contaminating films, high humidity, and sharp metallic points. Silicone treatments and plastic sprays on the market reduce the corona discharge considerably.

Electronic equipment used near nuclear reactors and sources of radiation is adversely affected, particularly with respect to the IR of dielectrics and insulators. Considerable research is being done presently in this field. In general it can be said that resistivity decreases for all known dielectrics, but IR of Polystyrene seems to be the least affected by radiation.

### Table 4.
**Effects of Previous Voltage Applications on Insulation Resistance of a Dry Mylar Unit**

<table>
<thead>
<tr>
<th>Trial</th>
<th>IR (Meg x μf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>59,000</td>
</tr>
<tr>
<td>2</td>
<td>87,000</td>
</tr>
<tr>
<td>3</td>
<td>94,000</td>
</tr>
<tr>
<td>4</td>
<td>98,000</td>
</tr>
<tr>
<td>5</td>
<td>66,000</td>
</tr>
</tbody>
</table>

**SPACE-SAVING FEATURES of these Illuminated Push Button Switches CAN CUT PANEL COSTS IN HALF**

Designers of equipment for electronic, aircraft, marine, railway and other low voltage a-c or d-c applications find the MICRO SWITCH line of illuminated push button switches to be ideal components—to meet a wide variety of applications.

All MICRO SWITCH illuminated push button switches incorporate the features of precision switching with self-contained indicating light or lights in one compact assembly.

Basic switching units of these switches are rated: 125 or 250 volts a-c, 5 amperes; 30 volts d-c inductive, 3 amperes at sea level, 2.5 amperes at 50,000 feet; 30 volts d-c resistive, 4 amperes at sea level, 4 amperes at 50,000 feet; maximum inrush 15 amperes.

For complete information on these illuminated push button switches, and the complete line of MICRO SWITCH Precision switches, we invite you to contact your nearest MICRO SWITCH branch office. Engineering Service is available to assist in the solution of your switch application problems.
are you killing that still, small voice?

When that voice prods your professional ego with, "You can do bigger and better things!" do you smother it with a wet blanket of doubt?

And when that same voice whispers to you of a gentle climate where the snow is yours just for the asking and sunshine is always yours for the basking, do you clobber it with the sledge hammer of self-denial?

Don't kill that voice! Its wisdom could lead you to a place where you'll find those bigger things, that better life—Firestone. If you've a mind that can matter in the guided missile field, Firestone needs you in its vital development program for the Army's "Corporal," first surface-to-surface guided ballistic missile. Here are just a few of our needs:

- Flight Simulation
- Electronics Systems
- Missile Component Design
- Systems Analysis
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Next time you hear that still, small voice, don't reach for your shotgun. Reach for your pen. Write—right now! Let that still, small voice guide you to big accomplishment for you, big happiness for your family!

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GUIDED MISSILE DIVISION
RESEARCH • DEVELOPMENT • MANUFACTURE

"Find your Future at Firestone"—Los Angeles • Monterey

WRITE: SCIENTIFIC STAFF DIRECTOR, LOS ANGELES 54, CALIF.

CUSTOM built appearance for complex enclosures can be obtained from six standard basic frame units by assembling them side by side or back to back. One piece cowlings and work-top shelf space add to appearance and utility. Design engineers can now select a complete system of enclosures to meet their own requirements.

Proper selection and combination of these units, manufactured by Amco Engineering Co., 7333 W. Ainslie St., Chicago 31, Ill., make available a large variety of assemblies. Accessories are completely interchangeable throughout the entire system. They include doors, drawers, chassis supports, shelves, pulls, casters and locks. Panels are available in 19 in., 38 in., and 57 in. widths with hole placement and heights conforming to RETMA and WE specifications, either plain, perforated or louvered.

All parts are finished with a tough, mar resistant, baked on metallic enamel. The two tone gray color combination harmonizes with any equipment finish. Special colors may be had if desired. All hardware is finished in brushed chrome.

Amco Enclosures are made from heavy gauge cold rolled steel, electrically welded. Each frame is capable of supporting 3000 lbs. Provision has been made in the base to fasten the frame to the floor, or the frames may be made mobile by adding heavy duty concealed casters.

For additional information on these cabinets, fill out the Reader's Service Card and circle No. 30.

ELECTRONIC DESIGN • December 1, 1956
This versatile easy-to-use instrument is valuable as:

- a secondary standard for precision voltage measurements
- a meter and transducer calibrator
- an absolute reference source for analog computers
- a standard reference* for use with Epsco's DATRAC® and ADDAVERTER voltage-to-digital conversion equipment
- a low-impedance precision attenuator

**SPECIFICATIONS**

Size: 11\(\frac{1}{4}\) x 15\(\frac{1}{4}\) x 16\(\frac{1}{2}\)" (portable model). Rack-mounting unit occupies 14" height.


*Originally designed to meet the precision requirements of Epsco's DATRAC® and ADDAVERTER.

Epsco

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CIRCLE 31 ON READER-SERVICE CARD FOR MORE INFORMATION
Potting With Epoxy Resins

A part of a project undertaken on behalf of the United States Air Force, under a Prime Contract held by the Division of Industrial Cooperation at the Massachusetts Institute of Technology, a microsyn stator was modified (Fig. 1) to be used in a gyroscope. As a means of improving the overall performance of the gyro, encapsulation of the microsyn was considered the first step. In the potting of this part precision was particularly important, since the dimensions and properties of the completed unit were critical. Because of these stringent requirements, it was decided to use epoxy resins.

Advantages of Epoxies

Potting of the stator with epoxy resins offered these advantages:
1. Individual coil windings and the coils themselves are rigidly held in a fixed location from which they cannot shift. This prevents variation in electrical output of the microsyn in use.
2. Dirt and other foreign matter cannot be trapped in the unit and subsequently be transferred to the assembled gyro.
3. The microsyn is protected from damage if accidentally dropped.
4. Potting with these resin formulations provides increased resistance to humidity and vibration.

### TABLE I Effect of Fillers on the Coefficient of Expansion of Epon 828

<p>| Compound Com- | Parts by Weight | Particle Sizes of Filler | Coefficient of Linear Thermal Expansion (in./in./°F.) | Remarks |</p>
<table>
<thead>
<tr>
<th>No. position</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Epon 828</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>piperidine</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Epon 828</td>
<td>100</td>
<td></td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Celite Superfloss</td>
<td>30</td>
<td>2-4 microns</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>Epon 828</td>
<td>100</td>
<td></td>
<td>140</td>
</tr>
<tr>
<td></td>
<td>white sea sand</td>
<td>140</td>
<td>124-246 microns</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Epon 828</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1240 silica</td>
<td>140</td>
<td>99.5% less than 43 microns</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>piperidine</td>
<td>5</td>
<td>68% less than 10 microns</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Epon 828</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>calcium carbonate</td>
<td>200</td>
<td>5-15 microns</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>piperidine</td>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### TABLE II Physical Properties of a Typical Electrical Potting Compound

<table>
<thead>
<tr>
<th>Physical Property</th>
<th>Formulation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Epon 828</td>
</tr>
<tr>
<td></td>
<td>Calcium Carbonate (5-15 microns)</td>
</tr>
<tr>
<td></td>
<td>Piperidine</td>
</tr>
<tr>
<td></td>
<td>Cure</td>
</tr>
<tr>
<td></td>
<td>Coefficient of Linear Expansion (in./in./°F.)</td>
</tr>
<tr>
<td></td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>100 parts by weight</td>
</tr>
<tr>
<td></td>
<td>200 parts by weight</td>
</tr>
<tr>
<td></td>
<td>7.5 parts by weight</td>
</tr>
<tr>
<td></td>
<td>8 hours at 212 F</td>
</tr>
<tr>
<td></td>
<td>1.7 x 10⁻⁵</td>
</tr>
</tbody>
</table>

**Remarks:**
- Casting unaffected
- Casting unaffected
- Casting slightly softened
- Casting unaffected
- Casting unaffected
- Casting slightly softened
- Casting slightly softened
- Casting slightly softened
- Casting slightly softened
The selection of Epon® 828 resin rather than a polyester or phenolic resin, as the base material for the potting compound, was made because of the specific requirements that had to be met.

Polyesters Ruled Out

Polyester resins were ruled out because of their weakness and tendency to degrade at elevated temperatures together with their high shrinkage during cure. The latter property would make polyesters more susceptible to cracking during temperature cycling because of the stresses set up during curing. Phenolic resins were not suitable because of the volatile products given off during polymerization.

By actual laboratory tests, we proved that the epoxy-based potting compound will not crack under stresses set up from thermal expansion and contraction of the various microsyn parts when the unit is cooled to -70°F or heated to plus 200°F. Other advantages are: it is highly resistant to solvents used to wash gyroscopic parts before and during assembly; and it resists flow under load at gyro-operating temperatures, ensuring that the potted parts will remain rigidly in position. In addition, no gaseous by-products are evolved by the compound during prolonged heating. Such products, condensing within the gyroscope, would shift the unit’s delicate balance.

Cured epoxy potting formulations are rigid, giving better encapsulation than flexible compounds which might have allowed the potted parts to move in relation to one another. Inert fillers were incorporated with the epoxy resin to give a coefficient of expansion close to that of the potted metal parts. Of the fillers referred to, a glass powder was found to be the most suitable.
available for this purpose, we chose a calcium carbonate with 5-15 micron particle size range. Because of its low density, this material gave the least tendency to settle out upon standing.

The physical properties of the calcium carbonate-filled epoxy formulation are given in Table II. Note that the properties after an 8-hour cure at 212°F are adequate for most commercial purposes. If the ultimate in chemical resistance is required, an additional cure of 40 hours at 300°F is given.

Piperidone, one of the least active of the amine hardeners, was selected as the curing agent. Being a liquid, it decreases the viscosity of the resin when mixed, and produces a compound with a fairly long pot-life at elevated temperatures.

**Mold Design**

An ideal potting mold should provide: a) complete impregnation of the item to be potted; b) precise positioning of parts during potting; and c) control of final unit dimensions. Also, there should be no shrink marks on the surface of the resin nor the need for costly machining.

A transfer-type aluminum mold was used to eliminate surface shrink marks and keep pressure on the compound during cure. As the material increases in viscosity and decreases in volume during polymerization, more resin is forced into the mold cavity to fill the void produced by shrinkage.

Aluminum was selected as the mold material because its thermal expansion coefficient was close to that of the potting compound—when the mold was cooled, the part did not shrink around inserts which would have made it difficult to eject. A 1/16-2-mil coating of Teflon was applied to the aluminum as a release because epoxy resin adheres to most metals but not to this plastic.

The mold used has two parts: the potting reservoir, and the mold or force. The reservoir (Fig. 2) consists of a 3/4" wall thickness 5-1/4" I.D. cylinder approximately 3" high. The reservoir is sealed at the bottom by a plug and silicone rubber O-ring. Bolts through the reservoir base plate hold the cylinder wall and plug in position.

The mold or force (Fig. 3) is made in two parts (Fig. 4), the lower part containing the actual mold cavity. The outer wall of the lower part is recessed to hold a silicone rubber O-ring, which prevents leakage of resin between the force and the reservoir wall. All inserts in the mold cavity are bolted from the underside, the bolts recessed, and the holes plugged. To prevent resin from flowing under the inserts during potting (making ejection of parts difficult) the underside of the insert is recessed to leave a 1/16" land around the outside edge of the insert base. When bolted to the mold, enough force is exerted against the land to pull the metal into the Teflon release film, insuring a positive seal.

The upper part of the mold is shown alongside the lower part in Fig. 4. The four holes closest to the center are for mounting the microsyn stator. Four equally-spaced holes near the periphery of the mold and the one hole in the center are for bolting the mold together. The other six holes on the periphery of the upper mold half are for ejection screws. The large recessed hole in the upper half of the stator mold is for the plug connector.

**Loading the Mold**

Prior to loading the mold, 5-mil Teflon gaskets were placed over the four mounting posts on the microsyn and a 15-mil silicone rubber gasket set on the lip of
the plug connector. The stator was inverted and placed on the upper mold half (Fig. 5). Machine screws were inserted through the mold into the four mounting holes in the microsyn, and two 0-40 machine screws were inserted through the mold and screwed into the plug connector. After an alignment fixture was positioned on the mold to locate the microsyn center, the mounting screws and plug connector screws were tightened.

The alignment fixture was then removed and the two halves of the mold bolted together.

Potting Procedure

The Epon resin, previously warmed to 212°F, was catalyzed with piperidine and poured into the reservoir which was kept at 212°F on a hot press platen. At this temperature, the resulting potting compound does not stratify during cure and has good fluidity.

The mold was positioned in the top of the reservoir cylinder (Fig. 6) and the outlet line connected to a vacuum system through a trap. Thumbscrews extending from the bar on top of the mold were adjusted to keep the bottom of the mold 1/4" above the warmed resin. The unit was then evacuated at 1/2-1 mm Hg. absolute pressure.

At this stage both resin and stator were being evacuated. This was necessary to remove dissolved gases and air bubbles from the resin, and also to eliminate air from the potting cavity.

After about ten minutes, the thumscrews were turned slowly. This allowed atmospheric pressure to force the mold downward into the reservoir, introducing resin into the mold cavity.

When the resin could be seen in the glass trap near the exit hole on the mold top, lowering of the mold was stopped and the evacuation continued for five minutes to remove any residual air. Thumbscrews were then completely loosened and the vacuum released. The mold was pressed into the reservoir, using light pressure (500 lbs) until more resin flowed out of the mold. When the pressure was released, the vacuum fitting was replaced with a pressure-tight fitting, and a pressure of 30,000 psi applied to the unit in the press for four hours at 212°F.

By this time, the mold was cooled in the press and the bar across the top of the mold and base plate of the reservoir was removed. The mold, polymerized excess resin, and reservoir base plug were pushed from the reservoir cylinder walls and the excess resin and base plate taken off the mold. The bolts fastening the mold halves together were then removed and ejector screws inserted into the upper portion of the mold. These screws go into the upper half of the mold and turn against the lower portion, ejecting the lower mold half and leaving the potting attached to the upper part of the mold.

After the screws holding the potted microsyn and plug connector are removed, the potting was easily removed from the mold by hand. The potted microsyn is shown in Figs. 7 and 8.

Polarad manufactures a complete line of color TV equipment including a Color Slide Scanner, Sync Generator, Bar Generator and Color Monitors.
Attenuation and Phase Shift Changes
In
RC Sections From Curves

Sidney K. Benjamin
General Precision Laboratory
Pleasantville, N. Y.

When using rc circuits as coupling circuits, filter sections or other applications, it is often desirable to know the effect of component tolerances, temperature changes, etc., on attenuation and phase shift. The curves given here may be used to find the percentage change in attenuation and the percentage change in phase shift for a given percentage change in corner frequency for one section (either high or low pass). The corner frequency \( f_o \) is defined as \( 1/2\pi RC \). The percentage change in resistance is \( dR/R \), the percentage change in capacity is \( dC/C \), and the percentage change in corner frequency is \( df_o/f_o = -(dR/R + dC/C) \). The equations from which the curves are derived are given later.

**Example**

As an example of the use of these curves, consider a three-stage 400 cycle amplifier containing three identical rc coupling circuits. Assume the objective is to use at best 5% tolerance resistors and capacitors for these coupling circuits. The problem is to determine what corner frequency to design the rc sections for, to keep the total percentage change in gain to 0.5% or less. Since \( R \) and \( C \) are 5% components \( dR/R \) and \( dC/C \) are 5%, from the above equation the percentage change in corner frequency \( df_o/f_o \) is 10%. For a 0.5% change in amplifier gain for three stages the gain per stage is 0.167%. Then the change in gain divided by the change in corner frequency is .167/10 or .0167. A horizontal line drawn from this value across to the intersection with the gain curve gives a value of \( f_o/f \) of .13. Since \( f \) is 400 cycles \( f_o \) is 52 cycles. This means the corner frequency for each rc coupling stage must be equal to or less than 52 cycles to insure an overall gain variation of 0.5% or less.

The change in phase shift may also be found from the curves. Drawing a vertical line from a value of \( f_o/f \) of .13 to where it intersects the phase shift curve, we find the change in phase divided by the change in corner frequency to be .13. Since the change in corner frequency is 10% this means a 1.3% change in phase shift for one stage or 3.9% for three stages.

**Derivation of Gain Equations**

\[
G = \frac{E_o}{E_{in}} = \frac{1}{1 + j\omega RC}
\]

For \( \omega_o = \frac{1}{RC} \)

\[
|G| = \frac{1}{\sqrt{1 + \left(\frac{\omega}{\omega_o}\right)^2}} = \frac{1}{\sqrt{1 + f^2/f_o^2}}
\]  (1)

Taking the derivative with respect to \( f_o \) and dividing by Eq. (1)

\[
\frac{dG/G}{df_o/f_o} = \frac{f^2}{f_o^2 (1 + f^2/f_o^2)}
\]  (2)

**Derivation of Phase Shift Equations**

\[
\theta = \tan^{-1} f/f_o
\]  (3)

\[
\frac{d\theta}{df_o} = \frac{1}{1 + (f/f_o)^2}
\]  for \( f_o \) constant

Dividing by Eq. (3)

\[
\frac{d\theta}{f_o} \left[ \tan^{-1} \frac{f}{f_o} \right] = \frac{1}{1 + (f/f_o)^2}
\]

To find \( df_o/f_o \)

\[
\frac{df_o}{f_o} = \frac{1}{2\pi RC}
\]

\[
\frac{df_o}{f_o} = \frac{\partial f_o}{\partial R} dR + \frac{\partial f_o}{\partial C} dC
\]

\[
\frac{\partial f_o}{\partial R} = \frac{1}{2\pi R} \left( \frac{-1}{R^2} \right)
\]

\[
\frac{\partial f_o}{\partial C} = \frac{1}{2\pi R} \left( \frac{-1}{C^2} \right)
\]

\[
\frac{df_o}{f_o} = -\frac{dR}{R} + \frac{dC}{C}
\]  (4)

\[
\frac{df_o}{f_o} = -\left( \frac{dR}{R} + \frac{dC}{C} \right)
\]  (5)

**From** December 1, 1956
10-Crystal Oven
High Frequency Miniature
A new miniature crystal oven, housing 10 high-frequency HC-18U holders is designed for extreme temperature stability and minimum power consumption. It has a temperature stability of \( \pm 0.25 \) C at a constant ambient temperature and has a temperature variation after warm-up of \( 2 \) C over ambient temperature range of \(-55 \) C to \(+75 \) C.

The JKO-11 comes in a choice of heater voltages from \( 6.3 \) v to \( 115 \) v, ac or dc. Its power requirements are \( 25 \) w maximum, and it weighs \( 1.6 \) oz.

It has a detachable cover, high temperature heater bonding tape and biphase low-inductance heater winding.

James Knights Co., Dept. ED, Sandwich, Ill.
CIRCLE 34 ON READER-SERVICE CARD FOR MORE INFORMATION

Light Spot Wattmeter
Precise to 0.1%
A precision light spot wattmeter, Model GL.M, built for accurate power measurement in laboratories, is a precision instrument conforming to extreme requirements. The accuracy of indication for dc and ac is within a limit of error of \( \pm 0.1 \) per cent, with constant calibration guaranteed.

Time setting is 0.6 sec; test voltage is 2000 v. Built for various ranges from 0.025 a up to 10 a and for voltages from 30 v up to 300 v; it has a parallax-free reading on a double strip scale.

Epic, Inc., Dept. ED, 154 Nassau St., New York 38, N.Y.
CIRCLE 35 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Potentiometer
Linear To 0.01%
The Model MD20 2 in. diameter ultra-precision potentiometer is designed for use under extremely rugged conditions.

A new potentiometer design provides independent linearity to as close as 0.01 per cent. For stability, the resistance coil is externally wound on a non-hygrosopic ceramic core, and for strength and dimensional accuracy.

Electrical angle is 3600 degree with 90 degree overtravel at each end. Resistance values of 1k to 100K are standard for the 2 gang, 10 turn version. Torque on dual section versions is as low as 1.5 in. oz.

Litton Industries, Components Div., Dept. ED, 215 S. Fulton Ave., Mt. Vernon, N.Y.
CIRCLE 36 ON READER-SERVICE CARD FOR MORE INFORMATION

Open Linear Bearing
For Supported Shafts
This linear ball bearing permits the use of shaft support members along the length of the shaft traversed by the bearings. These bearings are known as open type ball bushings and are useful where extreme rigidity or unusually long shafts are required.

The open construction of the bearing permits adjustment of its bore diameter by use of set screws or other clamping arrangements.

The ball bearings do not depend on the maintenance of an oil film. The open bushings are manufactured to standard dimensions for shaft diameters ranging from 1 in. to 4 in.

Thomson Industries, Inc., Dept. ED, Manhasset, N.Y.
CIRCLE 37 ON READER-SERVICE CARD FOR MORE INFORMATION

Dynamic Pressure Pickup
Uses Liquid Cell
In the Type 4-340 dynamic pressure pickup, dynamic pressure applied to the diaphragm of a sealed, liquid-filled cell causes an infinitesimal amount of polar liquid to flow through a porous disk, generating an electrical signal. About \( 1 \) in thick and \( 1.7 \) 8 in. in diameter, the new pickup will operate at a pressure range of \( 10^4 \) to 100 psig and temperature range of \(-10 \) F to \(+140 \) F. It will respond "flat" between 3 cps and 2500 cps. It has an internal impedance of 100,000 ohms and a 100 psig oscillating pressure and yields an unusually high output of 35 v.

Consolidated Electrodynamics Corp., Dept. ED, 300 N. Sierra Madre Villa, Pasadena, Calif.
CIRCLE 38 ON READER-SERVICE CARD FOR MORE INFORMATION

Variable Air Capacitor
For Instrument Use
Machined from solid metal, the Type 1420 variable air capacitors have both rotors and stators gang milled from shaped extruded aluminum rods.

Electrical gains include good linearity, lower metallic resistance and inductance than a soldered stack, low thermal drift, and a minimizing of microphonic tendencies. The insulators used are machined from a cast bar of cross-linked polystyrene for thermal adequacy.

CIRCLE 39 ON READER-SERVICE CARD FOR MORE INFORMATION
Copper-Clad Steel
Carbon-Hardened

A new clad metal combination, Conflex, consists of medium carbon hardenable steel (SAE-1065) clad on one or both sides with oxygen-free, high conductivity copper. The metals are inseparably bonded by a solid-phase bonding process. This produces a composite metal having high conductivity, excellent spring characteristics by heat treatment, resistance to corrosion, ductility, and good operating characteristics at elevated temperature.

The standard cladding ratio with copper on one side is 80 per cent steel to 20 per cent copper. With copper on either side the standard is 10-80-10. Other single and double clad ratios can be produced in 90-10, 70-30, 5-90-5, and 20-60-20.

Metals & Controls Corp., Dept ED, General Plate Div., 43 Forest St., Attleboro, Mass.

COMING JANUARY 1st
DESIGN '57
Yearly Feature Issue of ED

Permalloy Powder Cores
Offered From Stock

This firm's production facilities for unstabilized permalloy powder cores have increased. Popular standard sizes are now available for immediate delivery.

All cores are performance guaranteed. They are widely used as loading coil cores to provide suitable response in the audio and carrier frequency ranges. They are also widely used as filters in communications circuits. High Q applications, such as high, low, and band pass filters, and noise suppression filters are some uses.

The cores are made to a 2% molybdenum, 81% nickel, 17% iron formula. They can be color marked in 2% bands from -5% to +15% of published nominal inductance for 1000-turn winding.


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CIRCULE 41 ON READER-SERVICE CARD

CIRCULE 42 ON READER-SERVICE CARD >
Secure communications systems... JPL scientists and engineers have made outstanding contributions to the research and development of communications systems designed to operate in the presence of severe interference.

Protection of a communication system from deterioration by extraneous interference is of paramount importance to the ultimate utility of that system. At the Jet Propulsion Laboratory this pressing practical challenge has been met with concrete achievement in basic and applied communications research, paired with sound development engineering.

Notable Achievements at JPL

Pioneers in Guided Missiles

The Jet Propulsion Laboratory is an organization devoted to scientific research and development. Its prime objective is obtaining basic information in the various sciences related to missile systems development, including all phases of jet propulsion. The Laboratory maintains as its basic foundation, a major uninterrupted program of fundamental research in most of the physical sciences.

The Laboratory occupies an 80-acre plot in an otherwise residential area in the San Gabriel mountain foothills North of Pasadena. Its staff of approximately 1,250 persons are all employed by the California Institute of Technology, and it conducts its several projects under continuing contracts with the U.S. Government.

In its missile system and jet propulsion undertakings, the Laboratory maintains a broad technical responsibility, from basic research to prototype engineering. By virtue of the Laboratory's broad area of responsibility and the integrated nature of the JPL technical staff an individual scientist or engineer is brought into satisfyingly close contact with the general field to which his technical speciality contributes.

If you are interested in knowing more about the Jet Propulsion Laboratory and its specific employment offerings, please write.

Error Computer

For Wire Strain Gages

The K-7 error computer is a time-saving device for use with wire strain transducer systems. These systems are subject to small but cumulative errors, and a realistic solution involves 14 variables and 9 simultaneous equations requiring many hours to solve for one variable.

The Type K-7 error computer isolates this error in five minutes. It simulates all the system components and presents the error in per cent of correct magnitude.

Allegany Instrument Co., Inc., Dept. ED. 1091 Wills Mountain, Cumberland, Md.

CIRCLE 45 ON READER-SERVICE CARD FOR MORE INFORMATION

Traveling Wave Tube

X-Band Amplifier

This broadband traveling wave amplifier tube, the HA-9, operates from 8.2 to 11.0 K mc without the necessity of any electrical or mechanical operating adjustments. A high-gain, medium power broadband device suitable for many microwave applications, it includes provisions for grid modulation with which any electrode may be operated at ground potential. Important specifications include a small signal gain of 36 db min (8-11 K mc), a saturation gain of 30 db min, and a power output of 30 dbm.

Huggins Laboratories, Inc., Dept. ED. 711 Hamilton Ave., Menlo Park, Calif.

CIRCLE 46 ON READER-SERVICE CARD FOR MORE INFORMATION

Split-Contact Switch

Has Snap-Action

A new snap-action split-contact switch has a capacity of up to 3/4 hp, dual circuitry, five terminals, and the rolling spring snap-action principle.

The Model C-11008, a normally closed switch, can control two single pole throw circuits, or can be used for double make or break in a single circuit. Rating of the switch is 15 amps and it is furnished with a pin plunger or other actuator.

Acro Mfg. Co., Dept. ED. Columbus 16, Ohio.

CIRCLE 47 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic Design • December 1, 1956
Ultra Low Range Ohmmeter
Has Kelvin Test Leads

A portable instrument capable of measuring extremely small values of resistance, the Model 555 centi-low ohmmeter is used for detecting low resistance circuit troubles.

There are two ranges, the low ohm range with lowest increment of 0.01 ohms, center 0.5 ohms, high 5 ohms, and the high ohm range with lowest increment of 0.02 ohms, center 5.0 ohms, high 50 ohms. Kelvin principal test leads, which introduce no error into the meter indications are included.

Power is supplied by a dry battery.

Chicago Industrial Instrument Co., Dept. ED, 865 N. Sangamon St., Chicago 22, Ill.

CIRCLE 48 ON READER-SERVICE CARD FOR MORE INFORMATION

High Speed Sampler
Shock Resistant

Providing single pole sampling of 60 contacts at rates up to 30 rps, the Type AB high speed sampling switch requires only 3 oz in. torque. It is compactly built to provide long life under rugged conditions. Designed for direct mounting to standard servo appliance frames, it is completely shielded and all wiring can be potted. It has ball bearing construction with glass base contact plate and silver contacts.

Applied Science Corp. of Princeton, Dept. ED, P.O. Box 44, Princeton, N. J.

CIRCLE 49 ON READER-SERVICE CARD FOR MORE INFORMATION

AC Power Supply
Has Autotransformer

Intended for general utility service in the laboratory, or on the test bench, the Model 109 AC power supply features a fuse protected variable autotransformer, a neon pilot light, and a legible 4 1/2 in. voltmeter with an essentially linear scale.

Nominal input is 115 v, 60 cy, and output rating is 15 amp, with voltage infinitely variable from 0 to 110 v.

Slaughter Co., Dept. ED, Piqua, Ohio.

CIRCLE 50 ON READER-SERVICE CARD FOR MORE INFORMATION

SIGHTS of rockets swooshing heavenward become more and more familiar as we thumb through today's industrial publications. The recalcitrant rocket shown on this page indicates that things can go wrong in research, and we don't claim that the absence of a Sanborn oscillographic recording system somewhere along the line was the reason for this disappointing trajectory.

What we do wish to say is that Sanborn equipment is playing an increasingly vital part in rocket development. Used in the laboratory to record flight behavior simulated by analog computers, and in plotting rooms at testing bases to tape down telemetered data, Sanborn "150's" are helping rockets to get and stay where they belong.

You can see Sanborn systems in many other places, too. Oil fields, electronic component production lines, machine tool plants, hydraulic testing laboratories, numerous aircraft manufacturers, computing facilities . . . are putting single to 8-channel Sanborn systems to work. (Most are housed in vertical mobile cabinets, while those in the "field" are often divided into portable packages for each instrument.) All of them give their users inkless, permanent recordings in true rectangular coordinates, one percent linearity, as many as nine chart speeds, and the efficiency (and economy) inherent in Sanborn unitized design.

A dozen different plug-in preamps further extend their value, by making change-over to new recording inputs a quick and easy procedure.
AVIATION PROGRESS with G-E aircraft motors

NEW G-E AIRCRAFT GUN MOTOR DEVELOPS TWO HP PER POUND FOR 10 SECONDS!

POWER PLUS HAS BEEN PACKED INTO THIS COMPACT 18 POUND, 400 CYCLE MOTOR WHICH DELIVERS 37 HP FOR A 10 SECOND FIRING INTERVAL. NEWLY DEVELOPED INSULATION SYSTEM PROTECTS AGAINST INTENSE HEAT. DOUBLE ROTOR DESIGN PROVIDES HIGH STARTING TORQUE AND EXCELLENT OPERATING EFFICIENCY—PERMITS UTILIZATION OF SINGLE OR DUAL POWER SOURCE.

G-E HERMETIC MOTOR PARTS LESS THAN 6½ INCHES IN DIAMETER DELIVER 25 HP CONTINUOUSLY TO COOL AIRLINERS!

HERMETIC MOTOR PARTS WEIGHING ONLY 18 POUNDS DELIVER 25 HP CONTINUOUSLY AT A SPEED OF 23,500 RPM.
TWO-POLE, 400-CYCLE POWER PACK CONSISTING OF STATOR, ROTOR AND SHELL IS DESIGNED TO POWER AIRBORNE COMPRESSOR.

DIGITAL COMPUTER DETERMINES BEST MOTOR DESIGN IN SECONDS!

DAYS OF CALCULATIONS BECOME SECONDS WHEN G-E AIRCRAFT MOTOR DESIGNERS PUT THIS COMPUTER TO WORK IN DETERMINING OPTIMUM MOTOR DESIGN IN THE FASTEST POSSIBLE TIME! AFTER PRELIMINARY DESIGN WORK HAS BEEN COMPLETED, COMPUTER CAN THEN BE INVALUABLE AID IN ASSURING BEST-AND FASTEST-POSSIBLE ANSWER TO YOUR MOTOR REQUIREMENTS.

Casting Resin
Flexible Epoxide

Controlled flexibility is possible when using Stycast 2741, a new epoxy casting resin. Supplied as two components, cure is effected at room temperature, but can be accelerated at elevated temperature. The material retains flexibility at −70 F and is recommended for encapsulating, potting and sealing applications requiring low temperature use. Shrinkage during cure is negligible and adhesion to most materials is excellent.

Emerson & Cuming, Inc., Dept ED, 869 Washington St., Canton, Mass.
CIRCLE 53 ON READER-SERVICE CARD

Hot Tin Plate Process
Complete Absence of Slag

A special hot tin plate process which will provide the smooth surface, solderability, adherence and complete absence of slag essential to manufacturers of printed circuits, capacitors, and cable wrappings has been developed. Tin coatings of 0.00002 to 0.00008 and 0.0002 to 0.0003 are available on brass, copper, bronze and other thin strip metals in gauges from 0.012 down to 0.002, widths from 1/8 in. to 6 in. and wider.

Somers Brass Co., Inc., Dept ED, Waterbury, Conn.
CIRCLE 54 ON READER-SERVICE CARD

Tape Duplicator
1200 Codes Per Minute

The punched paper tape regeneration unit consists of a motorized tape punch cable connected to a motorized tape reader. The regeneration unit duplicates 5, 6, 7 or 8 channel tape at the rate of 1200 codes per minute, producing a composite tape.

Composite tapes are valuable as inputs to computers. Problems or phases of problems are prepared on an automatic writing machine which produces a by-product punched tape automatically. The tapes can be converted into a composite tape on the regeneration unit and the entire problem is ready for fast feed into the computer.

Commercial Controls Corp., Dept ED, 1 Leighton Ave., Rochester, N.Y.
CIRCLE 55 ON READER-SERVICE CARD

< CIRCLE 52 ON READER-SERVICE CARD
New Duo-Triodes from Sweden
Ruggedized-Longlife

Ericsson of Sweden has in production three new tube types, the 2C51/2C51L, 18C51 and 407A.

Each tube is a duo-triode, medium mu, 9-pin miniature. The triode sections are internally shielded and independent of each other except for the common heater, making the tubes useful in cascade amplifiers.

Life expectancy of the tube is above 10,000 hours. The use of pure nickel cathode sleeves insure freedom from interface formation, and suitability for on-off application. The tubes are highly resistant to impact shock and vibration.

The 2C51/2C51L has a 0.3 amp heater at 6.3 v, while the 18C51 is rated at 0.105 amps at 18 v. 407A has a center-tapped heater and may be operated in series at 0.050 amps. 40 v, or in parallel at 0.1 amps, 20 v.

State Labs Inc., Dept. ED. 649 Broadway, New York 12, N.Y.

CIRCLE 56 ON READER-SERVICE CARD

Plastic Gasket
Seals Vacuum Lines

Vacuum line sealing problems are being solved by a plastic gasket material, which by adding 1/64 in. film or coating to flange faces and gasket surfaces, reduces vacuum line leakage to a minimum.

Any leakage which may occur after line has been in service can be corrected without dismantling flanges by simply applying 1/32 in. of plastic gasket material around the outside surfaces of the flange where they meet with the gasket.

It is available in two formulations; one for air, steam, water, mild chemicals, and the other for gasoline, oil, solvents, etc. Where flange faces are marred and come together unevenly, the material can be used alone without any other type gasketing material.

The plastic is non-hardening, and flanges are easy to dismantle.


CIRCLE 57 ON READER-SERVICE CARD

CIRCLE 58 ON READER-SERVICE CARD

25% of external skin
on record-breaking F8U-1 made with magnesium

In Chance Vought's F8U-1 Crusader, fastest U.S. fighter by official record, many precious pounds are saved by using magnesium. Designers called for a total of 166 magnesium external skin parts—25% of the wing and fuselage surface area. 275 magnesium sand castings ranging in weight from a few ounces to thirteen lbs. were used inside the skin.

Weighing one fourth as much as steel and only two thirds as much as aluminum, magnesium gives you the best combination of strength and rigidity per pound. Its stiffness-to-weight ratio is the highest of any structural metal.

Magnesium permits clean, simplified designs—eliminates many stringers and detail parts. A selection of finishes provides remarkable protection against corrosion. Machinability is excellent, too. Fabrication, fitting and joining problems are always at a minimum.

Magnesium can help you make better designs for fuselage, wings and interior parts. Sheet, extrusions, and castings can be readily produced to meet your requirements. Call your local Dow sales office, or write to THE DOW CHEMICAL COMPANY, Midland, Michigan, Department MA363B.

you can depend on DOW MAGNESIUM
COIL CHARACTERISTICS:
- Operating Voltage: up to 330 volts D.C.
- Resistance: up to 1,340 ohms
- Operating Current: 0.005 amps, minimum

CONTACT ASSEMBLY
- 1, 2, 3, 4, or 5 pole
- Single or double throw
- Heavy Duty: 90 amps, non-inductive
- Special Heavy Duty: 95 amps, non-inductive

MOUNTING:
- Foot No. 0-32
- Tapped holes — standard

VARIATIONS:
- Plug-in mounting and terminals
- Solder or screw terminals
- Hermetically sealed assemblies
- Mechanical latching assemblies

is this your dish? Compact and efficient, this Type 27 power relay is designed for maximum reliability and long life. The armature is supported by stainless steel pins in two bronze bushings and the frame is held rigidly by brass side plates. Its stationary contacts are mounted on molded phenolic with integral barriers and the movable contacts on precision tempered blades. All movable blades are preset with locked adjusting screws. The restoring spring force is adjustable for accurate setting of pick-up and drop-out. The two-coil design of Type 27 power relay coupled with its efficient magnetic circuit provides high sensitivity.

But whether your dish is a power-type relay, AC or DC, or a multi-contact telephone type relay — you should call the “man with the PHILLIPS Plan”.

One-Inch Meter
Has Long Scale Arc

A new 1 in. round panel meter for flush mounting provides long scale arc in small panel space. The Model 104 employs a miniaturized D’Arsonval type movement, and accuracy is held to ±3 per cent of full scale deflection for dc instruments and ±5 per cent for ac instruments.

By using an optional external shroud, it can be adapted for edge-lighting requirements.

Model 104-W Meters, with a watertight seal, are designed for a dielectric strength of 1500 v rms.

International Instruments Inc., Dept. ED, New Haven 15, Conn.

Blower Motor
Has Variable Frequency

A new single phase 4-pole variable frequency blower motor maintains a fairly constant speed over a wide frequency range through the use of 2 small external capacitors. With a 2 in. blade fan, frequencies between 400-1500 cps, speed is between 7500-11,000 rpm. With a 3 in. blade fan, frequencies between 300-1000 cps, speed is between 4400-5200 rpm. Excitation is 115 v, continuous duty and operating ambient temperature range — 54 C to + 70 C. Housing and bearings are stainless steel, and lead wires are Teflon. Type 11-A-8223-01 is designed to run a fan which cools electronic and other equipment.


CIRCLE 60 ON READER-SERVICE CARD FOR MORE INFORMATION

Floating Anchor Nut
Has Deep Counterbore

The new F1934 floating anchor nut is a deep counterbore, two-lug, floating anchor nut developed principally for use around access doors or openings that require constant grip-length screws for different thicknesses of materials. It can be used wherever a long screw is required.


CIRCLE 61 ON READER-SERVICE CARD FOR MORE INFORMATION

GET THE EXACT TERMINAL YOU NEED AT NEW LOW PRICES!

STANDOFFS

FORK

POST

DOUBLE TURRET

SUB-MINIATURE

FEED THROUGH'S

SINGLE TURRET

FROM THE LARGEST STANDARD and CUSTOM LINE AVAILABLE...

Over 100 varieties are furnished as standard. This includes a full range of types, sizes, body materials and plating combinations. Special can be supplied to any specification. The Whitso line is complete to the fullest extent of every industrial, military and commercial requirement.

Standoff terminals include fork, single and double turret, post, standard, miniature and sub-miniature body types - male, female or rivet mountings—molded or metal base. Feed through terminals are furnished standard or to specification.

Whitso terminals are molded from melamine thermosetting materials to provide optimum electrical properties.

Body Materials: Standard as follows — melamine, electrical grade (Mil-P-14, Type MMB); melamine impact grade (Mil-P-14, Type MMB); and phenolic, electrical grade (Mil-P-14, Type MPE).

Plating Combinations: Twelve terminal and mounting combinations, depending on electrical conditions, furnished as standard.

Specials: Body materials and plating combinations, also dimensions, can be supplied to any custom specifications.

PROMPT DELIVERY IN ECONOMIC QUANTITY RUNS

Get facts on the most complete, most dependable source for terminals and custom molded parts. Request catalog.

WHITSO, INC.

9226 Byron Street, Sullivans Park, Illinois

CIRCLE 62 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 59 ON READER-SERVICE CARD
Ultra Compact Scaler
Counts Sine Waves

A scaler of quite unique characteristics has been developed which combines high counting capacity with extremely small size and weight. Measuring only 4-1/4 x 6-1/4 x 7 in. and weighing 8-1/2 lb, it has a binary capacity of over one million without the use of additional counters.

It will count sine waves of any frequency from 10 cps to 10 mc, and will also count pulses at any repetition rate from 0 to 10 mc. The scaler has a 3-pulse resolution time of 0.2 usec and a 2-pulse resolution time of 0.1 usec, and a sensitivity of 1 to 1-1/2 v over the entire range of frequencies.

The scaler accommodates a wide range of input waveforms due to a specially designed trigger circuit. Utilizing plug-in construction throughout, the scaler's light weight makes it particularly useful for field or airborne operation.

The Jacobs Instrument Co., Dept. ED, Bethesda 14, Md.

CIRCLE 64 ON READER-SERVICE CARD

Metallic Copper-Dispersion
For Plating Non-Conductors

A colloidal dispersion of metallic copper in a lacquer solution that provides a highly conductive surface coating has been introduced for use in printed circuitry, electro-plating of non-conductors, and for application on components for radar equipment.

Application of 'dag' dispersion No. 235 may be by spray or brush, no baking is required, and the film will air-dry.

The electrical resistance of 'dag' 235 is 6 ohms per sq in. for 0.001 in film thickness, and 1 ohm per sq in. for 0.003 in film thickness.

A spray application can give a film thickness of 0.0005 in per pass. The lowest resistance is obtained by applying multiple layers rather than a single thick coating.


CIRCLE 65 ON READER-SERVICE CARD
Dial and Index Hanger
For Disc or Drum Dials

These type "AN" dial and index hangers are universal in design and may be used with disc or drum dials as desired. They are available in three shaft sizes 1/8, 3/16 or 1/4 in.

The material is aluminum and they are finished in chronic acid anodized to meet Military specifications.

PIC Design Corp., Dept. ED, Div. of Benrus Watch Co., P.O. Box "C", E. Rockaway, N.Y.
CIRCLE 69 ON READER-SERVICE CARD FOR MORE INFORMATION

Air Pressure Switch
Subminiature

This subminiature absolute air pressure switch can be used over a wide temperature range under conditions of high shock and vibration.

The RS-16 pressure switch is available from 5 psi absolute to 25 psi absolute with pressure differentials between "on" and "off" as close as 2 psi.

Newark Controls Co., Dept. ED, 15 Ward St., Bloomfield, N.J.
CIRCLE 70 ON READER-SERVICE CARD FOR MORE INFORMATION

Magnetic Amplifier Components
Build Basic Circuits

Maximag magnetic amplifier circuit components are a new line designed to assemble any of the well-known basic circuits for fast response and high gain.

The units are available in up to 300 w capacity. Maximag components meet military specifications.

Three basic sizes are available to cover the range of 1.5 to 300 w, 60 cy and 400 cy. The largest unit, rated at 300 w at 400 cy measures only 4-1/16 in. in height by 2-7/16 in. in diameter. The other units for lower capacity are proportionately smaller.

Adler Electronics, Inc., Dept. ED, 1 LeFevre Lane, New Rochelle, N.Y.
CIRCLE 71 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • December 1, 1956
WHAT NEW PROGRAMMING METHODS Are
Causing Major Design Changes?
READ DESIGN '57—JAN. 1ST ED

Subminiature Accelerometer
Measures Three Axes

A subminiature high temperature accelerometer has been developed that will measure three mutually perpendicular accelerations simultaneously.

The glennite Model AHT-30T will operate accurately in temperatures from -65 F to +350 F and features an acceleration range up to 500 g, frequency response from 25 to 20,000 cps, and sensitivity of 0.8 mv per g.

Excellent linearity and stability characterize the AHT-30T which can measure one longitudinal and two lateral accelerations at the same time. The unit weighs less than one ounce and is less than one cubic in. in volume.

Gulton Industries, Inc. Dept. ED, 212 Durham Ave., Metuchen, N.J.
CIRCLE 72 ON READER-SERVICE CARD FOR MORE INFORMATION

Waveform Generator
Transistorized

The first of a line of fully transistorized, battery - powered test equipment, the Model 500 waveform generator provides clipped sawtooth and rectangular waveform output with a variable repetition rate from 10 cps to 50 kc. A square wave output is available from 5 cps through 25 kc. With one change in a capacitor, these repetition rates may be reduced to one every 5 seconds. At full battery voltage an output of seven volts at 2000 ohms impedance is available. The rectangular wave shape is continuously variable in pulse width from 5 to in excess of 200 usec.

With a total power drain of 300 mw, the anticipated life of the 22-1/2 v battery is better than 500 hours. As the battery output voltage drops off, there is no deterioration in wave shape or stability.

Cubic Corp., Dept. ED. San Diego, Calif.
CIRCLE 73 ON READER-SERVICE CARD FOR MORE INFORMATION

FOR COMPUTER RELIABILITY
IT'S GENERAL TRANSISTOR

The Univac® File-Computer, a new intermediate sized data processing system designed and manufactured by Remington Rand Univac Division of Sperry Rand Corporation.

Write for Specification Bulletins covering your applications.

GENERAL TRANSISTOR CORP.
Richmond Hill 18, N. Y.
Virginia 9-8900

Computer manufacturers know General Transistor always delivers reliability. That's why they depend on GT quality and GT service, and that's why General Transistor is one of the largest suppliers of transistors for computers.

* CIRCLE 74 ON READER-SERVICE CARD FOR MORE INFORMATION
New copper-clad MICARTA®
is easy to cold punch—no cracking, no chipping!

All holes in new H-3032 copper-clad MICARTA can be cold punched right on the assembly line in one operation, and there's no cracking, breaking or chipping. That is one of the reasons why this new laminate cuts costs and production time of printed circuits.

In addition, copper-clad MICARTA speeds up soldering, without the normal accompaniment of an increase in rejects and missed connections.

High bond strength — from 10 to 13 pounds versus an industry standard of six pounds — is retained even after heating and cooling are repeated many times, due to a new adhesive process.

If you have a circuit assembly problem, copper-clad MICARTA may be the answer. For further information and for technical data, write to Westinghouse Electric Corporation, MICARTA Division, Hampton, South Carolina.

Variable Speed Control Has Rotative Adjustment

Accurate speed settings and fine speed adjustments on zero-max variable speed reducers are obtained with a screw control that provides a rotative, instead of linear, adjustment.

In addition to providing positive setting and repeating of speeds, the new control is easily adapted to many types of remote control, and will not vibrate or creep. Fifty revolutions of the screw covers the full range of speed from zero to maximum, making it easy to calibrate for fine speed adjustments.

Revco, Inc., Dept. ED, 1900 Lyndale Ave. S., Minneapolis 5, Minn.

Instrument Cases
Deep-Drawn Aluminum

A complete line of drawn aluminum instrument cases for electronic and instrument manufacturers come in two styles featuring distinctive custom-designed appearance. Blank cases and covers are available, and cases and covers can be modified to specifications with holes, chassis slides, dimpled or rubber feet or other desired features.

All cases have seamless construction with close tolerances and sidewalls of uniform thickness.
Zero Mfg. Co., Dept. ED, 1121 Chestnut St., Burbank 9, Calif.

RF Connectors
Subminiature

Four new subminax RF connectors in a line of subminiature components are the 27-27 hermetic seal panel receptacle, the 27-28 between series adapter designed to provide a transition between BNC and subminax, the 27-800 printed circuit receptacle and the 27-801 cable termination. All of these have an impedance of 50 ohms. Subminax connectors are available in 50 and 75 ohms, and in push-on and screw-on coupling. All are gold-plated.
Amphenol Electronics Corp., Dept. ED, Chicago 50, Ill.
Millivolt Meter
Dual Unit

This dual electrolysis voltmeter is one meter with ranges of 2.5-5-10-50-100-500 mv at 2000 ohms per volt and one meter with ranges of 0.3-1-3-10-30-100-300 v at 50,000 ohms per volt. Both meters center zero. It eliminates push buttons and switching for changes in polarity and simultaneous readings, and accuracy is 1 per cent. They are clear plastic enclosed meters for better illumination, and have a wooden case, rugged meter movements.

Stewart Bros., Dept. ED, Div. of Instrument Labs., 315 Walton Place, Chicago 10, Ill.

CIRCLE 80 ON READER-SERVICE CARD FOR MORE INFORMATION

Synchronous Timer
Has Standby Clock Drive

Highly accurate, the duplex time component runs electrically or mechanically and does not stop upon power failures. It consists of an accurate synchronous electric time unit combined with a spring driven time unit which is held in reserve. If electricity should fail, the spring driven unit goes into action instantly. Upon power resumption or circuit repairs, the synchronous electric motor again takes over. The unit has been piloted in chart drives and dials, time switches and daylight thermostats.

Industrial Timer Instruments Co., Dept. ED. 189 W. Madison St., Chicago 2, Ill.

CIRCLE 81 ON READER-SERVICE CARD FOR MORE INFORMATION

Silicon Rectifier
High Inverse Rating

The silicon power rectifiers, type CK777, has a peak inverse rating of 325 v and an average current rating of 5 amp at 125 C. Maximum reverse current at the P.I.V. of 325 v is 5 ma and the maximum forward voltage drop at 10 amp is 2 v.

The addition of type CK777 provides a line of 5 amp, 125 C silicon rectifiers having peak inverse ratings from 25 to 325 v.


CIRCLE 82 ON READER-SERVICE CARD FOR MORE INFORMATION

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Does your family count?

One of the major reasons why Raytheon is attracting so many engineers is because Massachusetts, where most of Raytheon's plants are located, is an exceptionally fine place to live and bring up a family. A stimulating four season climate, above average schools and colleges, good and abundant water, the medical, cultural and research center of the world and nearness to all year round recreational advantages make it ideal. Your choice of urban or suburban living.

Raytheon as prime contractor for the Army, Navy and Air Force in guided missiles, and pioneer in the field of Doppler Radar Aircraft Navigation and Control Systems offers vital, interesting work, excellent salary and advancement prospects, modern facilities, company assistance in advanced engineering courses, relocation expenses, liberal vacations, group life & health insurance.

If you are interested in the design and development of guided missile or aircraft radar systems and have experience in these fields:

Circuit Design
Electronic Packaging
Test Equipment Design
Analog Computer Design

Come in or send brief resume to:

G. P. O'Neil

RAYTHEON MISSILE SYSTEMS DIVISION
BEDFORD, MASS.
ELECTRONIC RESEARCH is our business

We are permanently dedicated to RESEARCH and DEVELOPMENT in every conceivable field of ELECTRONICS. GM's long-standing policy of decentralization creates unlimited opportunities for qualified Electrical, Mechanical Engineers and Engineering Technicians.

AC The Electronics Division
GENERAL MOTORS CORP.

New plant (225,000 square feet) now being built in a Milwaukee suburb. This and our present plant will house the ELECTRONICS DIVISION—Milwaukee of the General Motors Corporation.

Your future is assured (if you can qualify) in this lovely cool, southern Wisconsin city where every conceivable living and cultural advantage, plus small town hospitality is yours for the asking. Send full facts today about your education, work background, etc. Every inquiry treated in strict confidence—and you will hear from us by return mail.

For Employment Application — Mr. John F. Heffinger, Supervisor of Salaried Personnel

AC THE ELECTRONICS DIVISION
GENERAL MOTORS CORPORATION
Milwaukee 2, Wisconsin

Hardness Gauge
Pocket-Size

This small, accurate hardness gauge, can be used in measuring hardness of materials such as rubber and plastics. This gauge, called Rex Model A, indicates hardness in Durometer units that comply with A.S.T.M. specifications for rubber hardness.

It has a hardened steel indenter which pushes up the runner of the vernier by direct contact. The runner is then held by friction so that the instrument can be removed and read elsewhere.

The vernier reads directly to 5 points which permits interpolation to about 2 points with average vision. With the magnifier, readings can be read more closely. Total range is 0.100 in. There are 100 divisions on the scale permitting readings of 0.001 in. or 1 durometer point. Overall accuracy is 0.001 plus or minus, and no adjustments are required.

W. F. Orth, Dept. ED, 802 S. Ada St., Chicago 7, Ill.

CIRCLE 85 ON READER-SERVICE CARD FOR MORE INFORMATION

Standard Test Jack
Beryllium Copper Contact

This new standard test jack is a rugged quality unit designed for long electrical and mechanical life. It meets all requirements of MIL-STD-242 (Ships).

The beryllium copper spring pin contact insures consistently smooth insertion and withdrawal of standard 0.080 in. diameter test prods. A nickel-plated brass mounting bushing secures mounting under extreme conditions of shock and vibration. The mounting bushing is insulated from the contact assembly by a nylon sleeve.

The contact assembly is silver plated with gold wash, providing low contact resistance with the test prod, and facilitating fast, strong solder connection at the solder terminal. The nylon insulator is available in nine colors.

Raytheon Mfg. Co., Dept. ED, 100 River St., Waltham 54, Mass.

CIRCLE 86 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • December 1, 1956
Servo Clutches
Have Adjustable Slip Torque

Three new model clutches are available in the array of Servoboard components.
The friction clutch unit provides clutch action only at a predetermined torque. The clutch can be set to slip at any torque from 2 in. oz for minimal settings to 20 in. oz for maximum friction. The single drive magnetic clutch is used to electrically connect or disconnect two shafts at a predetermined torque or at previously set stages in operational sequence. Maximum power requirement is 30 v 27 amp. Output torque is 40 in. oz.
The reversing magnetic clutch is used either as a reversing clutch or as a two speed drive. A closed container holds the essential rotating solenoid (to which the shaft is attached) between two rotating coils. An end gear is attached to each coil housing. Maximum power requirement is 30 v, 27 amp. Output torque is 40 in. oz.
Servo Corp. of America. Dept. ED, 20-20 Jericho Tpke., New Hyde Park, N.Y.

CIRCLE 88 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Dials
By Process Engraving

Precision instrument dials are reproduced with great accuracy by process engraving at low cost. Tolerance is as close as 2 minutes of arc, and graduations are kept concentric to locating holes within 0.0005 T.I.R. To achieve this accuracy a Master is engraved on optical flat glass and dials are reproduced photographically. The glass master enables the reproduced dials to have sharp, fine graduations; minimum graduation width being 0.002.
After processing is completed, the finish is solvent resistant and durable. Dials can be produced on metals and plastics such as, aluminum, brass, steel, lucite and plexiglas. Blank parts must be held to close tolerances before processing, as the accuracy of markings depends greatly on the accuracy of blank parts.
Ackerman Engravers, Dept. ED, 458 Broadway, New York 13, N.Y.

CIRCLE 89 ON READER-SERVICE CARD FOR MORE INFORMATION

New Grant 3400
thinslide
mounts standard 17" chassis
in standard 18" rack or cabinets

REQUIRES ONLY 19/64" SPACE PER SIDE—YET HAS
FULL ROLLER ACTION
(fits RETMA rack hole spacing)

The Grant 3400 Thinslide requires only 19/64" space per side—installs readily in standard racks and cabinets. Allows instant access to chassis measuring from 10" to 16" deep. Tilts through 100° for under-chassis servicing. Positive lock in "out" position. Lock has finger-tip release for instant return or removal of chassis. Eight hardened steel rollers carry the rated load of 100 lbs. smoothly and easily—durability insures frictionless rolling for thousands of cycles of use.

Slide mounting not only provides for quick access—it usually eliminates need for rear access doors and rear aisles—a very important saving of space.

The Grant 3400 is a versatile slide, suited for use in your process, in plant equipment, prototype and breadboard work, and in production line or field test equipment. Very moderate cost allows a wide range of applications in original equipment.

Write today for Grant 3400 Thinslide Technical Bulletin—contains full data and specifications.

Grant Pulley and Hardware Corporation
factories: 31-51 Whitestone Parkway, Flushing 54, N.Y.
944 Long Beach Avenue, Los Angeles 21, Calif.

CIRCLE 90 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • December 1, 1956
COMPLETE ELECTRONIC NEWS COVERAGE—EVERY WEEK—FROM ALL OVER THE WORLD

ELECTRONIC WEEK is reporting America's fastest-growing industry—clearly—concisely in a single publication. Here is all the electronic news brought to you from world-wide electronic centers by correspondents experienced in the electronic field. The Week in Electronics... Washington Report... Electronics and the Law... Broadcasting... Labor... Finance... Inside Wall Street... Taxwise Tips... Marketing... Contract Awards... Foreign News... People... Plants. This is information of value to management of all levels.

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Qualification for Subscription is Based on Job Function
Why are there
TWO SWEEP GENERATORS
in these Tektronix oscilloscopes?

The extra sweep generator makes an oscilloscope much more useful. With the Tektronix delaying sweep you can...

1. START THE OSCILLOSCOPE SWEEP WITH THE FIRST TRIGGER RECEIVED AFTER A CONTROLLABLE TIME-DELAY PERIOD.

   This is an important reason for the extra sweep generator and its associated pickoff circuit in Tektronix Type 535 and Type 545 Oscilloscopes. Triggering the delayed sweep by the observed signal guarantees a jitter-free display...ideal for examination of time-modulated pulses and signals with inherent jitter.

2. START THE OSCILLOSCOPE SWEEP AT THE END OF A CONTROLLABLE TIME-DELAY PERIOD...convenient for observation of occurrences after an accurately determined time interval.

3. MAKE MORE ACCURATE TIME-INTERVAL MEASUREMENTS.

   A calibrated ten-turn time-delay control divides each of the twelve delay ranges into a thousand units. Range accuracy is within 1%, incremental accuracy on any range is within 0.2% of full scale.

4. TRANSFER PART OF A DISPLAY TO A FASTER SWEEP.

   By initially displaying a signal on the extra, delaying sweep, and then transferring it to the main oscilloscope sweep, a continuously adjustable horizontal expansion can be obtained. Degree of magnification is determined by the time/cm ratio between the two sweeps. The average jitter of 1 part in 25,000 permits practical use of very large magnifications. Further, the exact portion of the display on the delaying sweep that will appear on the faster main sweep is positively identified by trace brightening. Unblanking pulses for both sweeps are applied to the crt grid, causing the main sweep to show up as a brightened portion of the display on the delaying sweep.

5. ARM THE OSCILLOSCOPE SWEEP FOR TRIGGERED ONE-SHOT OPERATION. A front-panel pushbutton or an electrical signal from a remote location can be used instead of the internal delayed trigger to arm the sweep. After the button is pressed, or the pulse received, the next trigger causes the main sweep to fire once and revert to the locked-out condition. Photographic recordings of a single transient made in this manner cannot be blurred by spurious signals following its occurrence. Because the single sweep can be triggered any time after the button is pressed or the pulse received, the time of occurrence need not be accurately predictable.

GREATER VERSATILITY PREFERRED

Customer preference for the Tektronix Oscilloscopes with a delaying sweep, Type 535 and Type 545, indicates that the increased utility is valued at much more than the small additional cost. Application possibilities of these versatile instruments make them worthy of your serious consideration.

TYPE 535 and TYPE 545 CHARACTERISTICS

A calibrated twelve-step range control and a ten-turn precision control provide for continuously-variable coverage of the full sweep-delay range—1µsec to 0.1 sec. Range accuracy is within 1%, incremental accuracy within 0.2% of full scale. Time jitter is less than 1 part in 20,000 in conventional sweep-delay operation. Display is completely jitter-free in triggered operation. The delaying sweep can be used as a rate generator, producing trigger rates from 10 cycles to 40 kc, continuously adjustable. The delayed trigger is available at a front-panel connector for external applications.

Other Specifications

Main-sweep range is 0.02 µsec/cm to 12 sec/cm continuously variable, with 24 calibrated steps accurate within 3%. Accelerating potential is 10 kv. Vertical-amplifier response with Type 535/54K Fast-Rise Plug-in Unit... Type 535, dc to 11 mc—Type 545, dc to 30 mc. Seven plug-in vertical preamplifiers are available for complete signal-handling versatility.

Type 535 (without plug-in units)..............$1300
Type 545 (without plug-in units)..............$1450

Your Tektronix Field Engineer or Representative will be happy to furnish complete specifications and arrange a demonstration at your convenience.

ENGINEERS — interested in furthering the advancement of the oscilloscope? We have openings for men with creative design ability. Please write Richard Roppe, Vice President, Engineering.

Tektronix, Inc.
P.O. Box 831 • Portland 7, Oregon
Phone Cypress 2-2611 • TWX-PD 265 • Cable: TEKTRONIX

CIRCLE 93 ON READER-SERVICE CARD FOR MORE INFORMATION

Tachometer Pickup
Dual Pad Mount

Designed to "sandwich" mount between an aircraft tachometer generator and the engine AND-20005 mounting pad, Model 2043 tachometer pickup provides a high-frequency signal required for electronic tachometers and frequency counters.

The wave shape is sinusoidal and frequencies to 240 cycles per revolution are available with this system. The output voltage is approximately 1 volt rms at 100 rpm.

Instrument-type bearings permit operation at speeds up to 10,000 rpm. Standard units are available with 60 to 120 impulses per revolution and special models may be obtained with from 3 to 240 impulses per revolution.

I-L-S Instrument Corp., Dept. ED. 10701 Briggs Rd., Cleveland 11, Ohio.

CIRCLE 94 ON READER-SERVICE CARD FOR MORE INFORMATION

AUDIO

INSTRUMENTS & CONTROLS

INSTRUMENTS & CONTROLS

Your Customers

INSTRUMENTS & CONTROLS

List Their

AIRCRAFT ELECTRONICS

List Their

AIRCRAFT ELECTRONICS

Requirements

READ DESIGN '57 JAN. 1ST ED

VIDICON TUBE

For Color Cameras

The 6326-A is a small camera tube intended for use in compact color television cameras utilizing three tubes, one for each channel, to produce a color-television image. The 6326-A is also suitable for use in black-and-white TV cameras for either film or live pickup. Its resolution capability is about 600 television lines.

Utilizing a photoconductive layer as its light-sensitive element, the 6326-A has a sensitivity such that it requires illumination levels comparable to those required for motion-picture film cameras. The spectral response of the 6326-A covers the entire visible spectrum and enables the tube to translate color very accurately when operated with appropriate color filters and optical arrangements.

RCA Tube Div., Dept. ED, Harrison, N.J.

CIRCLE 94 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • December 1, 1956
High Sensitivity Relay  
Shock-Resistant

The Model 266 VHS relay has been modified for operation under shock and vibration and ambient temperatures of -55 to 150 °F. Sensitivities from 0.2 μamp to 10 amp, or 0.1 mv to 500 v—with external multipliers even higher ranges of volts or amperes can be furnished. AC relays have built-in silicon or germanium diodes, or copper oxide rectifiers, depending on the performance requirements. Trip point accuracy varies from 1 per cent to 25 per cent.

Single contact high limit or single contact low limit can be supplied as well as double contact. Contact ratings from 5 to 125 ma dc. The relay has a moving coil armature which rotates in the flux gap of an Alnico magnet, similar to microammeters. A locking coil develops additional torque to drive the contacts together with considerable pressure. Reset can be manual or automatic.

Assembly Products, Inc., Dept. ED, Desert Hot Springs, Calif.

CIRCLE 96 ON READER-SERVICE CARD FOR MORE INFORMATION

Pulse Transformers
For High Voltages

This line of pulse transformers is designed for very high voltage, peak power, and average power operation. Two typical units are a 120 kv, 2 usec, 10 mw and a 500 kv, 2 usec, 250 mw. The units are for immersion, without impregnation, in insulating transformer oil. For applications where the output voltage is to be exposed to air, tanked and hermetically sealed units are available.

The transformers are used with klystrons, traveling wave tubes, particle accelerator injection guns, and other high voltage, high power pulse devices. Standard models cover a wide range of voltages, pulse lengths, impedances, rise and fall times and repetition rates.

Pearson Electronics, Dept. ED, 1200 Bryant St., Palo Alto, Calif.

CIRCLE 97 ON READER-SERVICE CARD FOR MORE INFORMATION

IDEAL ENGINEERING "CLIMATE"

The many advanced aircraft and missile programs at Convair San Diego today include: The F-102A Supersonic Interceptor, The Atlas Intercontinental Ballistic Missile, The Metropolitan 440 Airliner, the new Convair 880 Jet-Liner, and a far-reaching study of Nuclear Aircraft.

Within these vital, highly-diversified Convair projects in beautiful San Diego, California, engineers find the perfect "climate" for a challenging and rewarding engineering career. You will find Convair salaries, computer and test facilities, engineering policies, educational opportunities and personal working advantages the most desirable in the industry.

What's more, you and your family will almost certainly enjoy a new, exciting, happier way of life here . . . where the weather year 'round is unsurpassed.

For a significant engineering career in the engineering "climate" you seek, we invite you to forward a full resume today. Write H. T. Brooks, Engineering Personnel, Dept. 1024.

Generous travel and moving allowances to engineers.

CONVAIR
A DIVISION OF GENERAL DYNAMICS CORPORATION

3302 PACIFIC HIGHWAY
SAN DIEGO, CALIFORNIA
The servo amplifiers illustrated are typical standard types. Other models, including higher power types, are available for systems engineering. The complete MA line offers the designer a choice of compact, low cost types, amplifiers featuring fast response at high gain and all-magnetic models providing highest performance.

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SUPPLY</th>
<th>POWER OUTPUT</th>
<th>SENSITIVITY</th>
<th>RESPONSE TIME-SEC.</th>
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<tr>
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<td>115 volts</td>
<td>½, 3, 5, 10 watts</td>
<td>.02 volts</td>
<td>.003</td>
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<tr>
<td>MAGNETIC PRE-AMP + SATURABLE TRANSFORMERS</td>
<td>115 volts</td>
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<td>TRANSI-MAG*; TRANSISTOR + HIGH GAIN MAGNETIC AMPLIFIER</td>
<td>115 volts</td>
<td>2, 5, 10, 15, 20 watts</td>
<td>.08 volt</td>
<td>.01</td>
</tr>
</tbody>
</table>

In addition to standard types, custom designs can be produced for special applications, or complete servo and automatic control systems can be engineered to your requirements.

Call or write for new illustrated bulletins.

**Magnetic Amplifiers • Inc**
632 Tinton Ave., New York 55, N.Y.—Cy press 2-6610
West Coast Division
136 Washington St., El Segundo, Calif.—Eastgate 2-2056

CIRCLE 100 ON READER-SERVICE CARD FOR MORE INFORMATION
Speed-Feed Meter
For Linear Travel

The MF-2 speed-feed meter measures and indicates linear rates of travel and rpm in a variety of applications. The linear speed pickup converts linear motion of any length of travel into an electrical signal. A meter gives the reading directly, with push-button selection of four scale ranges from 0-1 to 0-125 inches per minute. Models are available with four speed ranges or with combinations of linear rate and rpm scales. The small fixed tachometer pickup or a hand-held tachometer pickup have almost no loading effect on the driving source. Neither pickup or indicator can be harmed by overspeeding or sudden starts and stops.

Maico Co., Inc., Dept. ED, 21 North 3rd St., Minneapolis 1, Minn.

CIRCLE 101 ON READER-SERVICE CARD FOR MORE INFORMATION

Motormounting Cleat
For Synchros

These type L2 motor mounting cleats are to be used for all synchro, potentiometer motor, resolver, autosyn generator or any rotating component that has the synchro groove mounting or clamping ring. They come in 4 different heights for all sizes of steps, made of No. 303 stainless steel and clear passivated to meet Mil-specification.

PIC Design Corp., Dept. ED. Div. of Benrus Watch Co., Inc., P.O. Box "C," E. Rockaway, N.Y.

CIRCLE 102 ON READER-SERVICE CARD FOR MORE INFORMATION

Flush Clinch Nuts
Are Self-Locking

Clinch nuts combining flush mounting and self-locking features, the Kay- lock line K7000, are miniature, lightweight, and self-locking. They effect weight savings up to 87 per cent, resist temperatures up to 550 degrees, and they meet AN-N-10 full strength requirements.


CIRCLE 103 ON READER-SERVICE CARD FOR MORE INFORMATION

ESSEX ELECTRONICS
Berkeley Heights, New Jersey

Write for Data Sheet

CIRCLE 104 ON READER-SERVICE CARD

ELECTRONIC DESIGN • December 1, 1966
Printed Circuit Connector

Feed-Thru Feature

Solder lugs of two printed circuit receptacles are permanently soldered together to form a single feed-thru connector which accommodates a printed circuit board on each side. Available in 6, 10, 15, 18 and 22 contacts (single or dual) with molding compounds of mineral filled Melamine or Plaslon reinforced (glass) Alkyd 440A, the contacts accommodate a printed circuit card thickness of 0.051 to 0.071 in. Overall depth of the combined connector is 0.86 in.

DeJur AMSCO Corp., Dept. ED, 4501 Northern Blvd., Long Island City 1, N.Y.
CIRCLE 105 ON READER-SERVICE CARD FOR MORE INFORMATION

Sampling Switches

Precision Phasing

No force or phase adjustments are required in these switches which provide constant force brushes, and precision phasing. Available with one to three poles, up to 60 shorting or 30 non-shorting channels per pole, with 6, 12, or 24 x d.c. motor, shielded r.f. filter, spur gear reduction, and speed governor. Plugs are recessed and mounted into housing.

Approximate dimensions as shown 3.625 in. sq by 2.875 in. high. The units come hermetically sealed or with 400 c.y. ac motor.

General Devices Inc., Dept. ED, Princeton, N.J.
CIRCLE 106 ON READER-SERVICE CARD FOR MORE INFORMATION

Silicon Rectifiers

10 Kw Miniatures

A new series of miniature, 10-kw silicon rectifiers are capable of operation in an ambient temperature range of from -65 C. to 200 C. Combinations of the new rectifiers will allow power output ratings of 1000 kw and above. In most circuits the new rectifiers have efficiency ratings of 99 per cent. Because of a lack of aging effects, it is unnecessary to derate them for industrial or military applications for long life.

General Electric, Semiconductor Products Dept., Dept. ED, Electronics Park, Syracuse, N.Y.
CIRCLE 107 ON READER-SERVICE CARD FOR MORE INFORMATION

This letter moved a man ahead 5 years

Two years ago a man took 10 minutes to write this letter. Today he enjoys the responsibility and professional standing in the AUTONETICS Division of North American that might have taken 7 to 10 years to achieve in other fields.

THE FIELD AT AUTONETICS—A FIELD OF OPPORTUNITY

Now under way at AUTONETICS are nearly 100 projects, comprising some of the most advanced and progressive work being done today in the fields of Electronics, Electro-Mechanics, Control Engineering and Data Processing.

You will work on automatic control systems of many kinds, for manned and unmanned vehicles. Every state of the art is represented, from preliminary conception right through flight testing. Facilities are the finest obtainable. Your colleagues will be men of ability and imagination, of the highest professional standing.

The long-range potential in this field is truly limitless. The techniques being developed at AUTONETICS today will have the widest application in the industrial methods of tomorrow.

You owe it to yourself to consider how far you can advance by entering this exceptionally promising field right now. Here are the opportunities:

COMPUTER SPECIALISTS • COMPUTER APPLICATION ENGINEERS • ELECTRO-MECHANICAL DESIGNERS • ENVIRONMENTAL TEST ENGINEERS • ELECTRONIC COMPONENT EVALUATORS • INSTRUMENTATION ENGINEERS • FIRE CONTROL SYSTEMS ENGINEERS • FLIGHT CONTROL SYSTEMS ENGINEERS • ELECTRONIC RESEARCH SPECIALISTS • AUTOMATIC CONTROLS ENGINEERS • ELECTRONIC ENGINEERING WRITERS • INERTIAL INSTRUMENT DEVELOPMENT ENGINEERS • PRELIMINARY ANALYSIS AND DESIGN ENGINEERS • RELIABILITY SPECIALIST

Write your letter today. Decide now to get the facts, so you can make the most of your potential. Just put your address and brief qualifications on paper—handwritten will be fine. Reply will be prompt, factual, confidential.

Write: Mr. A. Brunetti, Autonetics Engineering Personnel, Dept. 991-11 IRE, P. O. Box AN, Bellflower, California
Drafting Lead Holder
Has Firm Clutch

A lead holder which offers positive protection against lead slippage and turning, the Damascus, possesses a self-cleaning clutch which eliminates build-up and clogging from graphite particles and holds the lead in a tenacious, immovable grip.

The hardened-steel clutch and socket assures maximum life and resists abrasives when sharpening points. It has a spring-loaded release mechanism which grasps the lead securely and operates quickly. The barrel is of anodized aluminum.

Richard Best Pencil Co., Dept. ED, Springfield, N.J.

CIRCLE 110 ON READER-SERVICE CARD FOR MORE INFORMATION

Ferrite Isolator
High-Power

The field displacement resonance absorption technique with the ferrite material acting as a resonant dielectric waveguide, is being applied to this line of ferrite isolators.

A new high power displacement absorption ferrite isolator, Model W-167-1A, is rated at 200 kw peak and 300 w average. Isolation is 17 db minimum and insertion loss is 0.5 db maximum. V.S.W.R. approximately 1:1, unit weight is 18 ozs and insertion length 1.75 ins.


CIRCLE 111 ON READER-SERVICE CARD FOR MORE INFORMATION

Printed Circuit Connector
Has 15 Coded Contacts

A new connector developed for pressurized printed circuits, has 15 coded contacts mounted in Orlon filled molding compound. Design permits either horizontal or vertical mounting. A potting shell is supplied with the connector. Wiring feeds through holes in potting shell, which line up with right angle solder lugs. In assembly of printed circuit, a rubber boot fits over the printed circuit board to form a moisture-proof assembly.

Dejur-Amsco Corp., Electronic Sales Div., Dept. ED, 45-01 Northern Blvd., Long Island City 1, N.Y.

CIRCLE 112 ON READER-SERVICE CARD FOR MORE INFORMATION

How to Calibrate Your own Instruments

FAST ACCURATE CALIBRATION
Now possible with one completely self-contained AC-DC calibration standard requiring a minimum of operator training and previous instrument calibration experience.

Use the Compact Model 829
INSTRUMENT CALIBRATION STANDARD for LABORATORY STANDARDS PRODUCTION TESTING INSTRUMENT REPAIR INSPECTION & SERVICE

All Circuits, Power Supplies and Standards are contained in One Single Cabinet!

Precise, practically error-proof checking of most types of electrical indicating instruments in daily use is a routine convenience for Model 829 users. Maintenance of quality control by frequent calibration of instruments and allied test equipment can be accomplished within departments by available personnel. A mechanical index explains step-by-step test procedure.

WESTON Special Meters
used as standards have 5-inch mirror precision scales, knife edge pointers and are adjusted to better than 0.2% accuracy.

Calibration to full scale accuracy of 0.5% can be accomplished for all instruments measuring d-c voltage (22 ranges) from 0.25 mv to 2000 volts, d-c current (22 ranges) from 2 µa to 20 amperes, a-c voltage (19 ranges) from 1.5 mv to 1500 volts, and a-c current (14 ranges) from 1.5 ma to 20 amperes. Net price $2345. FOB Boonton, N.J.

Write for Technical and Application Data.
Shaft Mounted Motor
For Automatic Control

Designed to provide remote and automatic control, this shaft-mounted gear motor, called Shaftrol, mounts readily on shafts from 1/4 in. to 7/8 in. diam. Light and compact with both the housing and cover made of aluminum, it is furnished with a torque arm or torque plate with resilient mounting. It can be equipped with linear bushings to allow axial movement.

Speeds from 1/2 rpm to several hundred rpm can be had from the standard units. They can be had to reproduce torques from a few in. ozs to several in. lbs. Single phase Shaftrols use an instantly reversible permanent split capacitor motor and three-phase units are available in the larger sizes. They can be furnished for face or foot mounting with a wide variety of output shafts including pinion-on-shaft designs.

They provide overload protection both for themselves and for the controlled equipment, while smaller units are suitable for continuous duty under "locked rotor" conditions without damage to the motor or to the gearing.

The Jordan Co., Dept. ED, 3235 W. Hampton Ave., Milwaukee 9, Wisc.

CIRCLE 115 ON READER-SERVICE CARD FOR MORE INFORMATION

Supersensitive Meter Relays
Are Non-Locking

An improved series of meter relays feature platinum alloy contacts and increased contact force, which minimizes sticking and provides high reliability. Operating on power inputs of less than 50 mW, the new relays will control up to one watt, a power amplification of 20 million.

They are of a non-locking type, currently available in 2 in. dc and 3 in. ac and dc models as microammeters, milliammeters, ammeters, millivoltmeters and voltimeters. Pyrometer types with bimetal compensation are also available, as well as four contact arrangements. The housing, bezel and ring are black phenolic with glass front and bezel removable. Front and back are dust-tight and splashproof.

Simpson Electric Co., Dept. ED, 5200 W. Kinzie St., Chicago 44, III.

CIRCLE 116 ON READER-SERVICE CARD FOR MORE INFORMATION

11 million operations without a miss on low-energy switching test!
New test proves outstanding reliability of General Electric's Miniature relays

Laboratory tests using standard, production relays have confirmed the remarkable performance of General Electric Miniature relays on low-energy switching applications. These hermetically sealed relays made contact 11 million times without failure—switching 25 microamps at 50 millivolts—indicating permanent reliability.

This low-energy performance is combined with proved mechanical life. On one typical application, several of these relays continued to function after 300 million switching operations.

A key reason for this outstanding reliability is extremely high (40 to 55 grams) tip pressure—designed into all miniature relays. Ample wear allowance provided by G-E engineers also contributes to extra-long life.

Description: Available in standard, current-sensitive, and voltage-sensitive models; in 2-, 3-, or 4-pole double-throw and 6-pole normally open forms. Rated 5 amps at 28 volts DC at 85C.

OTHER G-E RELAYS TO MEET YOUR NEEDS

1. Micro-miniature relay: Weighs .35 oz.; rated 2 amps resistive at 28 v DC or 115 v AC. Also, current-sensitive model. Standard relays withstand ambient temp of 125C.

2. 2PDT sub-miniature relay: 2 amps; .651 in. in diameter, 1.6 in. long; weighs one ounce. Withstands shock tests in excess of 50Gs. Available in wide variety of coil ratings.

MAIL TODAY FOR SEALED-RELAY DATA

General Electric Co., Schenectady 5, N. Y.

CIRCLE 117 ON READER-SERVICE CARD
**UPB... the capacitor...with immortality**

Well, isn't quite. But for the critical applications where extended long capacitor life and highest dependability are imperative, the C-D UPB Electrolytic takes over where the normally long-life electrolytic succumbs. Many intricate communication systems, telephone networks, laboratory and control instruments, computing equipment, military and aircraft devices, and the like, require capacitors having this extra high degree of dependability and long service life.

Such a capacitor is the C-D

**UPB ELECTROLYTIC.**

Materials ordinarily quite acceptable for commercial capacitors are discarded—only super-pure materials are used in the UPB. Every processing step is meticulously supervised under controlled atmospheric humidity and temperature conditions. All of the engineering and manufacturing skill of C-D's 40 years of experience is built into this UPB.

The result is an electrolytic capacitor with "Immortality," service life far beyond that of the conventional high-grade commercial electrolytic capacitor.

Engineering data and ratings gladly furnished. Address Manufacturer's Division, Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey.

---

**WHAT ADVANCED COMPONENTS and Assembly**

**Methods are in Sight?**

**FIND OUT IN DESIGN '57—JAN. 1ST ED**

**Phone Jacks**

**Meet Military Specs**

These Han-D Jacks, requiring a minimum of panel space and depth behind panel, assure electrical contact with pressure from nickel silver springs. Notched insulating washers that engage both spring blades and terminals provide a locking arrangement that restricts shifting of electrical connections or changes in adjustment.

Currently supplied in three models. No. 334 (Jan Type JJ-034) is a 2 conductor open circuit jack. No. 389 (Jan Type JJ-089) provides a 2 conductor closed circuit. No. 333 (Jan Type JJ-033) is a 3 conductor open circuit type. All have heavy brass nickel plated frames and fit any standard mating plug.

Richards Electrocraft, Dept. ED. 3741 N. Kedzie Ave., Chicago 18, Ill.

CIRCLE 120 ON READER-SERVICE CARD FOR MORE INFORMATION

**Flyback Analyzer**

**And Capacitor Checker**

A new television tester combines both an in-circuit horizontal system analyzer and a capacitor checker in one unit.

It will check an entire TV horizontal deflection system, in-circuit, test flyback transformers for opens and shorts, check deflection yokes for opens and shorts, measure capacitances from 10 μfd to 0.1 μfd by direct reading. It registers with better than 10 per cent accuracy, and can be used as a continuity meter.

The Model 382 has a 4-1/2 microammeter with 60 μamp, full scale sensitivity. Capacitance measurements are read from three of the meter's scales. It uses a single 6K6 tube in an oscillator circuit for the measurement of Q of horizontal circuit components, and an ac ohmmeter type circuit for continuity and capacitance measurements. Operation is on 110-125 v. 60 cycle ac, and a special test cable is included.

Simpson Electric Co., Dept. ED. 5200 W. Kinzie St., Chicago 44, Ill.

CIRCLE 121 ON READER-SERVICE CARD FOR MORE INFORMATION

---

**HOLTZER-CABOT**

**D-C Miniature Servo-Motor**

Holtzer-Cabot's Type 0810 has been used widely in gun fire control, radar navigation and radio tuning. Versatile and efficient, it features immediate response to minimum input signal. The armature is designed for continuous excitation from a 24 to 29 volt D.C. source through a 28 ohm series resistor. The field has two 10,000 ohm sections: one for CW and the other for CCW rotation. Full rated motor output is obtained by 6 ma. differential.

SPECIFICATIONS: Rating 0.3 oz. in., 6500 R.P.M., .002 H.P.; Diameter: 14”; Field Current 6.0 Milliamps; Armature Current 0.4 amp; Duty Cycle: 4 reversals per minute; Altitude: 50,000 feet; Amb. Temperature: -65°C. to +72°C. Designed to meet MIL specs.

---

CIRCLE 122 ON READER-SERVICE CARD
Look no further—
If you're looking for
"BORON-FREE"
fused quartz
LABORATORY WARE

The world's largest producer of fused quartz products can help you with your most critical and exacting needs for your laboratory ware.

Vitreosil® products can be supplied in an unusually large variety of types and sizes. Also fabricated to specification to meet individual requirements.

TRANSPARENT VITREOSIL
For ultra-violet applications, metallurgical investigations, chemical research and analysis, photochemistry, spectroscopy and physical, optical and electrical research.

Send specifications for your requirements. Please use coupon below.

THERMAL AMERICAN
FUSED QUARTZ CO., INC.
18-20 Salem Street, Dover, New Jersey

Please send technical data on

Company  
Name & Title  
Street  
City  Zone  State

CIRCLE 124 ON READER-SERVICE CARD

WHAT IS NEEDED by the Manufacturer of Communication Equipment in '57?
READ DESIGN '57—JAN. 1ST ED

5-Inch Scope Kit
With Printed Circuits

The Knight-Kit scope is designed for general purpose high frequency applications. Included among its features are a sweep range from 15 to 150,000 cps in 4 ranges; vertical response is down only 3 db at 700 ke (1000 cycle references); high vertical sensitivity, 25 rms mv in; 1-v peak-to-peak, square wave, regulated calibrating voltage internally injected by front panel switch, horizontal amplifier is down only 3 db at 200 ke (1000 cycle reference); directly coupled positioning controls assure fast positioning of trace on both horizontal and vertical, free of overshoot.

The kit is supplied complete with all tubes, including CRT; steel case with disappearing handle, all parts; plus detailed instructions and diagrams and is listed as Allied Stock Number, 83 YZ 146. Allied Radio Corp., Dept. ED, 100 N. Western Ave., Chicago 80, Ill.

CIRCLE 125 ON READER-SERVICE CARD FOR MORE INFORMATION

Lead-Plastic Compound
For Molded Shielding

A new lead-plastic compound, leadcast, is suitable as shielding for radio-active materials, and adaptable to methods for precision molding of the material.

A plastic compound containing 95 per cent lead, it is both harder than and has a structural rigidity greater than pure lead. It may be molded with any structural members and into any shape within a tolerance of ±0.0005 in. The surface requires no finishing and is inert to oxidation or other corrosive contamination.

The amount of lead can be varied up to 95 per cent by weight, and hardness can be controlled from that of a semi-rubber like material to that of cast aluminum.

Telectro Industries Corp., Dept. ED, 35-18 37th St., Long Island City 1, N.Y.
CIRCLE 126 ON READER-SERVICE CARD FOR MORE INFORMATION
We have present openings for experienced Electronic Engineers in the design and development of ground radar systems, airborne transmitters and receivers and in the electrical systems of guided missile fuzes.

We also have a need for Mechanical, Aeronautical and Structural Engineers of the same experience levels in the design of servomechanisms, the design of large, light-weight structures of the airframe variety and the design and layout of electronic and electromechanical chassis and packages.

In the computer field, we have a need for Physicists and Mathematicians for the programming and solution of engineering problems utilizing analog computers and IBM equipment. Experience in the development of new applications and techniques for digital and analog computers combinations is also desirable. Attractive openings also available for Packaging Engineers, Technical Writers and Illustrators.

CROSLEY'S continued and extraordinary success in the sphere of government electronics, has placed the name of CROSLEY as one of the forerunners in this ever-expanding field. Our present and anticipated demands call for additional engineering personnel at all levels. CROSLEY offers you a partnership in its continued expansion program—"A Partnership in Opportunity."

CROSLEY has numerous company benefits including a group insurance and retirement plan, subsidized educational program, periodic merit reviews and up to three weeks paid vacation after five years. We would also pay relocation expenses including moving expenses, reporting to work pay, family transportation and a generous subsistence allowance.
RADIO
INTERFERENCE
AND FIELD INTENSITY
measuring equipment

Stoddart equipments are suitable for making interference measurements to one or more of the following specifications:

**AIR FORCE — MIL-I-6181B**
- 150 kc to 1000 mc

**BuAer — MIL-I-6181B**
- 150 kc to 1000 mc

**BuShips — MIL-I-16910A (Ships)**
- 14 kc to 1000 mc

**SIGNAL CORPS — MIL-I-11683A**
- 150 kc to 1000 mc

**SIGNAL CORPS — MIL-I-11683A**
- 150 kc to 1000 mc

The equipments shown cover the frequency range of 14 kilocycles to 1000 megacycles.

Measurements may be made with peak, quasi-peak and average (field intensity) detector functions.

**F.C.C. PART 15** — Now in effect, the revised F.C.C. Part 15 places stringent requirements upon radiation from incidental and restricted radiation devices. Stoddart equipment is suitable for measuring the radiation from any device capable of generating interference or c-w signal within the frequency range of 14 kc to 1000 mc.

Write Stoddart Aircraft Radio Co., Inc., for your free copy of the new revised F.C.C. Part 15.

The Stoddart NM-40A is an entirely new radio interference-field intensity measuring equipment. It is the commercial equivalent of the Navy type AN/URM-41 and is tunable over the audio and radio frequency range of 30 CPS to 15 kc. It performs vital functions never before available in a tunable equipment covering this frequency range. Electric and magnetic fields may be measured independently over this range using newly developed pick-up devices. Measurements can be made with a 3 db bandwidth variable from 10 CPS to 60 CPS and with a 15 kc wide broadband characteristic.

Stoddart Aircraft Radio Co., Inc.
6644-J SANTA MONICA BLVD., HOLLYWOOD 38, CALIFORNIA • Hollywood 4-9294

CIRCLE 129 ON READER-SERVICE CARD FOR MORE INFORMATION
9-Speed Direct Drive
For Recording Equipment

This 9 speed direct-shaft drive is designed for better recording equipment. Using two specially developed synchronous continuous duty motors, one worm gear and synthetic notched belts, the drive provides smooth, positive speeds of 16-2/3 - 33-1/3 - 45 - 66-2/3 - 78.26 - 90 - 156.52 rpm plus two additional speeds useful in lab work.

Damon Recording Studios, Inc., Dept. ED, 117 W. 14th St., Kansas City 5, Mo.
CIRCLE 130 ON READER-SERVICE CARD FOR MORE INFORMATION

Magnetic Tape Head
For Stereo Sound

This magnetic head has been designed for high quality recording and reproduction in stereophonic sound applications. The head can be compensated for flat response between 30 and 10,000 cps at 7.5 in. per sec. It is compact and has negligible oxide accumulation, excellent rejection of surrounding fields, and uniformity of frequency and amplitude response.

The Nortronics Co., Dept. ED, 1015 S. 6th St., Minneapolis 4, Minn.
CIRCLE 131 ON READER-SERVICE CARD FOR MORE INFORMATION

Photorelay
Compact Control

A new photoelectric control utilizes a broad area cadmium sulfide photocell and a relay, which are mounted on a 5-pin plug-in base and housed in a dust can measuring 1-1/2 in. square x 2-1/4 in. high.

This Model 1 photorelay operates at five foot-candles or less, releases at 0.1 fc or more, at a guaranteed speed of two operations per second. Supply voltage is 115 ac, 50 to 60 cycles and temperature range is -40 C to +75 C.

Sigma Instruments Inc., Dept. ED, 59 Pearl St., South Braintree, Boston 85, Mass.
CIRCLE 132 ON READER-SERVICE CARD FOR MORE INFORMATION

AMAZING NEW SILICONE COATING

Insulates and Protects Resisters

Serviceable to 275°C.

- A special formulation of SICON now protects Corning Glass Works LP resistors against damage from moisture and handling, and acts as an effective insulating coating. It thus guards against dielectric breakdown and subsequent shorting to other parts of TV and radio equipment. SICON does not change the characteristics of the Corning low-power line, and is serviceable to 275°C.

The Original Silicone Base
Heat Resistant Finish

- The versatility of SICON as a high temperature protective coating is shown by its remarkably varied use on products of all kinds—resistors, jet engine parts, manifolds, heating elements—and its amazing adherence and color retention when used as a decorative finish for heaters, grills, incinerators, etc. Easy to apply, SICON protects up to 1000°F. in black or aluminum, and up to 500°F. in smart colors.

WRITE FOR BULLETIN NO. CG 100 TODAY

Midland Industrial Finishes Co.
Dept. L-23, Waukegan, Illinois
ENAMELS • SYNTHETIC • LACQUERS • VARNISHES
CIRCLE 133 ON READER-SERVICE CARD
Planetary Gear Box
Wide Range of Radio Speeds

A small planetary gear box, ideal where small size and intermittent service are required, is available in ratios from 4 1/7 to 40,188. Output torque varies from 100 in. lbs at the low ratio to 250 in. lbs at higher ratios.

Ball bearings on input shaft and oilite bearings on output and planets together with hardened gears will provide long service. The TA-120 reducer can be furnished with leg or flange mounting and various housings.


CIRCLE 135 ON READER-SERVICE CARD FOR MORE INFORMATION

Phenolic Laminate
For Cold Punching

A new paper-base phenolic laminate with excellent electrical properties has the added benefits of cold punching and cold shearing characteristics. This P-25 material punches clean and sharp at room temperature, eliminating hot punching shrinkage allowances. It is especially recommended for copper clad laminates used in printed circuitry.

P-25 has high insulation resistance and low dielectric loss at high frequencies—even under extreme humidity conditions. It is available in plain sheet form or copper clad.


CIRCLE 136 ON READER-SERVICE CARD FOR MORE INFORMATION

Heating Cartridges
For Instrumentation

These ceramic-body heating cartridges come in units as small as 5/32 in. in diameter and 1 in. in length. Wattage ratings are available to provide densities up to 50 w per sq in. There is a wide selection of terminal configurations. The nickel alloy leads are swaged to rigid external terminals to facilitate repair of damaged leads.

Hotwatt, Inc., Dept. ED, 16 Gould St., Danvers, Mass.

CIRCLE 137 ON READER-SERVICE CARD FOR MORE INFORMATION
in the
EARTH SATELLITE

...Chemelec Insulators

To withstand the shock, vibration and extreme temperatures involved in acceleration to 18,000 m.p.h., Chemelec (TEFLON*) Stand-off and Feed-Through Insulators were selected for use in the 10-pounds of vital instruments nestling inside the earth satellite.

Chemelec compression-type insulators are replacing brittle materials in many electronic devices which must withstand rigid government tests, because they offer the highest quality—electronically and mechanically—without increasing costs ... due to the assembly savings they provide.

Simply press into position—no additional hardware.

Write for Catalog EC-756. FLUOROCARBON PRODUCTS INC., Division of United States Gasket Company, Camden 1, New Jersey.

*Cuno trademark for its tetrafluoroethylene resins.

Sold through leading electronic parts distributors by Erie Resistor Corp.
Voltage Stabilizers

Have Close Tolerances

A new series of constant voltage stabilizers have ±1 per cent voltage tolerance, and complete recovery within two cycles. Output voltage stabilization is automatically obtained by a parallel combination of a fixed capacitance and a magnetic core inductance to provide the variable capacitive current.

The stabilizers cannot be damaged by overloading, for as the per cent of overload increases, the output voltage decreases up to zero output voltage.

The 15, 25 and 50 VA units can be supplied with the output voltages of 6.3 v or 115 v. Units of 100 to 500 VA capacity are available with input of 95 to 130 v and output of 115 v.

Acme Electric Corp., Dept. ED, Cuba, N.Y.

CIRCLE 140 ON READER-SERVICE CARD FOR MORE INFORMATION

Small Relay

For Heavy Currents

Reliable switching of heavy current in limited space through long service life is achieved by a new Class 22D telephone type relay.

Specially designed double break contacts switch up to 20 amps, non-inductive load. Contacts are single pole, single throw, normally open.

Overall dimensions are 2-1/16 in. long, 1-9/16 in. high, 1-1/16 in. wide. Available for operating voltages to 280 dc and 440 v, 60 cy ac.

Magncraft Electric Co., Dept. ED, 3350 D W. Grand Ave., Chicago 51, Ill.

CIRCLE 141 ON READER-SERVICE CARD FOR MORE INFORMATION

Substitution Box

Has Variable R and C

The X-Checker is a substitution box with a continuously variable resistor and capacitor which may be inserted alone or in series combination in an electronic circuit. The resistance range is from 20 to 450 µf.

Ram Electronics, Dept. ED, Irvington-on-Hudson, N.Y.

CIRCLE 142 ON READER-SERVICE CARD FOR MORE INFORMATION
WHAT IMPORTANT DEVELOPMENTS WILL AFFECT THE DESIGN OF MICROWAVE EQUIPMENT?

Components? General Communication?

SEE DESIGN '57—JAN. 1ST ED

Rack Panel Scope
Uses Square CRT

A new rack panel oscilloscope provides the equivalent of a 5 in. diameter viewing tube on its 3-1/2 in. square cathode ray tube. Model K-10-R uses printed circuits throughout. Sensitivity is 0.028 v per in., Z-axis intensity modulation is 2 to 56 v peak (negative) depending on intensity setting required to blank the beam. Input impedance to the vertical amplifier is 2 Mohm, and frequency response of vertical amplifier is flat to dc, 3 db at 300 kc. The linear sweep time base is 2 cps. to 30 kc, external capacitor position for slower sweeps. Positioning permits examination on screen of any portion of the sweep expanded to 8 times full screen diameter. Internal, external or line synchronization.

Electronic Tube Corp., Dept. ED, Philadelphia, PA.

Battery Eliminator and Vibrator Checker

A combination battery eliminator and vibrator checker, EMC Model 905-6A, can supply 6 v at 10 amp or 12 v at 6 amp continuously. The output voltage is continuously variable from 0 to 8 v or from 0 to 16 v with smooth dc output voltage assured. Able to check both 6 v and 12 v vibrators, the unit checks both interrupter and self-rectifier types for proper starting point as well as quality of operation. It can be used as a battery charger and is housed in a single sloping rugged metal case.

Electronic Measurements Corp., Dept. ED, 625 Broadway, New York 12, N.Y.
The Model X-146 X-band isolator which offers many advantages in applications where minimum size and weight are important considerations. This new isolator is 2.7 x 8 in. long, 1.7 x 8 in. high and weighs only 25 oz.

Frequency range is 8.6 to 9.6 kmc over which VSWR is less than 1.1, (typically 1.04), forward attenuation is 0.5 db. Load isolation is 9 dB at band edges and 12 dB at band center. Power rating, (into load with VSWR = 2.1) is 125 w average and 150 kw peak.

Cascade Research Corp., Dept. ED, 53 Victory Lane, Los Gatos, Calif.

CIRCLE 152 ON READER-SERVICE CARD FOR MORE INFORMATION

Polarized AC Bridge
And DC Shunt Box

This new combined shunt box and Wheatstone bridge facilitates electrical measurements in chemistry and physics. The CM-21A Poly-Functionist uses a 10 Kohm 10 turn Heliot control alternatively as a calibrated shunt for the measurement and recording of dc currents or as the measuring arm of an ac or dc Wheatstone bridge. When used as an ac bridge, it delivers a polarized dc output signal, it is positive if the resistance being measured is lower than the balancing value and negative if it is higher. Thus the instrument provides the possibility of making measurements in a calibrated unbalanced bridge condition with proper discrimination above-par and below-par ac resistances in the same manner in which a dc bridge indicates a deviation of a resistance beyond and below the balance point.

Millivac Instrument Corp., Dept. ED, 444 Second St., Schenectady, N. Y.

CIRCLE 153 ON READER-SERVICE CARD FOR MORE INFORMATION

THE ELECTRONICS INDUSTRY LOOKS AHEAD
SEE DESIGN '57—JAN. 1 ISSUE ED
Microphone Rig
For Stereo Recording

A simple method of positioning two microphones for stereo recording has resulted in what is now called the Fen-Tone B&O binor rig. This rig utilizes the polar characteristics of a velocity microphone, that is, a spiral and logarithmic increase in sensitivity from the side towards the front or back. If two microphones are placed approximately 10 in. apart and each faces 45 degrees away from the front of the rig, the side portion of the polar pattern is utilized.

Fenton Co., Dept. ED, 15 Moore St., New York 4, N.Y.
CIRCLE 159 ON READER-SERVICE CARD FOR MORE INFORMATION

Pulse Transformers
Plug-in Miniature

Featuring high reliability, these pulse transformers are mounted in several types of encasements. Type A is designed to be plugged into a seven pin miniature tube socket; Type B is designed for mounting on printed circuit boards and Type D is a molded unit for direct soldering as a permanent component.

The transformers are encapsulated in exopy resin or hermetically sealed in metal can.

Electronic Computer Co., Dept. ED, 6191 Ridge Ave., P.O. Box 5826, Philadelphia 28, Pa.
CIRCLE 160 ON READER-SERVICE CARD FOR MORE INFORMATION

Shock Mounting
Highly Damped

A new 125500 Series diagonal spring "Equi-flex" vibration isolator and shock mounting features all-metal construction, nonlinear spring characteristics, high damping, and all-positional or all-attitude performance. It withstands hours of resonance with input of 0.036 in. double amplitude with equipment mounted either horizontally or vertically, and has low amplification at resonances—approximately 2 times input.

The Ucinite Co., Div. of United-Carr Fastener Corp., Dept. ED, Newtonville 60, Mass.
CIRCLE 161 ON READER-SERVICE CARD FOR MORE INFORMATION
Clip Fastener
For Wiring Bundles
A steel fastener clip, designed for sliding around the bolt of a wiring or hose clamp, holds tension during arranging and screwing on the nut. The Clip-It device can be inserted around a clamp bolt to fasten or release the clamp's prongs for adjustments while arranging wiring bundles and lines on jigsaw boards, or when fastening hose.

A slot extending halfway into the clip is engineered to snugly grip the inside thread diameter of the clamp's bolt. One end is bent upward for handling. It is effective as a washer, or may be taken off after the use as a grip and re-used.

CIRCLE 165 ON READER-SERVICE CARD FOR MORE INFORMATION

Ceramic Capacitors
Have Ribbon or Tab Leads
These subminiature ceramic capacitors are produced with a great variety of wire, ribbon or tab leads to fit a wide range of terminal requirements.

Where high capacitance is required, connecting leads are available for any desired number or thickness, radially or axially arranged. Lower inductance for ultra-high frequency is obtained with ribbon leads. The shapes of the ceramic elements vary from square to rectangular with thickness as little as 0.065 in. if needed. Where larger values of capacitance are required in the same area, two or more plates are stacked and connected in parallel.

Mucon Corp., Dept. ED, 9 St. Francis St., Newark 5, N.J.
CIRCLE 166 ON READER-SERVICE CARD FOR MORE INFORMATION

Better Surface Quality
In Less Time...
with Linde FINE ABRASIVES

These powders produce an excellent scratch-free finish on metals and other hard materials. The extremely uniform ultimate particle size of these powders makes levigation unnecessary. Elimination of this preparatory step, together with the swift polishing action of the powders, allows superior finishes to be obtained in a fraction of the usual time.

Two types of Linde Fine Abrasives are available. Type A is a very fast cutting powder, which produces a fine finish. Type B is somewhat slower in its cutting action, but it produces an extremely fine finish.

For detailed information on the properties of these polishing powders, call or write the nearest Linde office.

Linde Air Products Company
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street New York 17, N. Y.
Offices in Other Principal Cities
“Linde” is a registered trade-mark of Union Carbide and Carbon Corporation.
CIRCLE 167 ON READER-SERVICE CARD FOR MORE INFORMATION

DC-AC CHOPPERS
For 60 Cycle Use
Built to rigid commercial specifications.
Twenty-two types, both single and double pole.
Long life.
Low noise level.
Extreme reliability.
Write for Catalog 370.

HOW FAR WILL COMPUTERS Penetrate Industrial Applications in '57?
READ DESIGN '57—JAN. 1ST ED
CIRCLE 168 ON READER-SERVICE CARD FOR MORE INFORMATION
HOW WILL COLOR TV AFFECT THE COMPONENT
Parts Picture?

GET YOUR COPY OF DESIGN '57—JAN, 1ST ED

Electromagnetic Clutch
Has Double Input

These miniature electromagnetic clutches have
one input gear hub normally clutched to the
output shaft while the opposite end input
hub is free turning. When energized the
input hub is clutched to the output shaft and the
other hub is free turning.

The MBC units are suited for use as a speed or
direction changer in servo type applications. All
units will withstand vibration as specified in
MIL-E-5272A and operate on dc voltage.

A. J. Thompson, Inc., Dept. ED, Rte 1, Box 812,
Florissant, Mo.

CIRCLE 171 ON READER-SERVICE CARD FOR MORE INFORMATION

50-Contact Plugs
Withstand Stress

New 50 contact plugs and receptacles feature a vise-action
screw lock mechanism for maintaining positive mating under
unusual physical stress. The connectors have a
temperature rating of 750 °C
rms 60 cps at sea level.

Shells are aluminum,
hinge hardware is cad-
mium-plated brass for extra strength and the handle
and screw assembly is made of stainless steel.

Male contacts are silver-plated tellurium copper.

Female contacts are silver-plated leaded commercial bronze,
and dielectric is brown phenolic. Connectors are available with
either extended solder cup contacts or with taper pin contacts.

Amphenol Electronics Corp., Dept. ED, 1830 S.
54th Ave., Chicago 50, Ill.

CIRCLE 172 ON READER-SERVICE CARD FOR MORE INFORMATION
Precision Potentiometer

Has Air-Core Winding

A 10-turn, 1-13.16 in. diameter unit for servo or 3-hole pilot mounting. This precision potentiometer has a choice of two windings; air-core winding with a range of total resistance from 200 to 5000 ohms; copper-mandrel winding from 5000 to 200,000 ohms.

In air-core windings, linearity approaches the resolution of the unit without padding or shunting. Air-core wound units of the 7700 series have negligible phase shift in AC circuitry, less than 0.1 degree. Incorporating 11 mechanical coil turns, it provides 180 deg overtravel at each end. Mechanical stops are standard, with stop-load strength of 50 in-lbs.

The first measurement yields the absolute sensitivity at any precalibrated standard. The second measurement gives frequency response between 20 and 20,000 cps.

Heliot Corp., Div. of Beckman Instruments, Inc., Dept. ED, Newport Beach, Calif.

CIRCLE 176 ON READER-SERVICE CARD FOR MORE INFORMATION

Microphone Calibrator

For Condenser Units

A microphone calibration apparatus, Model BL-4119, is designed for accurate calibration of the Brush condenser microphone Model BL-4111 as well as the condenser microphone cartridge MK 0002 employed in the Brush artificial ear BL-4109 or artificial voice BL-4210.

The calibration apparatus enables both a calibration procedure which is a simplified form of the standardized reciprocity calibration technique in accordance with the American Standard Association standard Z24.4, and the determination of the complete frequency response curve of the microphone by means of an electrostatic actuator.

The winding process corrects for errors in the unit resistivity of the wire.

Brush Electronics Co., Dept. ED, 3405 Perkins Ave., Cleveland 14, Ohio.

CIRCLE 177 ON READER-SERVICE CARD FOR MORE INFORMATION

DOES THE COMPUTER INDUSTRY Need More Specialized Equipment?

READ DESIGN '57—JAN. 1ST ED

NEW—UNBRAKO socket set screws with Nylok*

The Nylok self-locking feature locks these screws securely in place, seated or not. They won't work loose. Use them in holes tapped in soft materials or against hardened shafts. Can be used as self-locking adjusting screws. Can be used repeatedly. Tough, resilient nylon locking pellets permanently installed. Successfully resist temperatures ranging from -70 to 250°F. Deep, accurate hex sockets for positive, non-slip internal wrenching. Heat treated alloy steel, continuous grain flow, fully formed Class 3A threads for high strength and exact fit. All standard point types—including knurled cup point—available. Sizes #6 to 1 in. Also available in plated finishes and in stainless steel.


STANDARD PRESSED STEEL CO.

Unbrake products are sold through Industrial Distributors

CIRCLE 178 ON READER-SERVICE CARD FOR MORE INFORMATION

Accurate Temperature Control in “Tight Spots”...

Fenwal Miniature controls ideal for aircraft and other applications

Sturdy Fenwal miniature controls are versatile, space-saving units that utilize the famous Fenwal Thermostat Switch principle. The outer shell is the positive activating element. It is sensitive to temperature change over its entire area. Fenwal Miniature units may be controlled within 2° to 6°F — even under 5G acceleration. They have fully adjustable ranges of from -20° to 200°F or -20° to 275°F.

Ideal for aircraft, guided missiles, motors, wave guides, crystal ovens, precision instruments, radar, and other “tight spot” applications. Write for new bulletin, Aviation Products Division, Fenwal Incorporated, 912 Pleasant St., Ashland, Mass.

CIRCLE 179 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • December 1, 1956
Selenium Rectifiers
High Current

A new line of selenium rectifiers has a wide range of current handling capabilities.

The rectifiers will charge at 6 or 12 v over a current range from 30 to 100 amps dc. The rectifiers are available with either positive or negative center taps, low resistance bus connections, and strong mechanical construction. Six types of 12 volt stacks have current ratings of 30, 40, 60, 70, 90 and 110 amps respectively. The stacks are designed for use with forced air cooling, (750 L.F.M.), permitting a reduction in size. The cells vary in size from 5 in. x 5 in. to approximately 6-1/4 in. x 7-1/4 in.

The line provides interchangeability with miniature incandescent lamps in a full range of voltages. It provides both grounded and insulated models in all standard lens colors. It provides lenses bearing numbers, letters, and special designations.

Federal Telephone and Radio Co., Components Div., Dept. ED, 100 Kingsland Rd., Clifton, N.J.
CIRCLE 183 ON READER-SERVICE CARD FOR MORE INFORMATION

Neon Lamp
Subminiature

A subminiature neon lamp, designated the NE2C, designed with a midget flanged base will be interchangeable in many assemblies with existing miniature aircraft lamps of the No. 327 to 339 series.

Electrical design of the lamp makes it of interest for indicator and computer applications. Power consumption is only 0.04 w. Current drawn is extremely low at 0.0003 amps. The lamp produces practically no heat, and has an average life of over 25,000 hours. Starting voltage is 65 v ac. The lamp has been tooled for automated production with segmented busing and spot-welded shell connections.

The units are available as shelf items, eliminating custom-built stacks.

Circon Component Co., Dept. ED, Santa Barbara Municipal Airport, Goleta, Calif.
CIRCLE 184 ON READER-SERVICE CARD FOR MORE INFORMATION

WHAT IS THE TREND in Printed Circuits?
Transistors?

WATCH FOR DESIGN '57—JAN. 1ST ED
ARE THE RESULTS OF RESEARCH AND DEVELOPMENT PROGRAMS for Guided Missiles
Beginning to Affect Suppliers?
SEE DESIGN '57—JAN. 1ST ED

Sensing Relay
Unbalance Detector

This negative sequence sensing relay has all static components for high reliability to protect 115/200, 3-phase, 400 cycle power systems.

Employing a circuit which is unaffected by changes in system frequency, it is sensitive to phase unbalances of as little as 5 negative sequence volts. The unit closes a three ampere output circuit when an unbalance is detected. An appropriate inverse time delay is provided to prevent nuisance tripping. Designed primarily for aircraft service, it weighs 23 ozs.

This control device has a patented circuit, and provides automatic protection.


CIRCLE 190 ON READER-SERVICE CARD FOR MORE INFORMATION

Dynamometer
Has Photocell Tachometer

This dynamometer features a system of torque indication which is independent of speed, rotor bearing friction and external sources of mechanical or electrical error. Pendulum weights, attached at the outer periphery of the hysteresis brake of the Magtrol Dynamometer, balance against the actual running torque delivered from the test motor.

There is no error due to the tachometer generator, as a photo electric pick-up is used which requires no torque. Speed accuracy is 1/2 of one percent of full scale on 60 cycle supply reference.

The torque is read on a large torque dial mounted on the brake assembly.

Magtrol, Inc., Dept. ED, 38 Virginia Place, Buffalo 2, N.Y.
Self-Contained VU Meter
Saves Panel Space

A new self-contained VU meter requires the panel space of a 1-1/2 in. meter, yet provides scale length and readability of a standard 2-1/2 in. round meter. The MM-1 VU meter offers the features of improved readability and wide choice of case and dial colors.

All necessary rectifiers, associated resistors and shunts are contained within the instrument housing.

Physically, the MM-1 VU meter is interchangeable with standard 1-1/2 in. JAN types. Installation is provided by a threaded ring mount.

The meter is available in various colors to suit styling requirements.

Marion Electrical Instrument Co., Dept. ED.
Grenier Field, Manchester, N.H.
CIRCLE 193 ON READER-SERVICE CARD FOR MORE INFORMATION

Multiplier Phototube
For Ultraviolet Radiation

The 6903 is a head-on type of multiplier phototube intended especially for the detection and measurement of ultraviolet radiation.

It is constructed with a fused-silica faceplate which transmits radiant energy in the ultraviolet region down to and below 2000 angstroms. At 2000 angstroms, the spectral sensitivity is more than 50 percent of the maximum response. The spectral response of the 6903 covers the range from about 2000 to 6500 angstroms. Maximum response occurs at approximately 4400 angstroms. Photoduced current produced at the cathode is multiplied by a median value of 400,000 times.

The tube is also useful in applications involving low-level radiation sources.

Radio Corp. of America, Dept. ED.
Continued from page 6

WILL CHANGES IN THE GROWTH of the Magnetic Tape Market Affect Requirements?

FIND OUT IN DESIGN '57—JAN. 1ST ED

ELECTRONIC DESIGN • December 1, 1956
One of the most critical problems encountered in the development of a successful missile system involves attaining rapid responses of controls consistent with system stability. Moreover, it is a problem of increasing importance as new aerodynamic configurations require major advances in flight controls performance.

At Lockheed, Flight Controls engineers are developing unique control methods to cope with this growing problem. Their expanded activities have created new positions for those possessing experience and a high order of ability in:

- Hydraulic servomechanisms
- Circuit design
- Aerodynamic stability and control
- Flight analysis
- Autopilot simulation

A number of the positions now open are on supervisory levels. Inquiries are invited for positions at Lockheed's Engineering Centers in Van Nuys and Sunnyvale, California.
Class H Insulating Tape
Dielectric Strength 5 Kv

Among the unique properties claimed for this tape are its high dielectric strength of 5000 v and its temperature insulation properties. The tape will withstand exposure to 550 F.

Backing of Permacel 211 is silicone varnish treated glass cloth. The silicone adhesive is both heat curing and pressure-sensitive. Overall tape thickness is 6 mils.

Basic average properties of the new tape are: tensile strength of 85 lbs per in.; elongation of 3 percent; and adhesion of 25 ozs per in. The insulation resistance at 96 percent relative humidity is 9000 megohms and the indirect corrosion current at the same relative humidity is 111 microhms. The tape, which is transparent, is available in 60 yd rolls, ranging in width from 1/2 in. to 1 in.

Permacel Tape Corp., Dept. ED, New Brunswick, N.J.

CIRCLE 302 ON READER-SERVICE CARD

Rosin Core Solder
30% Greater Spread

This new activated rosin core solder, designated RTS 300, has outstanding non-corrosive characteristics and minimum odor. The activating chemicals used in RTS 300 are not toxic to the touch or to the respiratory tract. The makers claim that spread is 30 percent greater than with most conventional rosin core solders. RTS 300 solder can be stored for extended periods without losing its stability.

Federated Metals, Dept. ED, 120 Broadway, New York 5, N.Y.

CIRCLE 203 ON READER-SERVICE CARD

Redesigned Gear Box
Seven Day Cycle

A reduction range of final shaft speeds from 4.5 to 1 through 2,592,000 to 1 can now be supplied through standard gearing. Shaft speeds between these limits are available in a virtually continuous range, although not all torques are available in all shaft speeds.

Gleason-Avery, Inc., Dept. ED, 45 Aurlius St., Auburn, N.Y.

CIRCLE 204 ON READER-SERVICE CARD

NOW IS THE TIME TO SELL THE FUTURE

In the electronic industries, tomorrow's sales are being formed in the minds of today's design engineers. If you want to sell this market of the future, now is the time to tell your story to the men who will specify your products. Your electronics advertising will be read in ELECTRONIC DESIGN.
The Baird-Atomic Model KT-1 Beta Tester, developed for applications in quality control, inspection of incoming transistors, circuit design, trouble-shooting, etc., combines speed and accuracy of measurement with compact portability. A self-contained instrument, it houses a 1 kc oscillator with a mercury cell power supply. Life of the mercury cell is approximately 1000 hours.

Only 11½ inches high, 6 inches in width and 5¾ inches in depth, this Baird-Atomic Beta tester features a direct-reading scale, calibration adjustment for temperature variation, and an external jack for oscilloscope connection. The meter is provided with positive overload protection.
1957 Radio-Electronic Catalog

The 21st Edition of The Radio-Electronic Master will be available in December. Its 1546-pages list over 125,000 items from 350 manufacturers. With more than 11,250 illustrations, the catalog gives detailed descriptions, specifications and prices. A detailed set of indexes pinpoint the thousands of products. Among them are tubes, test equipment, capacitors, resistors, relays, coils, antennas and accessories, transformers, recording and PA systems, Hi-Fi equipment, hardware, tools, transmitters, communication receivers, wire and cable, speakers, microphones, rectifiers, converters, amateur gear, switches, and volume controls. United Catalog Publishers, Inc., 110 Lafayette St., New York 13, N.Y.

X-Ray Spectrograph Chart

A revised 17-1/2 x 22-1/2 in. X-ray spectrograph chart shows characteristic secondary X-ray beams for elements from Magnesium (Atomic 12) to Californium (Atomic 98). Suitable for wall display, the chart will help technicians to understand the theory and application of X-ray spectrography. K Alpha and K Beta lines are shown for EDDT, ADP, topaz, lithium fluoride and rock salt. Horizontal scales show two Theta angles in degree and wavelengths in Angstroms for all elements under various operating conditions. North American Philips Co., Inc., 750 So. Fulton Ave., Mt. Vernon, N.Y.

Vibration Pickups and Meters

Vibration pickups and meters are featured in a 6-page illustrated bulletin. Given for these velocity-type pickups are design and method of operation, general specifications and typical frequency-response curves for damped and undamped types. The type 115 hand-held probe-type pickup is described in detail. Design features and performance specifications are given for vibration meters M-1 and M-3. A table shows natural frequency, damping factor, dc coil resistance, available stroke and sensitivity. Maximum limits on shock and acceleration magnitude and temperature are given for appropriate types. MB Mfg. Co., 1060 State St., New Haven 11, Conn.
High Temperature Cushion Clamps 211

Temperatures as high as 1500 F. are resisted by the Light-Weight All Stainless Steel Cushion Clamps now being manufactured. Both the clamp and its cushion are made of type 321 stainless steel, spec. MIL-S-6721. The TA1500 Series is available in a size range from 1/4" to 3" I.D., and the clamps are interchangeable with any standard AN, MS or commercial type cushioned loop clamps. The cushion is spot welded to the clamp and cushion edges are cramped for abrasion-free grip. TA Mfg. Corp., 4607 Alger St., Los Angeles 39, Calif., formerly Thomas Associates.

Custom Power Supplies 212

A “Custom Design File” illustrates a variety of custom power supply work in 9-pages. Included are series-tube-regulated-supplies, constant-current-supplies, unregulated high voltage power supplies, semiconductor brute-force power supplies and thyatron-controlled supplies. Data given on each unit includes voltage, current, ripple, line regulation, load regulation, and price. The publication offers a ready and reliable means of estimating price and performance of non-catalog equipment. NJE Corp., 345 Carnegie Ave., Kenilworth, N.J.

Special Copper Alloys 213

A tabulation of non-standard, wrought copper base alloys has been prepared on a 1-page sheet. The list provides the trade name, generic name, nominal composition, forms available, typical applications and mill source for each alloy. Copper & Brass Research Assoc., 420 Lexington Ave., New York 17, N.Y.

Tubing for Encapsulation 214

Two mimeographed sheets describe the use of precision cast tubing made from thermo-setting types of resin. Casting materials, characteristics, advantages, and available diameters of tubing for encapsulation and coil forms are cited. Resdel Corp., P.O. Box 217, Wildwood, N.J.

Magnetic Pickups 215

Magnetic pickups that generate electrical energy from mechanical motion without contact are discussed in a 2-page catalog sheet. Pictured and described are performance curves and specifications for high sensitivity and miniature pickups. The sheet also details principles of operation and diversified applications. Electro Products Labs., 4500 N. Ravenswood Ave., Chicago 40, Ill.
HOW THERMISTORS CAN HELP YOU

Maintaining Constant Lamp Brightness with GLENNITE® Thermistors

Versatile GLENNITE Thermistors can help you solve your circuit design problems. For instance, in the schematic shown above, by placing a thermistor (T1) in parallel with the lamp, the brightness of the lamp remains constant because this thermally sensitive resistor compensates for voltage fluctuations in the circuit or ambient temperature variations in the lamp. By using another thermistor (T2) in series with the lamp, an effective time-delay is obtained, preventing current surges from blowing the lamp filament.

Thermistors from Gulton Industries are now available for every application in a complete assortment of configurations and sizes including wafer, bead, probe, and rod units. Space-saving wafer thermistors, for example, occupy 1/5 the space of conventional types possessing the same power handling abilities, are made as small as .06", and have temperature coefficients up to 7%/°C.

If your project encompasses temperature compensating, controlling or indicating requirements, GLENNITE Thermistors can help you. And if you have a design problem that needs outside assistance, it's immediately available from our field representative without obligation.
Cluster Fittings

Cluster Fittings for aircraft applications titled "Aircraft Piping and Engineering Application Manual," is now available in a 44-page comprehensive booklet. It presents data on fitting dimensions, installation and assembly methods, piping application categories, and engineering recommendations. The manual contains information on the planning, selection, and installation of various aircraft piping systems. The Weatherhead Company, Aviation Division, 300 E. 131 St., Cleveland, Ohio.

Automatic Purging Systems

Automatic systems for pressurizing and purging transmission lines are described in an 8-page catalog. Several of these units, which supply dry air at various pressures, are illustrated. The folder cites applications and features and tells how the equipment was developed. Industrol Corp., Roselle Park, N.J.

Electrical Insulating Materials


Precision Wire Wound Resistors

A catalog of precision wire wound resistors features a complete handbook for engineers, designers, and purchasing agents. The catalog lists types of wire, temperature coefficients, types of coatings, and ac characteristics. Encapsulation, installation precautions, wattage ratings, stability, operating characteristics, and typical problems are described. There are complete glossary of terms and ordering instructions. Eastern Precision Resistor Corp., 675 Barbey St., Brooklyn 7, N.Y.

Single and Multi-Turn Potentiometers

Standard specifications for 6 single and 8 multi-turn precision potentiometers are given in illustrated data sheet 54-34, issued to supersed 54-33. Among the models described are the 1-1/4 in. diameter 5300 series, the 1-7/16 in. diameter 5400 series, the 2 in. diameter 5600 series and the 3 in. diameter 5700 series. Noise ratings and life expectancy are noted, as well as several specification changes for series AJ, B and T. Helipot Corp., Div. of Beckman Instruments, Inc., Newport Beach, Calif.
Replacement Capacitor Catalog 225

Replacement Capacitor Catalog 200D-3 for 1957 is now available. This illustrated edition covers electrolytic, paper tubular, industrial, mica, ceramic, filter and motor start capacitors. The 44-page, 3 color catalog is sectionalized and thumb-indexed for quick reference. Cornell-Dubilier Electric Corp., So. Plainfield, N.J.

Teflon Tubing 226

Bulletin 157 is a 2-page data sheet devoted to the f.500 spaghetti teflon tubing. One side of the sheet cites uses and characteristics. The other side lists specifications and available stock items. Prices are also given. Birnbach Radio Co., 145 Hudson St., New York 13, N.Y.

Heat Testing Beryllium Copper 227

Bulletin 8 presents new heat treat recommendations to produce maximum strength and hardness in beryllium copper strip. In the 4-page brochure hardness-response curves are given in detail, together with specification properties for Alloys 25 and 165. Penn Precision Products, Inc., 501 Crescent Ave., Reading, Pa.

Coil and Parts Catalog 228

Catalog 57-A lists nearly 1000 different replacement coils. Noteworthy is a series of transistor antenna rods, oscillator coils, and I.F. transformers. A complete line of adjustable RF coils and chokes is also shown. The 32-page catalog is fully illustrated and gives prices for all items. J. W. Miller Co., 5917 So. Main St., Los Angeles 3, Calif.

DC Amplifier 229

The Hilger-Negretti dc amplifier for measurement of low currents and potentials is presented in a 4-page illustrated bulletin. The zero-drift galvanometer amplifier is discussed with respect to operating principle, characteristics, application, and construction. Jarrell-Ash Co., 28 Farwell St., Newtonville 60, Mass.

Temperature Controllers 230

MC-139 is an illustrated brochure which gives complete specifications on a series of bulb-and-capillary indicating temperature controllers. The brochure shows how a controller can be tailored to fit specific operating requirements with "building blocks." Also illustrated is the design of a temperature sensing response mechanism. Fenwal Inc.,Ashland, Mass.
The right people with the right facilities produce the right solutions

Observing measurement of circuit parameters in the Electronic Systems Division's Buffalo Engineering Laboratory. From left: H. S. Title, Manager—Buffalo Operations; M. C. Scott, Manager—Buffalo Engineering Laboratory; R. W. Fern, Advanced Development Engineer; and A. W. Puttick, Engineering Manager.

Keeping electronic equipment cool with controlled air flow "Packaging"

Intense heat generated by airborne electronic equipment and supersonic flight is posing new problems for the safety and performance of crewmen and their planes.

An ingenious method for combating the heat menace was recently developed by Sylvania's Electronic Systems Division. Vacuum tubes are mounted in carefully sized ducts in light foam plastic material of the desired thermal properties. Accurately controlled air flow results in optimum cooling, while exhausting the air at high temperature.

Tests have proved that this is an extremely effective method, giving cooling efficiencies of approximately 90 per cent. Through the use of such electronic "packing" in supersonic aircraft, it is possible to reduce the amount of air-cooling equipment, with its accompanying weight penalties.

Problem solving, whether in research and development or in practical application, is the chief task of Sylvania's Electronic Systems Division. In all of its installations, the right people work with the right facilities, within a sound managerial environment. That is why they have produced right solutions to a variety of problems, and have made many important contributions in the fields of aviation electronics, guided missiles, countermeasures, communications, radar, computers, and control systems. Whether the problem is military or industrial, Sylvania's business is to come up with solutions that are producible.

The Electronic Systems Division has plant and laboratory facilities at Buffalo, N.Y., Mountain View, Calif., and Waltham, Mass. All are staffed with top-ranking scientists and engineers, backed with Sylvania's extensive resources in the electronics field.

Sylvania is looking for enterprising engineers

Sylvania has many opportunities in a wide range of defense projects. If you are not now engaged in defense work, you are invited to contact Edward W. Dorr, Manager of Personnel, Electronic Systems Division, Sylvania Electric Products Inc., 100 First Avenue, Waltham 54, Mass.

Rods, Tubes and Shapes 236

A color bulletin on acrylic rods, tubes and shapes supplied to manufacturers has been released. All these products are made of Lucite and Plexiglas, clear crystal methyl methacrylates possessing unusual optical properties. The bulletin illustrates a wide range of rods, tubes, and shapes including hard-to-obtain shapes, half rounds, squares, and twists. Illustrated also are products in which acrylic material is used. Complete tables are shown, tabulating physical properties of the material, such as refractive index, compressive and impact strength, dielectric strength and resistance to chemical agents. Exhaustive information on all types of test conditions for these factors is also included. Ace Plastic Co., 91-90 Van Wyck Expressway, Jamaica 36, N.Y.

Aircraft Fire and Overheat Detector 237

Brochure MC-130 illustrates a variety of aircraft fire and overheat detectors. Data given include physical dimensions, weight, service temperature ranges, extreme exposure temperatures, current ratings, and conformance to applicable government and MIL specifications. The 4-page booklet also contains installation instructions. Fenwal Inc., Aviation Products Div., Ashland, Mass.

Corrosion-Resistant Fastenings 238

How the "Flo-Form" process cuts the cost of corrosion-resistant fastenings is told in a book of 24 pages. Text and illustration show parts, specifications, and small and large quantity manufacturing methods. The book explains hot and cold forming and when each system is best. All fastenings described are made from stainless steel or non-ferrous metals. H. M. Harper Co., Morton Grove, Ill.

Shock-Resistant Meters 239

An 8-page illustrated catalog describes a line of shock-resistant meters which are more than 25 per cent accurate and can register 1 million ohms per volt. Information on construction, performance and characteristics is given. The catalog explains a light beam pointer that eliminates parallax and the bifilar movement used in the meters. Two pages of charts and diagrams show scales and ranges available. Gulton Industries, Inc., 212 Durham Ave., Metuchen, N.J.

How will innovations in Air Navigational Systems Affect The Component Picture in '51

Find the answers in Design '57—Jan. 1st Ed
TWO-WAY STEPPING SELECTOR

For Computing, Control, and Indicator Systems

The flexibility of forward and reverse stepping at the operator's choice or by automatic cycling is now obtainable in a compact unit—the GENALEX two-way stepping selector. Each of these units can replace several conventional oneway stepping relays, thus adding efficiency and versatility to circuit designs.

The GENALEX two-way stepping selector operates in either direction at a speed approximately 65 steps per second on self-interruption, and at speeds up to 20 steps per second from external impulses. Positive stepping action and freedom from over-stepping are assured by driving the wiper assembly on the forward stroke of the appropriate armature. The unit is designed for use with standard 25-contact banks up to three levels. All selectors can be supplied with bridging or non-bridging wipers, or any desired combination of both. The armature coils can be supplied for operation at 12, 24, 50, 110, or 220 volts a. c. Bank contacts, wipers, and wiper brushes are of nickel silver for maximum life. The interrupter springs, designed for easy adjustment, are fitted with platinum contacts. The finish of the units makes them suitable for either standard or tropical use.

For detailed descriptive bulletin and prices, write: General Electric Company, Limited, of England, c/o Imtra Corporation, (U.S. Agent), 58 Charles Street, Cambridge, Massachusetts, U.S.A.

CIRCLE 245 ON READER-SERVICE CARD FOR MORE INFORMATION

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CIRCLE 246 ON READER-SERVICE CARD FOR MORE INFORMATION

Static Control

"Fundamentals and Features of General-Purpose Static Control Logic Elements" is an 8-page bulletin designated as GEA-6578. It defines static control, lists advantages, and describes components of a general-purpose static control system. The illustrated publication explains how static control operates without moving parts. Also covered are the logic function concept, logic functions and conventional control, basic principles of static control, circuit characteristics, monitor lights and amplifiers. General Electric Co., Schenectady 5, N.Y.

Cooling Effect Detector

MC 142 is a 4-page bulletin about the series 18501 cooling effect detector. Designed to protect airborne electronic equipment against inadequate cooling, the detector has its own heat source which duplicates the heat output from the protected equipment. The brochure illustrates and describes the instrument's operating principle and gives complete physical and performance specifications. Fenwal Inc., Ashland, Mass.

WHAT NEW PLANS Will Directly Affect the Component Parts Manufacturer in '57

SEE DESIGN '57—JAN. 1ST ED

Drawn Metal Boxes

A 60-page illustrated catalog describes deep-drawn and fabricated cases of aluminum, brass and steel. Featured is a line of aluminum instrument cases for electronic and instrument manufacturers. Over 1400 cases are listed with drawings and specifications for all types. Also described are custom deep-drawn cases, MIL-W specification cases, and complete component facilities and processes. Zero Mfg. Co., 1121 Chestnut St., Burbank, Calif.

Injection Molded Tiny Plastic Parts

A bulletin which describes and illustrates a specialized injection molded of tiny thermoplastic parts has been released. It states the maximum wt. is .03 oz and 1-1/4" long with no minimum size limit. The bulletin further describes approximate dimensional and weight limits for plastic molded tiny parts; illustrates many of the parts that may be molded at low tooling costs of thermoplastics, especially nylon; and includes a chart of the properties of nylon. A design engineers' check list is also included to help engineers. Gries Reproducer Corp., 400 Beechwood Ave., New Rochelle, N.Y.
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CIRCLE 255 ON READER-SERVICE CARD FOR MORE INFORMATION

Servo Analyzer 256

A revised 4-page bulletin TDS 1100 discusses the Servoscope servo analyzer, an instrument for solving control system problems. The booklet offers illustrations, specifications, applications and outstanding features for four standard models and shows how they are used to solve various problems. Servo Corp. of America, 20-20 Jericho Tpke., New Hyde Park, N.Y.

Rare Earths 257

A brochure has been published which gives information on rare earths or lanthanides—elements of atomic number 57 through 71 in the periodic tables. The pamphlet gives background information on separation, production and applications and contains a list of prices and a table of properties. St. Eloi Corp., P.O. Box 307, Newtown, Ohio.

AC Capacitors 258

Bulletin 179 describes the KGN series of capacitors which permit size and weight reductions in existing ac equipment and are available at 236, 330, 440 and 660 v ac, 60 cy, in capacitance ranges from 1 to 60 µfd, depending on voltage. Included in the 4-page booklet are illustrations and specification tables. Cornell-Dubilier Electric Corp., So. Plainfield, N.J.

Guide to TV Picture Tubes 259

A booklet has been published classifying 211 tube types. Booklet EDT-1001C includes breakdown lists as to size, bulb structure and deflection angle, aluminization, external conductive coating capacitance, ion-trap magnet type, face, dimensions and style of anode terminal. General Electric Co., Tube Sales Div., 1 River Rd., Schenectady 5, N. Y.

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CIRCLE 260 ON READER-SERVICE CARD FOR MORE INFORMATION
Panel Instruments

Data sheet, 81556-T, has been published describing panel instruments. The 4-page booklet includes full-size scales of various types of panels as well as dimensional diagrams of round, rectangular and special instruments in which panels are used. Typical external shunts as well as illuminated meters are included. Triplett Electrical Co., Bluffton, Ohio.

Digitizers

A 4-page bulletin CR-181 has been prepared which gives additional useful information concerning three, four, five and six decade decimal digitizers. Included in this bulletin are many typical uses and applications of these digital readout systems and ten photographs of the equipment in use. Coleman Engineering Co., Inc., 6040 West Jackson Blvd., Los Angeles 16, Calif.

Molding Presses

Bulletin No. A-456, recently released on the completely automatic compression molding presses, is now available. High production at low cost, flexible feeding mechanism, quick-set cycle control, safety interlock of all functions and other features are illustrated and described. Hull-Standard Corp., 1505 Race St., Philadelphia 2, Pa.

Speed Reducers

A data sheet has been released on the Rampe SW-1 economy speed reducer. It was developed to fill the need for a more efficient, dependable and durable unit than the "clock-work" stamped gear type at a cost under that of heavy cast-metal case and cut-gear reducers. Data includes line drawing and horsepower rating table. Rampe Mfg. Co., Cleveland 10, Ohio.

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CIRCLE 275 ON READER-SERVICE CARD FOR MORE INFORMATION

Dead Reckoning Tracer

A paper entitled "Airborne Analog Computer Plots Aircraft's Own Position on a Mercator Chart," by T. A. Westover has been reprinted for distribution. Presented at a meeting of the A.I.E.E. Committee on Air Transportation, the article discusses design and application features of a navigation system which automatically traces the course of an aircraft. Photographs show the electro-mechanical analog computer and plotting board equipment, and block diagrams illustrate the system as a whole. The price of this 8-page booklet is 40 cents for A.I.E.E. members and 80 cents for nonmembers. There is an additional 5-cent charge for first class mailing.

Servo Corp. of America, 20-20 Jericho Tpke., New Hyde Park, N.Y.

Standard Non-Linear Potentiometers

Data sheet 54-74 is 4 pages of information on standard non-linear potentiometers. The illustrated folder lists available models in a comprehensive table which gives resistance ranges and peak-to-peak conformities. A section is devoted to a standard conformity called "absolute" and a new voltage indexing system. Helipot Corp., Div. of Beckman Instruments, Inc., Newport Beach, Calif.

Self-Locking Socket Screws

Vibration-proof, self-locking socket screws and how they work are illustrated in a 16-page booklet. Sizes, critical dimensions, threads per inch, package quantities and weight per box are given for socket head cap screws, socket head set screws, button head socket screws, flat head socket screws, socket head shoulder screws and socket pressure plugs. There are also locking pellet specifications on material, temperature range of application, resistance to fluids, durability and plastic memory. Standard Pressed Steel Co., Box 202, Jenkintown, Pa.

Capacitor Interchangeability

A comprehensive guide of 24 pages shows the electrical and mechanical interchangeability of single, dual, triple and quadruple capacitor units. The booklet, TM-1-1, lists the latest twist-mount electrolytic capacitors for television receivers. There is also an index of all the firm's products. Pyramid Electric Co., 1445 Hudson Blvd., No. Bergen, N.J.

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WHAT ARE THE LATEST TRENDS in Instrumentation?

BE SURE TO READ DESIGN '57—JAN. 1ST ED
Titanium Analysis 286

A 2-page bulletin shows how X-ray diffraction is used to analyze titanium and other alloys. Illustrated with photos, graphs and charts, the literature describes specimen preparation and results obtained with three X-ray techniques: powder camera, diffractometer and spectrophotograph. In addition to titanium, such metals as 17-TPH, 303, 321 and 347 stainless steels, 24S, 75S and 78S aluminum alloys, nickel-chrome salt pot electrodes and lead-tin solders are discussed. North American Phillips Co., Inc., 750 So. Fulton Ave., Mt. Vernon, N.Y.

Small Seamless Tubing 287

A 4-page catalog covers small seamless tubing and small tubular components. The illustrated brochure details fine aluminum alloy pointer tubing and seamless metal-shielded wire. Production facilities are also described. Uniform Tubes, Inc., Collegeville, Pa.

Pumps for High Vacuum 288

The recently increased performance ratings of rotary mechanical vacuum pumps and other useful information helpful to engineers confronted with vacuum processing problems, contained in a revised edition of the 28-page catalog on ‘Microvac Pumps for High Vacuum’ which has just been issued. The new catalog, No. 752, includes, in addition to specifications for the complete line of pumps, valuable tables of formulas, constants, and conversion factors frequently used in vacuum processing; solutions to problems of pump selection for typical vacuum system; and useful information on continuous oil purification and other maintenance procedures for high vacuum pumps. F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa.

Instrument Bulletins 289

Publication of five technical bulletins describing recent instruments is announced. The bulletins illustrate, describe and give specifications for the 58-AS radio noise and field strength meter, the 84-TVR UHF standard signal generator, the 202-C standard barretter bridge, the 210 series of standard FM signal generators, and the model 505 standard test set for transistors. Measurements Corp., Boonton, N.J.

Parts From Laminated Plastics 290

Availability of an 8-page booklet on precision parts fabricated from plastic laminates is announced. The illustrated bulletin describes the range of parts produced by punching, turning, milling, automatic screw machining and other processes. Also shown are examples of molded, molded-macerated and postformed parts. Mica Insulator Co, P. O. Box 1076, Schenectady 1, N. Y.
OPENING NEW HORIZONS IN DATA PROCESSING SYSTEM DESIGN

The requirements for a switching system that will handle the high information rates of input and output devices in data processing systems have been so demanding that, until now, they have constituted a serious barrier to data processing system design.

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CIRCLE 291 ON READER-SERVICE CARD FOR MORE INFORMATION
Silicone Rubber Selector

Users of silicone rubber mechanical goods may now obtain a “lightning selector” to speed their choice of compounds. Designated AD 24 E, the 4-page illustrated selector lists the major categories of silicone compounds and typical properties of each. Cross references to AMS and ASTM specifications are included. A more detailed description of silicone rubber and its applications is contained in the 24-page publication, “Imagineering with Silicone Rubber.”

General Electric, Silicone Products Dept., Waterford, N.Y.

Reactor Plant Types

A “nuclear scorecard” for laymen, with thumbnail profiles of various reactor types and how they compare or differ has been prepared in an 8-page booklet to meet the need for clarification of the basic reactor classifications and the specific reactor types. In familiar terms it tells the name of a reactor, how it was arrived at and what the reactor’s essential features include. Minneapolis-Honeywell Regulator Co., Industrial Div., Philadelphia 44, Pa.

Assembly Methods

An illustrated booklet contains 8 pages of data on high speed methods of assembling lock nuts and fasteners with specially designed wrench attachments, shanks and applicators. Manual and power tool tightening procedures are outlined. Descriptions, dimensions and prices are given for magnetic socket wrenches, internal hex wrenches, magnetic wing nut wrenches, box wrenches and applicators for pushnut fasteners. The Palnut Co., Glen Rd., Mountainside, N.J.
Seals for Toggle Switches 305

Series N-1000 high pressure seals for toggle switches are the subject of Hex-7, a 1-page bulletin. Featured is a high pressure switch boot which contains an internal hexagonal nut. Applicable military specifications, sealing materials and their properties, and operating characteristics are given. Colors, sizes and special modifications are also described. A cross section drawing shows construction. Automatic & Precision Mfg. Co., 252 Hawthorne Ave., Yonkers, N.Y.

Zinc Alloy Gears and Pinions 306

Bulletin listing gear and pinion combinations which can be furnished from stock die elements at no tool charge is available. Various combinations of these gears, pinions, hubs and shafts or hole diameters are now on hand. The combinations are die cast in one piece on specially designed automatic machines. Holes, shafts, spacers, shoulders and others are made to specifications. More than 40 individual elements are listed on this catalog sheet. Gries Reproducer Corp., 400 Beechwood Ave., New Rochelle, N.Y.

Analysis of Plating Solutions 307

“Simple Methods for Analyzing Plating Solutions,” a 36-page bulletin, is prefaced by a discussion of analytical principles, use of apparatus and methods for sampling a plating solution. It then outlines the necessary steps involved in 28 analytical methods for testing nickel, copper, silver and other metalfinishing solutions. Other sections describe necessary equipment, component chemicals of solutions, atomic weights, acid concentrations and electro-chemical data. Conversion tables are included. Analytical reagents are listed for brass, cadmium, chromic acid, copper cyanide and sulfate, gold, nickel, silver, tin and zinc plating solutions. Hanson-Van Winkle-Munzing Co., Matawar, N.J.

Color Difference Meter 308


A special porcelain body is used in the production of Lapp Resistor Cores. It provides a flawless surface of such nature as properly to receive a uniform deposit of carbon or borocarbon. It also has a temperature coefficient of expansion matched to that of the deposited film . . . to provide a constant resistance against temperature change. These resistor cores are produced in close tolerances for straightness, roundness and length . . . they reflect the same quality of workmanship and materials long associated with Lapp. Write for complete information on Lapp Resistor Cores. Lapp Insulator Co., Inc., Radio Specialties Division, 942 Sumner St., LeRoy, N. Y.
Waters miniature and micro-miniature wire-wound precision potentiometers are famous for accuracy, ruggedness, dependability and fast delivery in commercial and military uses. They are precision-machined, with anodized aluminum bodies, line-reamed phosphor bronze, ball or jewel bearings, centerless-ground stainless steel shafts, and gold-plated fork terminals; fully sealed and fungus-proofed. To meet your requirements Waters pots can be furnished ganged, tapped, servo or bushing mounts, with various electrical and mechanical angles, optional shaft locks, anti-rotation pins, 0 rings, and custom shaft or servo dimensions.

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**Series AP 1/2** — 4 watts continuous at 80°C; resistances 10 to 150,000 ohms; diameter 3/4", depth 5/8", weight less than 3/4 ounce; standard linearity 1%.

Waters has advanced facilities for the design and manufacture of miniature toroidal potentiometers and windings for use in equipment of special design.

Write today for complete information on all Waters potentiometers.
Harmonic Generator Circuit

In captive oscillator systems, it is necessary to generate a wide range of harmonic frequencies from an oscillator which is crystal controlled and provides the fundamental frequency. For example, it may be necessary to secure a range of harmonic frequencies from 3 to 30 mc from a fundamental frequency of 1 mc. A class C amplifier has been used to generate these harmonic frequencies. However, the amplitude of the output is not constant throughout the range and, in addition, high amplification is necessary in the higher harmonics. Another form of harmonic generator has some similarity to the circuit of the figure which generates a saw-tooth wave. From this saw-tooth wave, the harmonic frequencies desired are secured. With this latter circuit, however, a single rectifier is used and the circuit components present some difficulties in securing rapid discharge of the condenser at the higher frequencies. A saw-tooth wave of necessary form is not obtained unless rapid discharge of the condenser is secured.

In the circuit shown, the oscillator for generating the fundamental frequency consists of the tube 1 and oscillator circuit 9, the oscillations being controlled by the crystal 2. On the positive portion of the wave generated, the terminal 14 is positive with respect to junction 20, and the condenser 18 is charged slowly through the resistor 17 to form the rising portion of a saw-tooth wave. Upon the negative portion of the fundamental wave, the point 14 is negative with respect to junction 20 and the condenser 18 discharges rapidly through the rectifier 16 since there is no resistance in this discharge circuit. The rectifiers 15 and 16 are oppositely poled in order to secure this operation. The saw-tooth wave is applied to the grid of an amplifier 22 and the desired harmonic is selected by the tuned plate circuit 29.

With the circuit illustrated, the parallel resistor 19 may have a high resistance, such as 500,000 ohms, so that the input impedance of the amplifier tube may be matched. This value of resistance also prevents the fundamental oscillator from being unduly loaded. This desirable high value of resistance may be used since the discharge circuit for the charging condenser 18 is through the rectifier 16 which presents very little impedance to the condenser discharge and a sharply dropping saw-tooth wave results.

In a saw-tooth type of harmonic generator, the amplitude of the harmonic will vary inversely as the number of the harmonic. The amplifier 23, however, may be designed to amplify proportionally with respect to the number of the harmonic and thereby provide an output amplitude which is substantially uniform throughout the frequency range. The patent describes an alternative form of circuit which is not as efficient, although its operation is satisfactory.
Cathode Ray Tube Intensity Compensation


A cathode-ray tube circuit, particularly as used for radar and similar applications, connects the cathode with a resistor so that increased current through the tube changes the bias and in this manner stabilizes the beam brightness. This type of compensating circuit is shown in the series resistors 17, 18, and 19 with the cathode of the tube 105 connected with the resistor 18. It is desirable to compensate also for any changes in sweep frequency or in the duty cycle for any particular sweep frequency.

The patent shows a cathode-ray tube circuit which provides for variation of beam brightness controlled from the sweep generator 26 and therefore is controlled by the frequency of the traverse of the beam. In the circuit illustrated a portion of the voltage of the sweep generator is applied to a resistor 24 and a portion of the potential across this resistor is applied to a resistor 11 and an averaging circuit consisting of a resistor 12 and condenser 21. The average signal is applied to the grid of an amplifier tube 101. The amplified signal is applied to the control grid of a second tube 104, through voltage regulating gas tubes 102, 103. The tube 104 is connected in cathode follower manner and the potential across the cathode resistor 16 controls the potential on the grid 36 of the cathode-ray tube. 

As the sweep generator frequency increases to provide an accelerated beam traverse, the increased average signal is applied to the grid 31 of the amplifier tube. This amplified signal is transmitted to the grid 36 of the cathode-ray tube through the second tube 104 and increases the potential upon the grid and increases beam brightness.

Crystal Controlled Oscillators

Patent No. 2,742,573. S. W. Seeley. (Assigned to Radio Corp. of America)

Oscillator circuits which are controlled by two or more piezo-electric crystals have been used to improve the frequency stability of the oscillator. Stray coupling between the crystals broadens the resonant curve and results in a loss in sharpness of the frequency control. Wide separation of the crystals does not materially improve the frequency stability of the oscillator. The ideal oscillator should generate a frequency with a high degree of frequency stability irrespective of changes in power supply, temperature of circuit components, and varying factors.

The oscillator, shown in the figure, uses a crystal 14 which is parallel resonant at the desired frequency. It is connected in parallel with the grid resistor 16. In addition a series resonant crystal 18 is provided in the cathode circuit and an inductance 20 is in parallel with this crystal. Preferably, this inductance has a value of reactance the same or approximately the same as the capacitive reactance of the crystal. The tuned circuit 22 is provided in the plate circuit of the oscillator tube and is tuned to the desired frequency.
The Army's multi-channel AN/TRC-24 transmitter relies on MicroMatch Directional Couplers for continuous RF Power monitoring and VSWR indication. They give positive confirmation of the transmitter and antenna system’s performance.

MicroMatch Directional Couplers give your transmitters these invaluable features at extremely low cost. Their output is essentially independent of frequency over the range of 20 to 2000 megacycles. They are adjusted to produce full scale meter deflection at power levels of 1.2 watts to 120 KW. Accuracy of power measurement is ±5% of full scale.

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CIRCLE 316 ON READER-SERVICE CARD FOR MORE INFORMATION
METAL FILM RESISTORS

The Welwyn Welmet provides considerably greater stability than is obtainable in deposited carbon types. A Welmet, in fact, closely approximates the stability of a wire-wound resistor, yet is smaller in size and lower in cost.

Resistance Range. 1000 to 1,000,000 ohms.
Tolerance ... ±1%, ±2% or ±5% — closer tolerance in matched pairs can be supplied to special order.
Stability ... The resistance value will not change more than 0.05% over a period of six months.
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The temperature coefficient depends on resistance value, and lies between 300 and 360 parts per million per degree centigrade. The coefficient is positive in all cases, and in general the lower ohmic values have the higher temperature coefficient in the stated range.

Welwyn Welmet resistors are available in small production quantities for test and laboratory purposes.

Complete specifications and prices on request Dept. PM-5

Welwyn International, Inc.
3355 Edgecliff Terrace, Cleveland 11, Ohio
manufactured in England and Canada
Voltage-Controlled Ring Oscillators


There are circuits, such as counters which require a series of pulses of square wave form, which are precisely generated and may be variable as to duration and repetition rate. In some circuits, too, it is desirable that the variations may be controlled by one or more controlled voltages. The circuit shown in the figure accomplishes these results using two multivibrators coupled together in a manner as will be described. The patent also describes an oscillator circuit of three multivibrators, using the design principle set forth; the oscillator may include any number of multivibrators.

In the figure, one multivibrator includes the tubes 10 and 18 in which the tube 10 is normally non-conducting but may be rendered conducting by the application of a control signal at the terminal 16. The other multivibrator comprises the tubes 27 and 35, which may be controlled by a controlled signal applied to the terminal 32. The two multivibrators are monostable, cathode-coupled units.
Sweep Circuit

Patent No. 2,743,357. B. F. Casey. (Assigned to Allen B. Du Mont Laboratories, Inc.)

It is desirable in the generation of a saw-tooth wave that the rising portion of the wave be linear or, more nearly, approximate linearity. It is desirable, too, that the circuit be adjustable in order to provide a wide range of frequencies. With the circuit illustrated, these results are secured with a relatively small capacitance.

In the circuit shown, a synchronizing or gating signal such as a square wave is provided by the source 11, and is applied to the control grid of the tube 13. The positive portion of the signal maintains the tube conducting and discharges the charging condenser 16. The negative portion of the signal renders the tube 13 non-conducting, so that the condenser 16 begins to charge from the potential source 18 through the resistors 36, 35, 33, and 32. The rising potential on the charging condenser 16 is applied to the control grid of a regulator tube 22 so that a rising potential or the inclined portion 59 of a saw-tooth wave is provided across the cathode resistor 26. The output terminal 31 is connected with the cathode of the tube 22.

In order to improve the linearity of the rising potential of the saw-tooth wave, a constant voltage device 37 is provided between the output terminal and the junction 38 of the resistors 36 and 35. This constant voltage device feeds back some of the rising output potential to the charging condenser 16 to increase its rate of charging and thereby improves the linearity of the rising portion of the saw-tooth wave. At the end of the synchronizing pulse the tube 13 again becomes conductive and rapidly discharges the condenser until the next positive portion of the synchronizing signal repeats the cycle.
PLATE CIRCUIT 9500 OHMS RELAY
UNION 9500-ohm, current-sensitive relay picks up at a nominal value of 8 milliamperes throughout the entire temperature range of -65°C to +125°C, while maintaining the excellent shock and vibration characteristics inherent in our standard design. It can withstand 200 volts across the coil continuously.
These current-sensitive relays have a life expectancy of 100,000 operations. They meet or exceed all requirements of MIL-R-5757-B and withstand shock up to 50G’s, vibration through 1500 cycles at 15G’s.

AC SELF-CONTAINED RECTIFIER RELAY
UNION AC relay with self-contained rectifier retains all the best operating characteristics of the type M DC miniature relay. It permits operation in 115-volt, 60 to 400-cycle circuits over a temperature range of -55°C to 85°C. Withstands vibration up to 1000 cycles at 15G’s and shock in excess of 50G’s. Has a life expectancy of 1,000,000 operations. Meets or exceeds MIL-R-5757-B.
All the above relays are available in 6PDT or 4PDT models, with all the usual mountings and with plug-in or solder-lug connections.

DRY CIRCUITRY APPLICATIONS
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Complete stocks of relays and selenium rectifiers now available on the West Coast for immediate shipment.
MODEL 605
WIDE RANGE RESISTANCE BRIDGE

Features:
* 10 ohm to 100 megohm range
* Simple pushbutton operation
* High accuracy
* Negligible drift
* Guard terminal for high-resistance measurements

Description:
Shasta model 605 provides a rapid, easy and highly-accurate means of measuring unknown resistances. Seven full-scale resistance value ranges are selectable by pushbuttons. Values are read directly on the linear scale of a precision multi-turn Helipot after "nulling" the unknown resistance on the 4" zero center galvanometer.

BRIEF SPECIFICATIONS:
Ranges: 100, 1k, 10k and 100k ohms, 1, 10 and 100 megohms
Lowest Meas: 5 ohms
Accuracy: ± (0.15% of res. meas. + 0.05% full scale)
Drift: Negligible after 30 min. warmup
Dimensions, weight: 9¼" H x 8" W x 9" D; 8 lbs.
Price (f.o.b. factory): $170.00

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ELECTRO-MEASUREMENTS, INC.
7524 S.W. MACADAM AVENUE, PORTLAND 1, OREGON
CIRCLE 323 ON READER-SERVICE CARD FOR MORE INFORMATION
Books

Photoconductivity Conference

Available information on photoconductivity is thoroughly explored in this volume. It covers most phases of the subject in sufficient detail to serve as an introduction to the field as well as a monograph for advanced workers. It includes 30 papers by 45 authorities on solid state physics. These papers include basic theory, phenomenological theory, interpretation of photoconduction phenomena, and the most recent data on the properties of important photoconducting materials.

Currents, Fields and Particles

This book is designed to introduce the abstract concepts that stimulate a deeper understanding of natural laws. Dr. Bitter treats electricity and magnetism primarily as an introduction to atomic physics and field theory; and then brings in the basic ideas of wave mechanics. The illustrative examples and problems he has selected go beyond the usual range of electrical circuits and optical instruments. They include a variety of ideas in the general area of the physics of solids and gases and the structure of atoms.
RCA Magnetrons and Traveling-Wave Tubes


This publication includes information on operation theory of magnetrons and traveling-wave tubes, operating considerations and application, and techniques for measurement of important electrical parameters. Illustrations included in the booklet show the structural parts of both types of tubes, typical performance characteristics, test methods and representative circuit applications. It gives detailed applications of both magnetrons and traveling-wave tubes which should be of particular value to the designer. Data is given for four commercially available RCA Magnetrons and one traveling wave tube.

Transistor Circuit Handbook


A practical reference book covering over 200 basic circuits, practical applications and reference data on the uses of transistors, written in four parts. Part 1 is devoted to laboratory practice; part 2 covers basic circuits; part 3 discusses circuit applications; part 4 offers general reference material of value in circuit work.

This is an excellent self-study book for those heretofore unfamiliar with transistors and their applications and offers many practical circuits for home experiment. Included is a selected bibliographical listing of books and articles published to mid 1955. The state of the art is so rapid that many of the most important design articles are recent and not listed.

The Icosahedron and the Solution of Equations of the Fifth Degree


This well known monograph covers the solution of quintics in terms of the rotations of regular icosahedron around the axis of its symmetry. The book, which is a classic of mathematics, is valuable as a source book for those interested in higher algebra, geometry, or the mathematics of crystallography. An expert knowledge of high mathematics is not required to follow the presentation, since considerable explanatory material is included.

Frosting vs Fundamentals

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ELECTRICAL
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CIRCLE 326 ON READER-SERVICE CARD FOR MORE INFORMATION

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WE KNOW that equivalent diagrams for transistors are considerably more complicated than those of vacuum tubes, even in the frequency region where the influence of interelectrode capacitances and inertia of the carriers is not pronounced. In the design of amplification stages with transistors this leads to complicated and cumbersome calculations while the analogous problem with vacuum tubes is solved more easily and quickly owing to the simplicity of the equivalent diagram.

It is therefore of great practical interest to reduce the equivalent diagram of the output circuit of a transistor to that of the vacuum tube. Fig. 1 is a diagram of an ac generator with an emf $\mu U_1$ (or a current generator $SU_1$) and an internal resistance $R_1$. It is particularly convenient to reduce to this equivalent diagram a transistor connected in an arbitrary manner (grounded base, emitter, or collector). Such a reduction will permit extending the usual calculation methods for amplification stages with vacuum tubes to the case of amplification stages with arbitrarily connected transistors.

**Basic Parameters of Transistor Circuits**

In view of the complexity of the equivalent circuit of the transistor, its properties at various connections are best represented by the generalized diagram of Fig. 2, where the transistor is arbitrarily shown in the form of an active four-terminal network. From this diagram, in which $U_1$ and $Z_1$ denote the emf and internal impedance of the signal source, and $Z_H$ denotes the load impedance, it follows that:

$$U_1 = I_1 Z_{11} + I_2 Z_{12}; \quad U_1 = U_2 - I_2 Z_{21}$$

where $Z_{11}$, $Z_{12}$, $Z_{21}$, and $Z_{22}$ are the impedances characterizing the four-terminal network.

Determining from the diagram of Fig. 2 and from (1) the values of the voltage amplification factor $k_V$, which is the ratio of the output voltage $U_2$ to the input voltage $U_1$, the current amplification factor $k_L$, which is the ratio of the output current $I_2$ to the input current $I_1$, and the input and output impedances of the four-terminal network, $Z_{B1X}$ and $Z_{H1X}$, we obtain the known expressions:

$$k_V = \frac{U_2}{U_1} = \frac{Z_{21} Z_H}{Z_{11} (Z_{22} + Z_H) - Z_{12} Z_{21}}$$

(2)

$$k_L = \frac{I_2}{I_1} = \frac{Z_{21}}{Z_{22} + Z_H}$$

(3)

$$Z_{B1X} = \frac{U_1}{I_1} = \frac{Z_{11} - Z_{12} Z_{21}}{Z_{22} + Z_H}$$

(4)

$$Z_{H1X} = \frac{U_2}{I_2} = \frac{Z_{22} - Z_{12} Z_{21}}{Z_{11} + Z_H}$$

(5)

If the load impedance is zero, the current amplification factor $k_I$ reaches a maximum called the static current amplification factor and designated $a$; the value of $a$ is readily obtained by putting $Z_H = 0$ in (3):

$$a = \left. \frac{Z_{21}}{Z_{22}} \right\} = \frac{Z_{21}}{Z_{22}}$$

(6)

If the load impedance tends to infinity, the voltage amplification factor $k_V$ reaches a maximum; this maximum can be called the static voltage amplification factor and is denoted $\mu$, in analogy with the static amplification factor of the vacuum tube. The value of $\mu$ is obtained from (2) by putting $Z_H = \infty$:

$$\mu = \frac{Z_{21}}{Z_{11}}$$

(7)

Dividing the numerator and denominator of (2) by $Z_{11}$, and replacing $Z_{21}/Z_{11}$ by $\mu$ we obtain:

$$k_V = \mu \frac{Z_{21}}{Z_{22} + Z_{11}}$$

(8)

This expression does not differ from the known equation used to determine the amplification factor...
of a stage employing a vacuum tube with a static amplification factor $\mu$ and an internal impedance $Z_i$. It corresponds to the equivalent diagram of an amplification stage shown in Fig. 3, and consequently, this diagram applies to transistors as well as to vacuum tubes. In the case of the transistor $\mu$ is given by (7), and the equivalent internal impedance, taking the internal feedback in the transistor into account, is represented by the term in the parentheses of (8):

$$Z_i = Z_{22} - \frac{Z_{21}Z_{21}}{Z_{11}} = Z_{22} - \mu Z_{12}$$  \hspace{2cm} (9)

The equivalent diagram of Fig. 3 is valid for a transistor connected in any manner, and also for a vacuum tube. However $\mu$ and $Z_i$ have different values for each type of connection.

One of the generally accepted variants of the equivalent diagram of an amplifier stage employing a grounded base transistor is shown in Fig. 4, where the following symbols are used:

- $Z_e$ - emitter impedance
- $Z_c$ - collector impedance
- $Z_b$ - base impedance
- $I_e$ - current in emitter circuit
- $I_c$ - emf of equivalent generator in collector circuit

Comparison with Figs. 4 and 2 shows that for a grounded base circuit we have

$$Z_{11} = Z_e + Z_b; \quad Z_{12} = Z_b; \quad Z_{21} = Z_e + Z_b;$$
$$Z_{22} = Z_c + Z_b.$$  \hspace{2cm} (10)

Substituting the values of $Z_{11}$, $Z_{12}$, $Z_{21}$, and $Z_{22}$ in (6), (7), and (9) we obtain for a transistor in a grounded-base circuit the following values of $a_b$, $\mu_b$, and $Z_{1b}$:

$$a_b = -\frac{Z_e + Z_b}{Z_e + Z_b}; \quad \mu_b = \frac{Z_e + Z_b}{Z_e + Z_b};$$
$$Z_{1b} = Z_c + Z_b - \mu_b Z_b = Z_c - Z_b (\mu_b - 1)$$  \hspace{2cm} (11)

By analogy similar results can be obtained for common-emitter, grounded-emitter, or grounded-collector amplifier circuits.

The equivalent circuit of Fig. 3 makes possible calculation of the phase, frequency, and transfer characteristics for a transistor stage, using the same equations that are applicable to vacuum-tube circuits. The values of $Z_i$ from (11) are used as required in the equations.

The characteristics derived in this manner relate the output and input voltages in the same manner as for a vacuum-tube stage. The frequency and phase characteristics of multistage amplifiers at the load of each stage is the input impedance of the following stage. The input impedance is calculated from (4) in which the values of $Z_{11}$, $Z_{12}$, $Z_{21}$, and $Z_{22}$ are used for the particular transistor circuit and the load impedance $Z_L$. (Abstracted from an article by G. S. Zyskin, in Radiotehnika, No. 2, 1956.)
What the Russians are Writing

—Continued

Radiotekhnika, No 5, 1956

Propagation of UHF Waves at Large Distances Beyond the Horizon, V. N. Troitski, (18 pp, 13 figs).

Discussion of tropospheric propagation of UHF signals assuming this phenomenon to be due to both turbulent and laminar inhomogeneities in the dielectric constant. The mean value of the field intensity of the tropospheric wave is computed. Fading and distortion are discussed briefly and theoretical data are compared with experiments.

An appendix is devoted to the validity of the 2.3 law for tropospheric inhomogeneities and to a summary of experimental data obtained by various workers on the inhomogeneities of the dielectric constant. Many references to American articles.

Effect of Distance between Elements on the Resonant and Directivity Properties of a "Wave Channel" type of Antenna Array, D. M. Vysokovski, (5 pp, 3 figs).

The amplitudes and phases of the currents in such arrays are calculated for element separations ranging from 0.1 to 0.4 times the wavelength.

Noise Stability of the Correlation Method of Reception, A. E. Basharinov, (9 pp, 1 table).


Transients produced in Linear Networks by Irregular Voltages, Iu. I. Samoilenko, (7 pp, 2 figs).

The stationary parameters of the noise produced at the output of linear filters by stationary random input voltages have been discussed by many authors. This article employs statistical theory to determine the transients produced by such voltages.

Amplitude Modulation with Diodes, A. D. Artym, (9 pp, 9 figs).

A simple method, essentially a modification of the double limiter, makes possible modulation up to 95 per cent and detection at frequencies approximating the carrier frequency. The circuit diagram is quite simple. Its principal elements are two diodes (crystal or vacuum-tube), a limiting impedance, and two RC networks.

The non-linear distortion of the carrier envelope does not exceed 1 per cent when the hf voltage is limited by five times; greater limiting reduces the distortion substantially. All the odd harmonics are modulated simultaneously with the carrier. The harmonic distortion can be kept low by suitably limiting the hf voltage.

Modulation is possible at frequencies up to that of the carrier. With slight modification, the conventional amplitude detector can be used to demodulate such a signal.

Distortion in the hf carrier and nonlinearities in the internal resistance of the diodes do not distort the demodulated signal, but reduce the possible depth of modulation. This effect can be minimized by proper choice of modulator elements. The modulated voltage does not contain even harmonics if the carrier is free from them. This facilitates filtration of the carrier and sideband frequencies.


Essentially this is a method of transforming the standard Fourier series expansion

\[ f(x) = A_0 + \Sigma (A_k \cos kx + B_k \sin kx) \]

into a polynomial

\[ f(x) = a_0 + \Sigma a_n \cos^n x \text{ or } f(x) = b_0 + \Sigma b_n \sin^n x \]

The author shows that this transformation often simplifies the computations required in transient or non-linear analysis and discusses several advantages of this method.

Application of the Regeneration Method to the Design of Transistor Circuits, A. A. Rizkin, (9 pp, 2 figs, 3 tables).

To be abstracted in a future issue of ELECTRONIC DESIGN.


The design of vacuum-tube rectifier circuits with capacitive (RC) filters involves several simplifying assumptions, which must be modified if selenium rectifiers are used, principally because of the greater non-linearity of the forward current-voltage characteristic of the latter. The author employs piecewise linearization of this characteristic to improve the accuracy of the computations.

ACOUSTIC JOURNAL, Vol 2 No 2, Apr.–June 1956

None of the articles in this issue contain material that is of primary interest to electronic engineers. We translate, however, the table of contents for the benefit of our readers with interest in acoustics. The editor will be glad to supply further information about these articles.

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Another interesting sidelight concerns the control of ED's circulation. It is sent only to qualified electronic design engineers of U.S. manufacturing companies, industrial consultants and government agencies. All non-engineering titles have been dropped. Once again this is part of our continuing program to strengthen circulation—a program which has helped in large measure for ELECTRONIC DESIGN to deliver value to the reader.

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Transistor Reliability

**TABLE 1**
Electron Tube and Transistor Failure Rates of Well-Known Classes of Services

<table>
<thead>
<tr>
<th>Class of service</th>
<th>Electron tube type</th>
<th>Failure rate %/1000 hours</th>
<th>System interval unit-hours/failure</th>
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<tr>
<td>Computer service</td>
<td>6SN7</td>
<td>1 to 2</td>
<td>0.5 to 1 x 10^5</td>
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<tr>
<td></td>
<td>6J6</td>
<td></td>
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<tr>
<td>Computer service</td>
<td>IBM-special</td>
<td>0.14 to 0.7</td>
<td>1.4 to 0.7 x 10^5</td>
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<td>Telephone carrier</td>
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<td>0.2 to 0.1</td>
<td>0.05 to 1.0 x 10^6</td>
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<td>Submarine cable</td>
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<td>0.006</td>
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<tr>
<td><strong>Transistor type</strong></td>
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</tr>
<tr>
<td>Rural carrier</td>
<td>130 junction</td>
<td>0.6</td>
<td>1.5 x 10^5</td>
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<tr>
<td>Card translator</td>
<td></td>
<td>0.1</td>
<td>10^6</td>
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<td>Computer (1)</td>
<td>700 Pt. Ct.</td>
<td>0.1</td>
<td>10^6</td>
</tr>
<tr>
<td>Computer (2)</td>
<td>615 junction</td>
<td>0.1</td>
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<tr>
<td>Hearing aid</td>
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<td>0.2 to 0.5</td>
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**TABLE 2**
Comparison of Transistor and Electron Tube Removal Rates for Same Equipment Failure Interval

<table>
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<tr>
<th>Removal rates %/1000 hours</th>
<th>Unit hours per failure</th>
<th>No. of tubes or transistors</th>
<th>Equipment failure interval</th>
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<td>47</td>
<td>2,130</td>
<td>6 12AT7</td>
<td>354</td>
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<td>15</td>
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<td>3</td>
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<td>9</td>
<td>11,111</td>
<td>10 transistors</td>
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</tr>
</tbody>
</table>
These guarantee superior quality in all TRIPLETT meters:
- High torque to weight ratio for extra rugged movement. Specially developed bearings withstand severe vibration and reduce friction to a minimum.
- Bearings are microscopically graded not only for depth and radius, but also for polish. Only best quality jewels are used.
- Unique hardening method assures uniformly hard pivots.
- High flux scientifically aged alnico magnets for greatest permeability. Micrometrically balanced all metal frame construction protects bearings against vibration from any direction.

Simplicity of frame construction assures easy, accurate alignment in servicing.
Dials are all metal—no paper dials are ever used—will not become abrasive, warp, crack or discolor under normal conditions. (Printing presses in Triplet's own plant allow fast, inexpensive service on special dial requirements.)
Extra strong ribbed pointers precisely balanced with triple "slide and lock" adjusting weights.
Insulations provide extra allowance for breakdown voltages.
All metal parts processed, all molded parts pre-cured to eliminate distortions from stresses and strains.

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Triplet design and development facilities are available for your special requirements for meters and test equipment.

CIRCLE 331 ON READER-SERVICE CARD FOR MORE INFORMATION

Abstracts

Report Briefs

Magnetic Properties
Measurements of the susceptibility contribution to permeability made on Elgiloy, Iconel and Colmonoy alloys indicated that the first two have mainly paramagnetic contributions to the permeability. Colmonoy has equal contributions from both paramagnetism and ferromagnetic impurities. Extrapolation of the susceptibility data to low temperatures showing both Elgiloy and Iconel ferromagnetic below room temperature. An experimental arrangement for measuring low permeabilities in fields of about 100 gauss is described. PB 121169 Magnetic Properties of Low Permeability Alloys, T. R. McGuire and F. S. Smart, NOL, OTS, US Dept. of Commerce, Washington 25, D. C., Feb. 1954, 16 pp, $.50.

High Electron Mobility Semiconductors
This investigation was concerned with the preparation and evaluation of semiconducting materials of unusually high electron mobility. Indium antimonide was prepared in a state of high purity and its basic electrical properties were analyzed. Studies were made of the zone-refining process for InSb and the effect of a specified number of passes on both p- and n-type impurities. Specimens of indium antimonide were prepared with impurity contents as low as $10^{14}$ atoms/cm$^3$ and with electron mobilities of 75,000 cm$^2$/v-sec at room temperature, and 500,000 at 80 K. PB 121288 Research and Development Work On Semiconducting Materials of Unusually High Electron Mobility, Beer, Harman Willardson and Goering, Battelle Memorial Institute, OTS, US Dept. of Commerce, Washington 25, D. C., July 1955, 50 pp, $.50.

U. S.-Owned Inventions Available
Described in this compilation are 1,915 Government-owned inventions applicable to the electrical and electronic apparatus industry, covered by patents active as of Dec. 31, 1953. For each invention, the title of the invention, the U.S. patent number, and an abstract of the patent are given. PB 111488 Patent Abstract Series, No. 5, Electrical and Electronic Apparatus, OTS, US Dept. of Commerce, Washington 25, D. C., 160 pp, $4.00.
Statistical Design of Lab Experiments


Experiments With Thin Ferrite Films

Successful production of thin ferromagnetic films by sputtering is described. The report also reviews theories pertaining to the properties of thin ferromagnetic films and existing experimental data concerning the deviation of magnetization and other parameters of thin films from that of the bulk material. PB 121177 The Experimental Production Of Thin Ferrite Films And A Survey Of The Magnetic Properties Of Thin Films, R. J. Miller, Naval Research Lab., OTS, US Dept. of Commerce, Washington 25, D.C., Mar. 1955, 40 pp. $1.25.

Packaging and Materials Handling

Packaging and materials handling specialists from both the Armed Services and industry participated in a three-day exchange of information. This symposium was sponsored by the Department of the Navy with the cooperation of the Army, Air Force and Department of Commerce.

Subjects discussed were: materials handling in production; transportation and warehousing; packaging methods selection; transportation costs reduction; packaging requirements; automatic packaging; and automation in handling. PB 121350 First Joint Military-Industry Packaging and Materials Handling Symposium, OTS, US Dept. of Commerce, Washington 25, D.C., pp 695, $6.00.

Light Weight Ceramics Patents

World-wide patents on light weight ceramics, granted by some 14 different foreign countries, are catalogued and described briefly in this compilation. Patents on Light Weight Ceramics, A. J. Metzger, Bulletin 111, Virginia Polytechnic Institute, Blacksburg, Virginia, July 1956, 69 pp, $.25.
what makes tape wound cores reliable?

Reliability demands physical protection. Magnetic alloys which provide square hysteresis loop characteristics are strain sensitive. Distortion caused by coil winding will disturb precise magnetic characteristics, alter performance. So Magnetics, Inc. has devised a rigid, extra-strong aluminum core box to protect the magnetic core within from winding stresses, thus eliminating distortion.

Reliability demands electrical stability through the years. Suppose guided missiles failed to function in a future emergency because the magnetic properties of tape wound cores had changed. Cores must operate just as effectively years from now as they do today, whether or not they have been in use. Vibration, shock, and temperature changes can endanger such performance. That's why Magnetics, Inc. cushions tape windings with a special inert material in the extra-strong aluminum core box. And that's why it is especially important that our tape wound cores enclosed in aluminum boxes will withstand temperatures up to 150°F.

Reliability demands exacting standards on the part of the manufacturer. Judge a product by the company that makes it. Take a company that has pioneered a core box so advanced that it even permits vacuum impregnation. Take a company whose attention to design detail permits the offer of the only Performance-Guarantee in the industry. That's a real definition of reliability. Why not ask us how it will work for you? Magnetics, Inc., Dept. 32-ED, Butler, Pennsylvania.

CIRCLE 333 ON READER-SERVICE CARD FOR MORE INFORMATION

Standards and Specs
Sherman H. Hubelbank

This department surveys new issues, revisions, and amendments, covering military and industry standards and specifications. Our sources of information include the Armed Services Electro-Standards Agency (ASESA), the cumulative indexes to Military Specifications, Vols. II, IV, American Standards Association (ASA) and other standards societies.

Impact Testing

Nine papers presented at the Symposium on Impact Testing that was held at the ASTM meeting in June, 1955 and five papers which are appropriate to the theme of the Symposium are included in this recently published 176 page publication. The papers encompass impact in parts, components, and complete structures, and they are not confined to notched bar testing. Available from the American Society for Testing Materials, 1916 Race Street, Philadelphia, Pa., for $3.50 each.

Specs on Specs
MIL-S-25063 (USAF), INSTRUCTIONS AND REQUIREMENTS FOR PREPARATION OF SPECIFICATIONS AND ENGINEERING DATA FOR AIRBORNE ELECTRICAL EQUIPMENT ON SYSTEMS, 15 JUNE 1956.

Preliminary design specs, performance specs, and detail design specs pertinent to electrical equipment and their application for piloted aircraft and guided missile weapons systems are covered in this spec.

RETMA Request for Reaffirmation
In accordance with the RETMA policy of reviewing existing RETMA Standards, REC-119, Vibrator Power Transformers, has been submitted for reaffirmation. Although the official comment period may have expired, you are encouraged to contact the RETMA Engineering Department, 11 West 42nd St., New York 36, N.Y. if you are vitally interested.

Resistors
MIL-R-14293 (Sig C), RESISTORS, FIXED, HIGH MEGOHM (HERMETICALLY SEALED), 19 APRIL 1956

Fixed resistors, ranging in value from 10⁸ to 10¹⁰ ohms, with a tolerance of 10% at 25°C are covered in this spec. These resistors are hermetically sealed and are 1-15/16 inches long and 15/16 inch in diameter.
RETMA Standards

RETMA RS-163, RF Radiation Label, August 1956
Dimensions and copy for the RF Radiation Label which is to be affixed to receivers in accordance with Part 15 of the F.C.C. rules are specified. Available from RETMA for 25 cents per copy.

RETMA RS-162, Test Standard For Ceramic Based Printed Circuits, August 1956
The standard test procedures to be used for the ceramic based printed circuits, as defined in RETMA Standard RS-161, are described by this standard. The standard specifically covers the type A unit, which is a combination in which the components are separably and individually accessible at the terminations for individual measurements. It may also be used where applicable for the type B unit, which is a combination in which some of the components are not separably and individually accessible at the termination for individual measurement, and which, in whole or part, must be considered as circuits. Copies of the standard may be obtained from RETMA, 11 West 42nd St, New York 36, N.Y. for 30 cents each.

RETMA RS-161, Unit Standards For Ceramic Based Printed Circuits, August 1956
Physical and electrical specs of ceramic based printed circuits which have been standardized are established by this standard. The physical specs include maximum overall size, lead length and size, lead number and sequence, RETMA identification number, and manufacturer's number. The electrical specs include circuit schematic, component values and tolerance, component rating, the connections to lead wires and terminations, and additional information required for test. Copies of this standard are available from RETMA, 11 West 42nd St, New York 36, N.Y. for 70 cents each.

Power Supply

MIL-P-157369 (SHIPS), Power Supplies, Metallic Rectifier, Naval Shipboard, 9 July 1956
General requirements for class HI-shockproof metallic rectifier type power supplies are established by this spec. Two basic classifications of power supplies have been established: Class B, regulated and Class NR, unregulated.

Plastics

L-P-349a, Plastic Compounds, Molding, Celulose Acetate Butyrate; and Molded or Extruded Parts, 30 July 1956
This revision supersedes specs L-P-349, dated 9 May 1950, MIL-P-3414, dated 15 February 1951, and MIL-P-16414 (BuOrd) dated 29 June 1951, in their entirety, and that portion of MIL-P-10407 (Ord) dated 31 July 1950 concerned with the evaluation of the cellulose acetate butyrate molding compound.

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PRESERVES

Three NEW Miniaturized
HIGH VOLTAGE, HIGH VACUUM
External Anode Thermionic Rectifiers
TYPES: 552, 554, 589

These new United tubes will provide immediate answers to many complex design problems of modern electronic instrumentation.

Among the advanced design features, the flanged construction of the external Kovar anode provides for a rugged glass-metal seal which minimizes high thermic rise and electron deterioration of the glass seal region.

The use of specialized techniques in cathode processing in types 554 and 589, and the exclusive UNITED bonded thorium tungsten core filament in type 552, contribute to high emitter efficiency.

Far-sighted practical UNITED designing establishes new milestones by building into these tubes qualities which meet supremely well not one but all five vital requirements: good service life expectancy, ruggedness, small size, light weight, ease of installation. Also—moderate cost. Orders filled rapidly.
BOMAC produces a complete line of windows

Bomac manufactures a complete line of mica, glass, or ceramic pressurizing windows for all waveguide sizes—and offers experience and facilities unmatched in the industry for developing special windows to meet individual requirements. Bomac pressurizing windows are pressure and vacuum-tight—shock and vibration-proof—built to withstand pressures of 45 Psi, or more, and temperature ranges of \(-55^\circ\) C to \(100^\circ\) C.

Write today for complete specifications. Bomac Laboratories, Inc.
BEVERLY, MASSACHUSETTS
NOW E-I OFFERS
THE COMPLETE GRAPHIC DATA
HANDLING LINE...

3 NEW
x-y recorders

plus a COMPLETE line of ACCESSORIES!

Every operating convenience possible has been built into these new E-I X-Y Recorders to provide maximum simplicity of control and ease of maintenance.

In addition, numerous performance features such as freedom from jitter, isolated inputs, automatic pen lift, vacuum hold-down, high-performance servos, and sensitivities from 0.5 mv per inch to 50 volts per inch provide performance excellence found in no other recorders.

Models are available for general-purpose recording, data handling, and analog computer recording and function generations. Ask your E-I representative for the complete story.

All models available for standard rack mounting. 1x11" instruments may be used in standard cabinet or rack mounted — without changing metalwork!
Again RCA meets the needs of TV, AM, FM receiver designers and manufacturers...with the new and up-to-date Preferred Tube Types List tailored to the industry's requirements for a minimum number of tube types having the greatest over-all usefulness.

First introduced by RCA in 1940, the Preferred Tube Types Program aimed at concentrating production on the most useful radio receiver types to improve tube quality by longer, more efficient production runs—and to increase tube availability by decreasing stocking requirements. Was it effective? Yes! By the end of 1940, five million receivers had been designed and built around 36 RCA Preferred Tube Types—and 20 receiver manufacturers publicly endorsed the program!

Today—after two years of careful engineering analysis of radio and TV requirements—RCA offers a comprehensive selection of 61 Preferred Tube Types capable of handling virtually every TV, AM, and FM receiver circuit function now covered by hundreds of types available to the industry. The benefits to you: (1) Lower tube costs, (2) Uniform tube quality, (3) Standardization on fewer types of circuit components, (4) Better tube availability and faster delivery to support continuous production schedules, (5) Simplification of stocking and warehousing problems, (6) Increased customer satisfaction through ready tube availability from RCA Tube Distributors.

So whether you are interested in black-and-white or color TV receivers, portable or car radios, AM or FM sets or phono amplifiers, it will pay you to design around RCA Preferred Tube Types. For technical data on any Preferred Tube Type, refer to your RCA Tube Manual or RCA Receiving Tube Handbook. For further details on the RCA Preferred Tube Types Program, call your RCA Field Representative.

RADIO CORPORATION OF AMERICA

Tube Division

Harrison, N. J.

NEW RCA BROCHURE ON PREFERRED TUBE TYPES

New brochure outlines the new RCA Preferred Tube Types Program. For your copy, write RCA, Commercial Engineering, Section L-18-Q, Harrison, N. J. Or ask your RCA Field Man.