Standard-type modular wafer circuits are now commercially available.
FEATURING TEMPERATURE COEFFICIENTS AS LOW AS 10 PPM PER MILLION PER °C BETWEEN -55° AND +85°

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HIGH FREQUENCY – HIGH "Q"
TOROIDAL INDUCTORS

HIGH FREQUENCY TOROIDAL INDUCTORS featuring very high Q, temperature stabilization and low pickup utilizing the latest materials and techniques.

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<td>TI-20</td>
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<td>TI-21</td>
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<td>TI-23</td>
<td>1/2</td>
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If you have a design responsibility not indicated by your title, add a description of those responsibilities. Job changes require requalification.

Hayden Publishing Company, Inc.
19 East 62nd Street
New York 21, New York

ELECTRONIC DESIGN is the fastest growing of all business publications. Advertising increased 667 pages during first eleven months of 1955 over the same period of 1954.

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Electronic Design • November 1955
The Potter Digital Magnetic Head eliminates "digit drop-outs" due to oxide collection. Phosphor bronze head mount provides close tolerances insuring complete interchangeability of tape from one machine to another.

Model 002 Magnetic Tape Handler treats the tape gently while providing a start/stop time of 5-milliseconds. Fully reversible without stopping.

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Whether your data processing requirements call for perforated or magnetic tape handling, Potter offers a complete line of high-speed equipment to meet your needs... for either intermittent or continuous playback with speeds of up to 60 inches per second and start/stop times of less than 5-milliseconds!

Serve-controlled tape drives permit fast starts and stops without tearing or spilling tapes. At 30 inches/second speed, less than ½" of tape is consumed in a start/stop cycle!

For complete specifications on Perforated Tape Readers, Magnetic Tape Handlers and Digital Magnetic Recording and Playback Heads, write TODAY:

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Size has nothing to do with accomplishment

Inside these fully encapsulated miniature precision wire wound resistors, Daven furnishes the solution to problems presented by space limitations. A new winding technique permits the use of extremely fine sizes of resistance wire to obtain two or three times the resistance value previously supplied on a miniature bobbin. This new development more firmly establishes Daven's leadership in the field of miniature and standard size precision wire wound resistors.

**Types and Specifications**

<table>
<thead>
<tr>
<th>Type</th>
<th>Dia.</th>
<th>Length</th>
<th>Max. Res.</th>
<th>Wattage Rating</th>
<th>Terminals</th>
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<td>5/16</td>
<td>400K</td>
<td>.1</td>
<td>One End #22 Gauge</td>
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<tr>
<td>1283</td>
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<td>5/16</td>
<td>400K</td>
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<td>Axial #22 Gauge</td>
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<tr>
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<td>3/8</td>
<td>100K</td>
<td>.1</td>
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<td>1284</td>
<td>1/4</td>
<td>27/64</td>
<td>.5 Meg.</td>
<td>.25</td>
<td>One end #20 Gauge</td>
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<tr>
<td>1192</td>
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<td>1</td>
<td>1.0 Meg.</td>
<td>.75</td>
<td>Axial #22 Gauge</td>
</tr>
</tbody>
</table>

- Fully encapsulated.
- Meet and exceed all humidity, salt water immersion and cycling tests as specified in MIL-R-93A, Amendment 3.
- Operate at 125°C continuous power without de-rating.
- Can be obtained in tolerances as close as ±0.05%.
- Standard temperature coefficient is ±20 PPM/°C. Special coefficients can be supplied on request.

For maximum resistance in minimum space:

Daven’s new winding technique cuts giants down to size

![Image of Daven's new winding technique](image)

**THE DAVEN CO.**

524 West Mt. Pleasant Ave.
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Write for complete resistor catalog.

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**Editorial**

**Maturity**

Sooner or later, every industry reaches the point where statesmanlike actions and decisions must be taken to insure future growth. The quantity and quality of such decisions and actions is a measure of the maturity of the industry. In this light, just how mature are the electronic industries? Well, let’s see...

Take the matter of tubes. Both tube manufacturers and users decry the bewildering and excessive variety of tube types on the market. The circuit designer has to live with wide tolerances and cases where tubes with the same RETMA type number from different sources vary all over the lot.

Take the matter of standardizing components for automatic assembly methods—printed circuits and the like. Work has been going on in this field for some time—but we are far from reaching effective compromises.

These are only two of the many matters that require mature deliberation and action by the electronic industries. It can be argued that the industry is young and inexperienced. The problems are being considered and will be resolved “in due time”.

The trouble is that “due time” is not soon enough. The sheer size and rapid growth of the electronic industries makes mature decisions mandatory and they must be reached now.

We must exert more effort in this direction. If committees studying some of these problems meet once every two months—let’s have them meet once a month. If we need more people to serve on these committees, let’s make the need known, explain the problem, and get the needed people. If it takes money to tackle these problems, let’s make an appeal to industry through RETMA, IRE, AIEE, or independent groups and get the money. The dollars are there and the need is urgent.

Without concerted, intelligent, and immediate efforts the present rapid expansion will not produce healthy electronic industries, but chaos.

< CIRCLE 3 ON READER-SERVICE CARD>
We May Fall Behind in Nuclear Power ... The United States may fall behind England and West Germany in nuclear power development because those nations are so much closer to the point at which atomic power becomes economic. W. Kenneth Davis, Director, Div. of Reactor Development, Atomic Energy Commission, raised this possibility in a recent speech. England has started importing coal for the first time. Under greater pressure to develop atomic power, power-hungry nations may progress technologically faster than the United States.

Russian Scientist Visits U. S. ... The first Russian physical scientist to visit the United States since World War II attended the recent World Symposium on Applied Solar Energy in Phoenix, Ariz. He is Professor V. A. Baum, head of the Heliotechnical Laboratory, G. M. Krzhizhanovsky Power Institute, Moscow, U. S. S. R. It is hoped that the current lowering of the Iron Curtain will permit American engineers to visit Russia and learn what Russian scientists are doing in the applied sciences.

Increasing Tube Reliability ... By giving up a little in performance, electronic design engineers can greatly increase tube reliability. This point was made by M. A. Acheson, Sylvania Electric Products Co., New York, N. Y., in a paper presented at the Fall Radio Show. Mr. Acheson also stated that the gain in tube reliability through the use of series-string heater arrangement more than offsets other factors tending towards lower reliability introduced by this system of tube arrangement.

The series-string tubes are more reliable because their heaters are heavier, Mr. Acheson stated. He also urged designers to give more attention to conservatively rated tubes rather than the latest "hot" tubes to achieve greater reliability.

Automation Evolution Not "Revolution" ... A leading industrialist has objected to the frequent labeling of the trend towards automatic manufacturing as "The Second Industrial Revolution". "Evolution", is the proper term according to Henry F. Dever, President, Brown Instruments Div., Minneapolis-Honeywell Regulator Co., Philadelphia, Pa. In the same speech, given recently in Los Angeles, Mr. Dever objected to some of the science-fiction type of discussion of automatic developments. He considered this type of publicity a disservice to an important technical trend, which is giving the public a false and misleading picture.

Committee to Study Frequency Allocation ... The Radio-Electronics-Television Manufacturers Association has announced the appointment of a special committee to make an immediate examination of the TV frequency allocation problems before the Federal Communications Commission and to submit its recommendations to the FCC. The committee will be called the Frequency Allocation Study Committee and will be primarily concerned with the place of u-h-f in the TV system.

Electronic Aids to Carrier Operations

The world's largest ship, the U. S. S. Forrestal has been equipped with the latest electronic devices to insure instant communications with and safe return of its air fleet. A TACAN antenna is mounted at the highest point on the carrier (upper circle) and a newly developed u-h-f radio operates through an antenna on the bow (forward circle). This radio has one and one-half times the range of the gear it replaces. The equipment was developed by Federal Telecommunications Laboratories, Nutley, N. J.
microwave tubes and components

GAS SWITCHING TUBES — Bomac produces the most extensive line of TR, ATR, Pre-TR, attenuator tubes, duplexers and shutter tubes available, for all frequency bands and power levels.

HYDROGEN THYRATRONS — Bomac offers a complete line for use as switch tubes in line type modulators for pulsing magnetrons in radar equipment. Also used for precise triggering at high power levels.

PRESSURIZING WINDOWS — Bomac has windows available for all wave guide sizes, broad band characteristics with low insertion loss, temperature range —55°C to 100°C and 30 lb./sq. in. pressure differential either direction.

SILICON DIODES — Bomac diodes are manufactured to high standards to assure electrical uniformity, high burnout and humidity resistance.

MAGNETRONS — Bomac has available tunable and fixed tuned magnetrons with high peak RF powers for pulsed service in the higher frequency bands.

REFLEX KLYSTROMS — Bomac now offers X band klystroms having improved local oscillator performance and dependability.

Electronic Pilot Holds 'Copters Still

... Of particular value in rescue operations, an electronic control has been developed that can hold helicopters in hovering position or fly them forwards or backwards like an autopilot. The device can be used to fly the plane by remote control without a pilot.

A product of Aeronautical Equipment Div., Sperry Gyroscope Co., Great Neck, N. Y., the device should be available in 1956. The transistorized equipment weighs 60 lb. and occupies less than two cubic feet. Should the helicopter engine fail, the system remains operative during the glide down on a small fraction of the reserve electrical power from the craft's battery.

TV Protects Giant Press

... A closed-circuit TV camera helps protect a giant 35,000-ton forging press from the effects of off-center loads. The camera is fixed on a hydraulic mechanism that indicates eccentricity of loading. This mechanism is located at the foundation of the press. The monitor is located at the operator's station. The equipment is used at the Cleveland, Ohio, plant of the Aluminum Co. of America.

Transistor Transponder

... A miniature transponder has been developed to be worn on a pilot's uniform. If his plane crashes or he is forced to parachute, the transponder will guide radar-equipped rescue parties to him. The device was developed in Great Britain for use by NATO naval forces.

Cars Soundproofed Electronically

... Automobiles and planes that have been soundproofed electronically are predicted for the near future. Such use of electronic sound absorbers, which consist of a microphone, an amplifier, and a loudspeaker, was predicted by Mones E. Hawley, Radio Corp. of America, at the National Noise Abatement Symposium. Mr. Hawley also revealed that RCA has undertaken two contracts to apply such equipment to military problems.
Interlock plugs insulated with ZYTEL® easily crimped for solderless connections

Interlock Type B plugs are now available with jackets of Du Pont "Zytel" nylon resin to prevent shocks and shorts. This insulation of "Zytel" protects the complete plug except contact points - allows plugging in or disconnecting with greater safety.

"Zytel" has excellent crimping properties - the terminal can be crimped tight enough for a good connection without any danger of the insulation cracking and exposing the live portion of the plug.

Use the coupon below for complete property information on this tough, durable insulating material - Du Pont "Zytel" nylon resin.

This interlock Type B plug insulated with Du Pont "Zytel" nylon resin can be easily crimped and has excellent dielectric properties. Plug manufactured by Harvey Hubbel, Inc., Bridgeport, Connecticut.

ALATHON® has high dielectric strength, is strong and lightweight

The picture tube in the new RCA Victor color-televison receiver operates at 25,000 volts. To provide insulation for this tube, RCA Victor engineers needed a material that could be readily and inexpensively molded into the complex shape of a kinescope shield... yet had high dielectric strength. Du Pont "Alathon" polyethylene resin proved to be an ideal material for the shield on all counts. In addition to providing the needed insulation, the shield of "Alathon" gives mechanical protection to the tube when it is shipped or handled.

"Alathon" not only has excellent insulation properties but is strong, lightweight and flexible. It is chemically resistant, as well as odorless, tasteless and non-toxic. Because of these properties, and the ease with which parts can be molded, extruded or fabricated, "Alathon" has helped engineers solve many design and operating problems.

Get complete property and application data on "Alathon," and on the other Du Pont engineering materials. Each has unique properties suited to a wide range of cost-saving applications. Clip and mail the coupon below.

Laminations of TEFILON®

Typical uses of glass-cloth laminations of "Teflon" tetrafluoroethylene resin include:

1. Conductor insulation, electrode, and phase insulation and slot wedges (motors and generators).
2. Conductors and ground insulation, coil separators and layer insulation (transformers).
3. Hookup wire, power cables, ignition wire.
4. Printed circuit bases.
5. Structural parts.

The laminations combine the dielectric properties, chemical inertness and heat resistance of "Teflon" with the tensile strength, resistance to cut-through, and resistance to creep of woven glass fiber.

An informative free bulletin describing the preparation and uses of laminations and impregnations of glass cloth employing "Teflon" is now available. Write for a copy of Bulletin X-64.

NAME
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POSITION
STREET
CITY
STATE
TYPE OF BUSINESS
**Cable Winder**

Custom cable winding costs can be cut as a result of the development of this "Planetary Cabler". Made by Douglas Roesch, Inc., Los Angeles, Calif., it handles thin wire, co-ax cable, and heavy power conductors at the same time.

**Human Brains Better Than Computers**

To build a computer with the overall capabilities of the human brain would involve a machine of such tremendous complexity that it hardly seems practical today, Dr. D. E. Wooldridge, president of Ramo-Wooldridge Corp., Los Angeles, Calif., declared. "After all", he admitted, "in electronic terms, the human brain is the equivalent of a billion trillion electron tubes. Compared with that, as someone has observed, our best computer is still a low-grade moron."

**Coast-to-Coast Electronic Train Reservations**

By contracting to rent its electronic reservation-making system to the Santa Fe Railroad, the Tele-register Corp. announces that a coast-to-coast reservations network can now be set up. The new system can be linked to similar systems to be rented to the New York Central and New Haven Railroads, respectively. A customer in San Francisco, for example, could make a reservation within seconds on trains running between Boston and New York. The Central and the Santa Fe meet in Chicago.

If this all-electronic system is rented to all the major railroads, it would be possible to make reservations on any American train from any sizable town in the United States, or even Canada. However, the equipment will not be able to choose between competing lines; the customer must do that.

The Stamford, Connecticut, firm has also rented its reservation equipment to many air lines. The possibility of linking overseas ticket offices with the American reservation memorizing devices is of interest. Renting a transoceanic cable to link the system is prohibitively expensive. We suggest as a possible solution the installation of compact relay transmitters in transoceanic aircraft. If enough air lines...
cooperate in the venture, then there would always be a plane every few hundred miles over the Atlantic relaying the pulse signals. Such flying relay stations have already been used to relay a TV program from Florida to Cuba. At present, it is not likely that “over-the-horizon” microwave transmission will soon be developed to the point where it can bridge the Atlantic at its narrowest point—1900 miles.

**Electronically Controlled Camera Compiles Books**

The laborious task of compiling directories has been put on a semi-automatic basis by means of electronic controls. A camera rapidly photographs punched cards bearing the desired information on a long spool of film. The listings are therefore in the columnar form common in most business directories and telephone books.

The device is known as the Listomatic Camera Model 1, and it was developed by Eastman Kodak Co., Rochester, N.Y. The information on the cards should be typed with a justifying typewriter for even lines in the space where holes are not punched. By typing on punched cards, the information can be arranged in alphabetical or other groupings by machine. The next operation that could be done automatically is to develop a typewriter that prepares the punched cards according to spoken or handwritten instructions.

The device photographs 230 cards per minute. The unit is loaded with 400' reels of film. After all the cards for a particular directory have been photographed, and the reels developed, the reels are cut by hand to the correct column length and mounted on forms for photolithography. This device represents an advance for the printing industry through electronic means. A number of other electronic aids to the printing industry, or even electronic printing itself, are now under investigation.
**Brighter Color-TV Picture Tube...** Known as the "Post acceleration" tube, an experimental color-TV tube has been developed that features greatly increased brightness. The tube receives its name from the fact that the electron beams are accelerated after passing a grill located close to the phosphor screen. As a result of this feature, much lower deflection voltages and simpler convergence controls are required. The 22" tube, which is naturally rectangular, will not be available for use in the 1956 lines of receivers. Further development on this "Lawrence-type" tube is in progress.

The tube gives a brighter image because an electronic shadow mask is employed instead of a perforated metal disc. A new type of shadow mask permits 90% of the electrons to reach the phosphor screen compared to about 15% for metal shadow masks. It is under development by Tube Dept., General Electric Co., Schenectady 5, N. Y.

The shadow mask consists of an array of parallel wires. Three electron guns are employed, but they are mounted in the same plane, as illustrated, instead of in a triangular arrangement as in present color TV tubes. In normal operation the final gun electrode potential and one potential are held at about 6500v; the grill is at a potential approximately 200v lower than the gun, and the phosphor screen is maintained at approximately 2500v.

The three electron beams corresponding to the three colors enter the grill with a slight angular separation of less than 1°. Two effects occur. First, the central ray of a particular beam no longer travels in a straight line but assumes a parabolic path. Secondly, a focusing action occurs in which the diameter of the beams reduced from about 35 mils down to 5 mils.

<table>
<thead>
<tr>
<th>TYPE</th>
<th>DESCRIPTION</th>
<th>Vibration Output mVac* (max.)</th>
<th><strong>HEATER</strong></th>
<th><strong>PLATE</strong></th>
<th><strong>GRID VOLTS OR RX</strong></th>
<th><strong>SCREEN VOLTS</strong></th>
<th><strong>AMP. FACTOR</strong></th>
<th><strong>MUT. COND.</strong></th>
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*At 40 cycles, 15 g. Note: All dual section tube ratings (except heater) are for each section.

The electron beams are reduced in diameter by the grill in the "post-acceleration" tube.
The three electron guns are mounted in the horizontal plane.

because the beam width is so small in comparison with the vertical phosphor stripe width a guard band is formed on either side of the beams landing area. This allows the beam to move about on a particular stripe without striking an adjacent stripe, and therefore, affecting color purity. This wide guard band allows considerably larger mechanical tolerances in manufacture and electrical tolerances in operation.

The tube has one disadvantage. Because secondary electrons hit the screen in a random manner, there is a loss of contrast compared to present tubes. This loss is most apparent in a completely dark room, but is negligible in the more common partly illuminated room because of the greater brightness of the tube and the high attenuation (50%) in the safety glass face. This glass is also spectrally sensitive.

The earth's magnetic field changes the electron trajectories, and hence, the angle of entry of the beam into the grill region. This effect will cause the beam to strike a different portion of the filed in the absence of an external magnetic field. In the vertical direction color purity can easily be maintained due to the use of vertical continuous stripes of the same color. Therefore, any field which would cause a shift in this direction can be neglected. An axial field would cause rotation in the center of the picture coinciding with the center of rotation. The major cause of color impurity is then due to the vertical component of any stray fields because this will give a horizontal shift. This component includes the earth's magnetic field. This tube has been shielded without the use of expensive shields.

The present tube is a "sandwich" type containing the grill mounted on a frame and an internal flat phosphor plate. The next development will be a tube with the phosphor on the inside and on the envelope face. The designers of this tube believe that it could replace the present color-TV tube without requiring extensive changes in a receiver's circuitry.
These are the last twelve words of the invocation given at the launching of "Seawolf.
As the second nuclear-powered submarine to be completed within the past 20 months... it dramatically re-affirms our entrance into a brand new era!

In a smaller way... yet significantly... it also re-affirms Norden-Ketay's leadership in the field of electronics and instrumentation. For based upon their experience, research facilities, and performance in volume production... The Precision Components Division of Norden-Ketay was chosen by General Dynamics Corporation, builder of "Seawolf," to supply the SYNCHROS which translate electrical impulses into positioning data... another example of how Norden-Ketay serves most of the leaders in automatic controls... where reliability counts most!

Hidden Recorder
Up to eight hours of conversation can be secretly recorded on this tape recorder. It has been built into a conventional briefcase by Amplifier Corp. of America, 398 Broadway, New York 13, N. Y. The complete unit weighs about 12 lb. The on-off switch is cleverly concealed in the clasp.

Charge Accounts for Toll Roads... By means of new electronic devices, motorists on the nation's toll roads can charge toll fees instead of paying on the spot. In addition, new electronic equipment has been developed to feed information on toll-booth traffic to the control point from which the toll highway is controlled.

All of this equipment has been developed by Taller & Cooper Co., Brooklyn, N. Y. The charge-account gear has already been installed on the N. Y. State Thruway, the nation's longest toll road. This tollbooth equipment is tied into a giant computer for rapid processing of all this information.

The same firm has also developed an automatic toll collector that enables a motorist to direct questions to a supervisor located some distance away. If someone attempts to drive past this device without paying his toll, an alarm bell rings and red lights flash on. If the motorist then continues on his way and does not back up and pay his toll, an automatic camera photographs his license plate and simultaneously records on the film, time, date, and place. All of this automatic toll equipment includes features to safeguard the funds they collect.

The development of the above equipment is part of the nation-wide trend toward replacing all repetitive jobs with electronic devices and releasing workers for jobs that require judgment, such as repairing these devices.
Color TV Moves Slowly in UK . . .

After observing the failure of color TV to develop in this country as quickly as prophesized, the British are moving very slowly toward color TV according to the September Wireless World (p. 464), the official bodies governing broadcasting in Great Britain are not likely to approve any color TV system in the near future. Experimental compatible color transmissions are now in progress in the United Kingdom.

Audio Engineering Officers . . . Col. Richard H. Ranger, president of Rangertone, Newark, N. J., has been elected president of the Audio Engineering Society. W. O. Stanton, Pickering & Co., Oceanside, N. Y., was elected executive vice-president and the vice-presidents are E. D. Nunn, Audiophile Records, Saukville, Wis., and R. A. Long, Stanford Research Institute, Stanford, Calif.

International Technical Cooperation . . . International Business Machines Corp. will establish a research and development laboratory in Zurich, Switzerland. The purpose of the new laboratory is to establish closer contact between the American organization and development activities being conducted by European scientists and engineers in the accounting and processing field. IBM is located at 590 Madison Ave., New York 22, N. Y.

New Electronic Magazine . . . A new periodical dealing with experimental and theoretical developments in electronics has commenced publication in Great Britain. Known as the Journal of Electronics, it is affiliated with The Philosophical Magazine.

The initial number includes articles by scientists from the United States, Great Britain, Germany, Holland, and Switzerland. It is available at $2.80 (one pound) per issue from Academie Press, 125 E. 23rd St., New York 10, N. Y.

IN COUNTING THE COUNTLESS...

Count on Du Mont multiplier phototubes — whether you're counting stars, scintillations or holes in punched cards.

Du Mont multiplier phototubes have become a standard for comparison. Their superior long-term stability, their high cathode sensitivity, their excellent signal to noise ratio and their very high amplification are all well known by critical users of multiplier phototubes.

From 3⁄4" size used in oil-well exploration and medical research to the 16" giants used for large area counting in astronomy and critical radiation studies, Du Mont multiplier phototubes share the same fine characteristics.

If you aren't familiar with Du Mont multiplier phototubes and want the complete story, just write on your company letterhead to:

Du Mont

Technical Sales Dept. ALLEN B. DU MONT LABORATORIES, Inc. 760 Bloomfield Avenue, Clifton, N. J.

CIRCLE 13 ON READER-SERVICE CARD ➤
Million Color TV Sets in ’57 . . . In 1957, when color TV prices will probably be around $500, the industry should sell as many as 1,000,000 color receivers, R. W. Galvin, executive vice-president, Motorola, Inc., has predicted. In the same year, black-and-white set sales should reach 6,000,000, he said. This increase in color set sales for the future may be attributed to a reduction in price and the fact that present black-and-white set owners will be looking for replacements for their old sets.

Award Winners . . . Dr. Claude E. Shannon, Bell Telephone Laboratories, Murray Hill, N. J., has been named recipient of the Stuart Ballantine Medal of The Franklin Institute, Philadelphia, Pa. The medal was awarded to Dr. Shannon for his achievements in the field of communications.

Dr. E. W. Engstrom, executive vice-president, Radio Corp. of America, received the Society of Motion Picture and Television Engineers Progress Medal Award “for his outstanding leadership and vision in sound motion picture and television development.”

Mobile TV Projection Gear . . . A mobile projection unit for projecting closed circuit TV images in theaters has now been placed on the market. The unit is of value for equipping theaters quickly for special closed circuit events such as championship fights, theatrical performances and operatic performances. The equipment was developed by General Precision Laboratory, Inc., Pleasantville, N. Y., and produces a sharp image on a 50” x 65” screen.

A-M Tuner for Areas Without F-M . . . A high-quality a-m tuner has been developed for sale in areas without f-m stations. Most good tuners available at present are a-m—f-m types. The new tuner is being marketed by Altec-Lansing Corp., 161 Sixth Ave., N. Y. 13, N. Y., at $99.
A New UHF Mixer Diode
Specifically Designed
for UHF Tuners

New
PHILCO
1N173A

FEATURES

- Low Noise Factor
- Uniformity of characteristics
- Low local oscillator drive requirements
- Rugged and compact mechanical construction
- Stability over long life

Production of the Philco 1N173A Diode is a special process!
In dozens lots, or thousands, these mixer diodes have characteristics unexcelled in uniformity. Special Philco production and control techniques assure a new standard of dependable performance never before available in UHF mixer diodes.

Precise electric pulse "forming" welds the platinum alloy whisker wire and germanium crystal into a complete, integrated unit. Impregnated and sealed in a ceramic moisture-proof case, the Philco 1N173A maintains unusual stability regardless of shock, vibration or wide variations of temperature.

Design engineers find the exceptional uniformity of the Philco Mixer Diode the answer to high performance tuner operation over the entire UHF band. Exact impedance . . . low noise level . . . minimum Local Oscillator drive requirements . . . all the features that insure optimum performance are designed into the Philco 1N173A . . . and these diodes are available now! For complete information on the Philco 1N173A Mixer Diode write to Philco, Department ED, today.
when there is no margin for error...depend on the Lavoie non-parallax scale

for accurate voltage and time measurements. The Lavoie LA-239CR (AN/USM-50A) Oscilloscope is the only commercial scope with this feature.

Parallax can be costly when an error in reading comparative voltage causes engineering changes. The exclusive Lavoie reflecting scale superimposes the reticule on the optical plane of the cathode-ray screen... Thus there is no error of parallax. The reflecting scale does not prevent the use of a camera with the Lavoie LA-239CR Oscilloscope. A camera adapter plate is available for use with the Fairchild F-284 or F-286 camera. The same instrument is also available in the conventional flush-face version (model 289CF).

OSCILLOSCOPE DATA

- **Width Bandwidth:** Complex waves from 5 cycles to 15 megacycles. Sine waves from 3 cycles to 20 megacycles.
- **Extended Wave Frequencies:** Linear from 10 cycles to 20 megacycles internally synchronized. Triggered sweep, from a single impulse to irregular pulse intervals up to as high as 6 megacycles.
- **Square Wave Response:** Rise time 0.022 microseconds, only 5% drop on flat-topped pulses as long as 30,000 microseconds duration.
- **Greater Stability:** Electronically regulated power supplies throughout to maintain accuracy and constant operation under varying line conditions or line surges. Surges on the line from which Model LA-239CR is being powered can be displayed without distortion.

Higher Signal Sensitivity: Maximum sensitivity without Probe: 10.4 millivols. With Probe: 100 millivols. (Maximum signals, 125 V. Peak and 450 V. Peak respectively.)

**Timing Markers:** Interval: Markers of 0.2, 1, 5, 20, 100, 500, or 2,000 microseconds may be superimposed on the trace for the accurate measurement of the time base.

**Voltage Calibration:** Signal amplitude is referenced to a 1,000 cycle square wave (generated internally) the amplitude of which is controlled by a step-and-slide attenuator calibrated in peak volts. (A jack is provided to deliver 60 V. Peak for use in calibrating other instruments.)

**Sweep Delay:** Any portion of the sweep longer than a 5 microsecond section may be expanded by 10:1 for detailed study of that portion of the signal.

**Power Source:** 110 to 130 V. AC from 50 to 1,000 cycles. 255 Watts. (Fused at 4 amperes.)

**Dimensions:** In Bench Cabins: 19% in. wide, 15% in. high, 16% in. deep. In Rack Mounting (with cabinet removed to fit standard relay rack): 19% in. wide, 14 in. high.

**Representatives**

- ALBANY, J. A. Reagan Co., Albany 6-7876
- ATLANTA, Southeastern Industrial Instruments, Exchange 7681
- BALTIMORE, Thomas L. Taylor, Belmont 5-9126
- CHICAGO, B. Edward Steem, Columbus 1-2227
- DENVER, Allen A. Williams Co., Main 3-0434
- FLINT, Sam Robbins, Inc., Cedar 6-3710
- FORT WORTH, Mitchell Squerco Co., Webster 8811
- HARTFORD, S. Coldwell Co., Jackson 2-5832
- LOS ANGELES, T. Louis Snitter, Webster 1-4504
- MONTCLAIR, Louis A. Garten & Associates, Montclair 3-0257
- SAN MATEO, R. L. Pfeifer Co., Fireside 5-1134
- ST. LOUIS, Edwin H. Murry, Evergreen 5-7228
- WESTERN RESERVE UNIVERSITY, Cleveland, Ohio

Lavoie Laboratories, Inc.
MORganville, NEW JERSEY
CIRCLE 16 ON READER-SERVICE CARD FOR MORE INFORMATION

Meetings

- **Nov. 14-17:** Second International Automation Exposition, Navy Pier, Chicago, Ill. The exhibition will feature automatic controls, materials handling devices, etc. The electronic computer clinic will be repeated. For information, write to Second International Automation Exposition, 845 Ridge Ave., Pittsburgh 12, Pa.

- **Nov. 21-22:** Symposium on Aeronautical Communications, Hotel Utica, Utica, N. Y. Sponsored by the IRE Professional Group on Communications Systems. The symposium will stress the communications systems both ground-to-ground and ground-to-air used in aeronautical activities. Both military and civilian aspects of these systems will be discussed and an exhibit will be held. For information, write to R. C. Benoit, Jr., 138 Riverview Parkway North, Rome, N. Y.

- **Dec. 12-17:** Nuclear Engineering and Science Congress and Atomic Exposition, Cleveland Municipal Auditorium, Cleveland, Ohio. Fifty technical sessions will cover every phase of peace-time uses of atomic energy and its by-products. Nuclear developments for applications in industry, science, and agriculture will be exhibited. For information, write to Atomic Exposition, 931 Book Bldg., Detroit 26, Mich.

- **Dec. 14:** Operations Research Symposium, University Museum, University of Pennsylvania, Philadelphia, Pa. Sponsored by the IRE Philadelphia Section and Professional Group on Engineering Management and the Delaware Section, Society for Industrial and Applied Mathematics. Subjects of talks will be the scope of operations research, operations research experience in various fields, statistical and forecasting, scheduling and queuing problems, linear programming, inventory and production control with emphasis on the use of computing machinery. For information, write to R. V. D. Campbell, O. R. Symposium Registration, Burroughs Research Center, Paoli, Pa.

- **Jan 16-18, 1956:** Conference on The Practical Utilization of Recorded Knowledge—Present and Future, Western Reserve University, Cleveland, Ohio. The conference will discuss problems in the processing, dissemination, and utilization of the increasing volume of recorded information in such fields as chemistry, physics, patents, etc. A series of papers is being prepared to summarize the “state of the art.” For information, write to Dean Jesse H. Shera, School of Library Science, Western Reserve University, Cleveland 6, Ohio.
Dec. 15-17: Acoustical Society of America, Sheraton-Biltmore Hotel, Providence, R. I. Sessions have been arranged on low temperature acoustics, ultrasonics of liquids, liquids and gases, noise, marcosonics and shock waves, speech and music, and architectural acoustics. For information, write to Acoustical Society of America, 57 E. 55th St., New York 23, N. Y.

Dec. 28-30: Conference on Low Temperature Physics and Chemistry, Louisiana State University, Baton Rouge, La. Sponsored by the National Science Foundation and Louisiana State University. Topics for discussion will include liquid and solid helium, superconductivity, ion and nuclear paramagnetism and magnetic cooling, electronic and thermal properties of metals at low temperatures. Those wishing to attend should write to Dr. J. M. Reynolds, Dept. of Physics, Louisiana State University, Baton Rouge, La.

Jan. 9-10, 1956: Second National Symposium on Reliability and Quality Control in Electronics, Hotel Statler, Washington, D. C. Sponsored by the Professional Group on Reliability and Quality Control of the IRE, American Society for Quality Control, and RETMA. Of particular interest to electronic designers are sessions on "Quality Control and Automation"; "Advances in Tube Reliability"; "Controlling Relay Characteristics"; and "Reliable Capacitors". For information, write to IRE, 1 E. 79th St., New York, N. Y.

Feb. 2-3, 1956: Symposium on Microwave Techniques, University of Pennsylvania, Philadelphia, Pa. Sponsored by the IRE Professional Groups on Microwave Theory and Techniques and Antennas and Propagation and the Philadelphia Section of the IRE. Sessions are planned on radiating systems, guided microwave transmission, components, propagation, and measurements. For information, write to IRE, 1 E. 79th St., New York, N. Y.

April 5-6: Conference on Magnetic Amplifiers, Hotel Syracuse, Syracuse, N. Y. Co-sponsored by the AIEE Committee on Magnetic Amplifiers, the IRE Professional Group on Industrial Electronics, and the Central New York Section of the Instrument Society of America. Special technical papers on the theory and application of magnetic amplifiers. Fifty companies will have exhibits. Those interested in presenting a paper should submit a 200-word summary to Paul Schmidt, Chairman, Technical Program Committee, 3A-104 Bell Telephone Laboratories, Whippany, N. J., by December 31, 1955. For information, write to C. F. Spitzer, General Electric Co., Building 3, Syracuse, N. Y.

ELECTRONIC DESIGN • November 1955
One look tells you 3 ways this new Sylvania socket can help you produce a better printed circuit chassis

1. "It supports"

new collar design supports the metal tube shield isolating it from the printed circuit board and contact tails. Short circuits are eliminated.

2. "It stacks"

designed for foolproof nesting to accommodate automatic assembly techniques. Ground-strap slot keys sockets for proper orientation.

3. "It sits up"

contact-tail barriers keep the socket perched higher off the printed circuit board for greater heat dissipation and freedom from flux contamination.

Available in 7- and 9-pin types

Sylvania printed circuit sockets offer you all the important advantages you need for design efficiency. You get freedom of layout. Contacts fit through smaller holes in the circuit board. You can arrange your circuits for shortest conductor paths.

Sylvania sockets are all-molded. Moisture traps are eliminated; insulation qualities are higher. Contact characteristics are superior. Printed circuit production is more economical because Sylvania sockets are designed for automatic production methods.

Before you package your printed circuit design be sure you take a close look at these sockets. Write for data or samples. Address Dept. L22S.
Needed Electronic Devices for the Atomic Industry

V. Lawrence Parsegian
Radiation Applications Inc., New York, N. Y.

Editor’s Note: The recent “Atoms-for-Peace” conference at Geneva focussed the World’s attention on the growing industry based on nuclear developments. In the spirit of that historic conference, ELECTRONIC DESIGN is publishing this article in hopes of aiding this new industry. Dr. Parsegian is also Chairman of the Engineering Group, Rensselaer Polytechnic Institute, Troy, N. Y.

Electronic devices can contribute practical answers to many of the problems facing the growing atomic industry. This article discusses instrumentation needs of this industry in the hope that electronic design engineers will be stimulated to solve them. Possible solutions to some of the problems and avenues of research are also offered.

Laboratory Needs

The analytic and research laboratories that make use of radioactive isotopes number many hundreds. In all of these laboratories the handling of radioactive solutions and powders is time consuming, and hazardous because the available instrument techniques and equipment were never designed for use with radioactive materials.

For example, the determination of weight, probably the most common measurement of the laboratory, is accomplished by placing expensive balances inside a hood, where it is subject to contamination. The tiny weights and specimens are handled with awkward tongs, reading through window systems that also introduce blasts of ventilating air. The danger of dropping the specimen, of having it blown around, of getting too close to it, and of being in the direct path of the radiation in the case of more active specimens, is always present.

Volume measurement, another most common operation, is accomplished with awkward tong systems and glassware that were never designed for use with radioactive materials. There is also considerable risk to this operation because they have to be observed closely. The tables give the results of a survey of the analytic techniques and of how they fall short. This field is wide open for ideas and invention. In fact, it offers a much more fruitful area for small companies that want to get into the atomic program than does the field of radiation measuring devices on which so many new firms have concentrated.

Reactor and Processing Plant Needs

The measurements called for in the nuclear reactor and in the associated processing plants are not unlike those required in more conventional plants, the principal ones being flow rate, pressure, temperature, liquid level, and one new variable, namely nuclear radiation.

The conditions under which these measurements have to be taken are so different, however, because of the presence of intense nuclear radiation, that in effect a wholly new set of specifications and performance characteristics and new instruments are needed.

In the reactor proper and in the reprocessing plant the sensing element or detector must do its work behind very thick shielding walls, and must be considered untouchable to human hands when replacement is necessary. Telemetering and operation or replacement by remote manipulating is needed.

The future atomic reactor systems will have to be much more automatically controlled than the early installations, and the majority of the instrument and equipment systems required for this job will have to be electrical and electronic.

In the reprocessing plants there is an intense mixture of gamma radiation, X-rays, and beta radiation emitted by the fission products, and secondarily from the process liquids, process equipment and from the surrounding shields. Alpha particles are also emitted by the product plutonium and from uranium. These same activities are present in the reactor also, with the important addition that the neutron flux is also present to a predominant degree.

These emissions actually constitute important process variables, just as temperature and pressure are process variables for process monitoring. The art of radiation measurement has not yet progressed to the required degree to use them as such.

To meet the needs of reactors and plants, a whole new series of detector elements are required. These must include detectors that withstand the high temperatures of the reactor, and do so with instrument parts that are small and that do not absorb neutrons excessively. Conversion devices that transform neutrons into heat energy for the measurement of neutron flux may not easily fall into this desired category.

The industry needs detectors that can differentiate neutron flux and gamma radiation. The methods whereby one measures total radiation and subtracts from it a measure of gamma flux to determine neutron flux density are far from satisfactory. The measurement of rate of change of radiation flux is important for proper control of reactors. The time-constant must be made short for certain applications. Also the range must be made large so that a few instruments will properly cover the range from say 10^6 neutrons/cm^2 per sec. to flux densities exceeding 10^{14} neutrons/cm^2 per sec., a factor from low-to-high of over 10^8 times when the instruments are used for control of reactors. Gamma-ray flux intensities exceed several hundred roentgens/hr in reactors. Similarly there are needed detectors that can be immersed in corrosive process fluids for the measurement of non-penetrating alpha particles. It would be very
This table shows the result of a survey of how present analytical laboratory techniques using radioactive isotopes fall short. Measurement techniques are given at the top, and manipulative ones at the bottom. The undesirable characteristics are listed from left to right in decreasing order of severity. The diamond symbol indicates that the limitation is not too serious or exists only at high levels of radioactivity. The round symbol in color means that there are severe limitations at all levels of radioactivity.

<table>
<thead>
<tr>
<th>Measurement</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Radioactivity:</td>
<td>alpha, weak beta</td>
</tr>
<tr>
<td></td>
<td>gamma, strong beta</td>
</tr>
<tr>
<td></td>
<td>absolute counting</td>
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<tr>
<td></td>
<td>monitoring</td>
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<tr>
<td>Temperature</td>
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<tr>
<td>Volume</td>
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<tr>
<td>Weight</td>
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<tr>
<td>Density</td>
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<tr>
<td>Pressure</td>
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<tr>
<td>Electro-conductivity</td>
<td></td>
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<tr>
<td>Surface tension</td>
<td></td>
</tr>
<tr>
<td>Viscosity</td>
<td></td>
</tr>
<tr>
<td>mechanical</td>
<td></td>
</tr>
<tr>
<td>flow rate</td>
<td></td>
</tr>
<tr>
<td>Refractive Index</td>
<td></td>
</tr>
<tr>
<td>pH, electropotentials</td>
<td></td>
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<tr>
<td>Fluorescence, colorimetry,</td>
<td></td>
</tr>
<tr>
<td>and spectrophotometry</td>
<td></td>
</tr>
<tr>
<td>Infrared</td>
<td></td>
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<tr>
<td>Emission spectroscopy</td>
<td></td>
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<tr>
<td>Mass spectroscopy</td>
<td></td>
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<tr>
<td>X-ray diffraction</td>
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</tbody>
</table>

**Manipulation**

| Analysis:                     | gravimetric       |
|                               | volumetric        |
|                               | washing & liquid transfer |
| Agitation:                    | mechanical        |
|                               | air agitation      |
|                               | vibration         |
| Centrifugation and precipitation |                 |
| Titration                     |                   |
| Extraction:                   | batch column      |
|                               | Distillation       |
|                               | Ion exchange       |
|                               | Heating            |
|                               | Sampling           |

Helpful if alpha particles or if beta particles could be measured specifically in the presence of gamma radiation. Detection of alphas at a rate of 10/sec in a gamma-beta flux of say 50 roentgens/hr could be useful in certain applications.

What directions are likely to achieve these goals? Perhaps we can develop detectors that make use of effects of radiation on solids and liquids, in addition to gaseous discharge. “Radiation damage” in such materials perhaps could be pursued to provide sensitive detectors of the integrating type, while perhaps self-healing detectors will provide the more usual measurement of flux and change of flux.

Another class of radiation-measuring instruments, safety monitoring instruments of the total ionization type are also needed. Such detectors could be used in substantial numbers throughout the plant to guard against the influx of radiation-carrying air and vapors into “safe” areas.

It is important to know the energy spectrum as well as the intensity of neutron fluxes and gamma ray beams. There are no simple instrument techniques available to make these measurements. It would be helpful, for example, to be able to selectively determine the energy spectrum from thermal energies up to several million electron volts in say eight or more energy bands, for both neutron and gamma types of radiation.

In the case of instruments to be used in reactors, the choice of materials is limited both because neutrons are destructive and because absorption of neutrons is expensive. In separation plants, and for most health and safety monitoring instruments, the problem is simpler because gamma-resisting materials are easier to find. The gamma ray intensities involved in health and safety monitoring range from background (0.3 mR/day) to something beyond tolerance level (100 mR/hr day). The gamma ray activities in separation...
<table>
<thead>
<tr>
<th>Undesirable Characteristics</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content with radioactive material</td>
<td></td>
</tr>
<tr>
<td>Open system</td>
<td></td>
</tr>
<tr>
<td>Hand-prepared samples</td>
<td></td>
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<tr>
<td>Eye observation</td>
<td></td>
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<tr>
<td>Does not permit manipulation of large unit</td>
<td></td>
</tr>
<tr>
<td>Difficult to decommission or replace</td>
<td></td>
</tr>
<tr>
<td>Transfer of samples</td>
<td></td>
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<tr>
<td>Chemical or other complications</td>
<td></td>
</tr>
<tr>
<td>Rupture by radioactivity</td>
<td></td>
</tr>
<tr>
<td>Damage by radioactivity</td>
<td></td>
</tr>
</tbody>
</table>

- Conditions satisfactory
- Condition satisfactory
- Severe problem
- Very severe problem
- Severe problem

Limited to 0.3 millicurie samples

Hood mandatory
Needs precaution against breakage

21
plants range from background up to hundreds of roentgens per hr. Fig. 1 illustrates a simple radiation detector and preamplifier. The detector can be simply suspended alongside the vessel containing the radioactive material while the preamplifier is somewhat removed to permit it to be shielded from the most active radiation. A simple quick-disconnect device beyond the preamplifier allows rapid replacement of the entire unit.

Process Instruments

Satisfactory measurement of flow rates is easily achieved in the petroleum industry by the use of orifice-type meters, despite the fact that such meters may require periodic servicing. When such an instrument is used in a nuclear reprocessing plant, its failure becomes extremely troublesome. Replacement of the unit must be accomplished by remote-manipulating devices, including the manipulation of bolts and nuts that connect the unit to the process pipe lines. Reassembly of the process equipment by remote mechanisms, and refilling, and recalibration of the system, can prove quite time consuming and expensive.

Certain generalizations can be made as to the characteristics one may require of instruments applied to this service. These are:

1. The most important characteristics to be sought for in instruments for these applications are long life and easy replaceability of the elements located in the radioactive areas. This is tantamount to requiring that the detector element be made simple and dependable even at the expense of transferring complexity to the instrument panel. It also places a premium on instrument systems that do not require contact with radioactive process streams, but can measure from outside pipe and tank systems.

2. The detector element of the measuring system presents the most serious challenge because it is the part that is subjected to radiation and to the fluids.

3. Telemetering of intelligence to and from the radioactive process areas to distant (100 to 300' away) instrument panels is necessary.

4. Adaptability to calibration check by remote means, overall simplicity, stability under variable plant conditions, sensitivity, adaptability to automatic control, absence of moving parts, “packaged” units, resistance to corrosive fumes, ruggedness against plant handling, and sufficient overall accuracy, are perhaps the other characteristics that are desirable in such instruments in roughly decreasing order of importance.

Process Measurements

The measurements of greatest interest in processing are the measurement of liquid flow rate, temperature, liquid level, pressure, radioactivity, and process fluid composition. Of these, only temperature measurement by means of thermocouples can be considered to be in a fairly satisfactory state of development for use in nuclear plants, since thermocouples can be readily protected from process fluids by means of conventional protection wells.

Fig. 2 illustrates a system where the liquid level is determined by a detector placed outside the vessel. and electrical wires and quick-disconnect electrical devices complete the telemetering to the panel.

Metering of fluid flow rates presents a very difficult problem. The conventional orifice of pressure differential type meters are unsatisfactory, because they usually include moving parts and cannot be depended on to give the required life performance. The problems are often accentuated when one must cope with corrosive liquids that have a wide range of viscosities, densities, and which may even include abrasives or precipitation products.

One attempt to improve this flow problem has been the use of electromagnetic induction methods, as illustrated in Fig. 3. The principle has been demonstrated in certain applications, but the instruments need to become less expensive, simpler, more rugged in the sense of conventional industrial instruments, and adapted to more applications.

Industry has also made some use of instrument techniques for the continuous analysis of stream composition, such as by fluorometers, infra-red analysers, and even with mass spectrometers.

Aside from the mass-spectrometer type of instru-
ment that identify specific atomic and molecular masses, much can be attempted by the use of electromagnetic phenomena, including effects related to molecular dynamics, dielectric properties, inductive coupling, absorption, and transmission phenomena. A number of instruments have been developed that will indicate a meter change with loading of search coils. Less progress has been made in development of electromagnetic detector systems that indicate concurrently both changes in a resistive component and in an inductive component of the field coil loading, along the lines developed by Foerster of the Kaiser Wilhelm Institute in Germany. Being able to read simultaneous changes in two components instead of the conventional single meter reading adds greatly to the information that can be derived from the instrument readings. While Foerster has applied this principle largely to metallurgical problems, there does not seem to be any obvious reason why the principle cannot be extended somewhat into liquid processing fields as well.

**Suggested Solutions**

There are many physical effects due to radiation that might be utilized in new radiation detecting devices. For example, the change in optical density of certain silver-activated phosphate glasses turns out to be fairly useful for measuring radiation dosages. This method requires the use of optical transmission measurements, but other changes might lend themselves to more easy application in simple, all-electronic instruments for measuring either total dosage, dose rate, or to distinguish types of radiation. A brief review of some of these observed changes might lead to much-needed new ideas.

**Color Changes:** A wide variety of materials change color when subjected to X-rays or nuclear radiation. Halite (NaCl) turns yellow-brown on irradiation to X-rays and sylville (KCl) turns purple. The change of color disappears when the crystals are annealed at 150°C. Compression changes the behavior somewhat. Dosages of from 10¹ to 10⁵ roentgen are needed to show these effects clearly.

Glasses show color changes when exposed to nuclear radiation. Soda-lime glass will color in the visible spectrum, going smoothly from the red to the violet end. “Pyrex” is slower to color. Small additions will change the behavior, some reports indicating that the most active additions are iron, titanium, arsenic, antimony, manganese and cerium, decreasing in that order. The phosphorus family of glasses change when there are contaminants such as arsenic or bismuth present. Fine borate glasses discolor when manganese is present. Some organics show changes that appear to be due to irreversible color changes. Among these are many dyes of the triphenyl methyl, alizarin, thiazine and indigic types. Changes in diazo dyes have been suggested for measuring intensity of radiant energy.

Dyed polymethyl methacrylate changes color under X-rays particularly in the case of Sudan III dye. Polyethene shows similar effects, becoming fluorescent to ultra-violet excitation after irradiation.

A wide variety of other gems, salts, fluorites, non-precious gems, and minerals show color changes due as a result of radiation.

**Luminescence:** The luminescence under radiation of a wide variety of sulfides (particularly zinc sulfide), of halides such as barium halide, chloride, and fluoride, of sodium chloride phosphors, calcium tungstates, zinc silicates, calcium silicates, and germanates, has been studied in great detail because of their importance to X-ray and television screens.

**Electrical Conductivity Changes:** X-rays will increase the electrical conductivity of polystyrene by a factor of 10⁹; the effect reverses on standing. Other solid dielectrics such as paraffin and sulphur show increases in conductivity when under radiation.

Liquids such as petroleum ether, carbon tetra-chloride, carbon disulfide, and benzene all show changes in conductivity. Carbon disulfide has been found useful for radiation measurement. However, in contrast with the solids, Ohm’s law is not obeyed by X-irradiated liquids; the current increases in the liquid with increasing voltage to a saturation value that is not exceeded until dielectric breakdown.

Further research may reveal some material that has sufficiently large and reproducible changes in conductivity to allow development of good, simple instruments to make use of this principle for the measurement of radiation.

**Other Electrical Effects:** Numerous metals show a photoelectric effect when exposed to X-rays. Copper-oxide barrier cells show good proportionality between soft X-ray intensity and the photoelectric current, but the proportionality constant fails for the region below 1 A°; their usefulness for dose-rate measurement is limited to between 1 A° and 100 A°. Results on selenium cells are inconclusive and contradictory.

Semiconductors are sensitive to nuclear radiation. The conduction of n-type germanium is decreased by alpha particles at a rate of 78 electrons removed per alpha particle. When all the electrons are used up, positive holes are created at the rate of 8.6 per alpha particle, making the germanium a p-type semiconductor. Both n-type and p-type silicon become non-conducting under such bombardment.

**Viewing Devices**

Viewing devices offer unusual problems, ranging from the simple mirror devices used in laboratories to the complex optical systems used in large production plants. Binocular vision is very important in this connection, particularly in maintenance work in large plants. Television is useful for many of these applications; it would be even more useful if binocular vision were available with it.

![Fig. 3. This diagram illustrates the principle of the magnetic induction flowmeter.](image-url)
Standard Modular Wafer Circuits

MODULIZED standard circuits are now available in sample lots for circuit-characteristic and production-process evaluation. Prototype circuits and preproduction runs of specific circuits can also be ordered. This program is being undertaken in cooperation with the Department of Commerce to further the development of modular techniques for production equipment. See production sample on cover.

Under contract to the Department of Commerce, the Aerovox Module Div., of Aerovox Corp., 1200 Jefferson Davis Highway, Arlington, Virginia, will also bid on production quantities, contingent on government approval, to supply customer's production requirements. The company will offer the services of their engineering staff to help convert electronic circuits and systems to modular design; these services are available on a consulting or contract basis. The original facilities developed in "Project Tinkertoy" are being used (ED June, 1955, page 11), and the company is currently expanding their own production plant to mass produce modules (deliveries are scheduled for January, 1956).

This low-level cathode follower circuit, module illustrated top center, is one of many that are available.
Many National Bureau of Standards preferred circuits are currently being made by this modular process of machine-making ceramic materials with adhesive carbon resistors, including printed conductors and mounted miniature components. Individual wafers are stacked into building blocks to perform functions such as video limiting, d-c regulation, intermediate video amplification, low-level cathode follower action, video driving, and multivibrator action. These circuits represent designs that are well stabilized. As mentioned earlier, modules to customer's specifications can be made. It is expected that the line of modularized standard circuits will include some 40 or more circuits to cover the majority of applications.

To aid the engineer in inter-connecting standard circuit modules to form complete electronic subassemblies, breadboard accessories, illustrated, are available. These breadboards for solder or wire interconnection includes sockets for mounting modules. For more information on these currently available wafer modules, turn to the Reader's Service Card and circle 18.

HERE ARE CAPACITORS OF THE SAME MAXIMUM RELIABILITY which Sprague has long supplied to the telephone systems ... now available for your own high reliability electronic applications.

The use of especially high purity materials ... utmost care in manufacture, constant observation and quality control of all operations have made Sprague Telephone Quality Capacitors outstanding for their long life and faultless performance.

Type 17D Telephone Quality Electrolytics have turret terminals and twist-mounting lugs. A special vent construction is molded right into the cover, as are the numbers identifying each terminal. The aluminum cans are covered with a corrosion-resisting insulating coating.

Nineteen standard ratings, all characterized by low maximum leakage current and remarkable life test capabilities are available in the new series. Complete technical data are in Engineering Bulletin 340, available on letterhead request to the Technical Literature Section, Sprague Electric Company, 347 Marshall Street, North Adams, Massachusetts.

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CIRCLE 19 ON READER-SERVICE CARD FOR MORE INFORMATION
Here's a voltage reference that can be depended upon for many laboratory functions, but specifically suited for calibrating meters, powering multi-stage amplifiers and computers.

**OUTPUT TOLERANCE** for 10% line voltage variation: \( \pm 0.007\% \) or less.

**VOLTAGE RELIABILITY** read on decade dials: 0.0% or 5 millivolts, whichever is greater.

**OUTPUT VOLTAGES:**
1. 10 to 310 volts in 1 volt steps @ 150 ma. max.
2. 0-150 volts continuously variable @ 5 ma. max.
3. 6.3 volts unregulated @ 3 amperes CT.

A Magnetic Amplifier Power Supply with output at 15 amperes continuously variable from 5 to 32 volts without switching.

**REGULATION:**
- \( \pm 1\% \) from no load to full load.
- \( \pm 1\% \) from 105 to 125 volts input.

**RIPPLE VOLTAGE:** 1%, RMS @ 32 volts and full load, increasing to 2% @ 5 volts and full load.

Complete specifications and details upon request—write or wire today.
Foaming Potting

High voltage capacitor network before and after potting. Curing takes place in mold at room temperatures. No machining or shaping is necessary.
Compound

Each foamed cube has same weight but varies in density. Samples are 3, 8, 13, and 20 lb/cu. in., left to right.

FOAMING around intricate component shapes when poured into a mold, this potting compound obviates need for fabricating preformed insulation. Known as Sta-Fome, its curing temperature and liberated heat can be kept below 80°C so that components such as diodes, transistors, capacitors and so on will not be "cooked" and damaged during potting. Throughout the reaction Sta-Fome releases less than half the heat encountered with some earlier commercial isocyanates. A casting can be completed in 30 min. No toxic acids are released during curing.

This light weight, rigid and elastomeric material with special properties for thermal insulation and chemical agents for foaming during polymerization is made by Eastern Precision Resistor Corp., Richmond Hill 18, N. Y. It can be formulated with varying densities from 2 to 30 lbs per cubic ft. It has a thermal conductivity comparable to standard insulating materials (0.25-0.30 btu/sq.ft/hr.°F/in. at 70°F). It has good adhesion to all types of surfaces without special treatment.

Tensile strength varies with density ranging approximately from 25 lbs psi to 400 psi. Sections regain original shape after compression. Stress to produce a 10% deflection for the 3 lb per cubic ft density material is 4.6psi—475psi as required for density of 20 lbs per cubic ft. water absorption is very low. The compound withstands continuous service up to 212°F and will not crack on repeated heating and cooling cycles which go as low as —80°F. The material can be readily sawed, drilled or sanded with ordinary tools. For more data, turn to the Reader's Service Card and circle number 21.

EASTERN INDUSTRIES, INC.
100 SKIFF STREET
HAMDEN 14, CONNECTICUT

CIRCLE 22 ON READER-SERVICE CARD FOR MORE INFORMATION
DESIGNING an electronic device that produces music is a far more challenging task than designing a device that reproduces music. In this article the design of a small electronic chord organ selling for less than $1000 is discussed with particular reference to evaluating design changes later incorporated in the firm's larger organs. The Minshall Chord Organ was designed to be sold at a minimum price, give pleasure to competent musicians, while remaining simple to operate for the novice.

A major consideration in organ design is the public's standards for reliability. The electronic organ is competing with trouble-free instruments like the piano and conventional organ. Therefore, the designer of electronic organs has a considerable component problem. Present top-quality commercial capacitors, for example, still exhibit initial and long-term instability of an order that can be tolerated in radios and TV receivers, but which represents a challenge when used in quality electronic musical instruments. Since the cost of hermetically sealed military type capacitors is prohibitive due to the quantity involved and the price structure of the organ market, the design objective has been suitable circuitry and operating impedances that would offset the influence of effect of initial tolerance and subsequent drift of commercial components.

The first step in designing the chord organ was to evolve a block diagram of functions and the sequence of these functions. The chord organ can be broken down into three divisions: the organ section, the chord section, and the pedal division. The method of generating musical notes by these three divisions and the switching problems involved are too complex to be discussed in this article. It is sufficient to say that the latter problem was solved by a bus-bar arrangement. The front panel controls were kept to a minimum at the same time.

The tone generators are the most important electronic element in the organ. We utilized the basic principles of the tone generators from our larger organs and developed a circuit that we have been considering for some time as a future refinement for the more expensive models. This circuit, which is illustrated, is direct coupled.

In order to change from an r-c coupled circuit, a negative power supply closely related to the positive supply was required. Since some regulation was required, we decided to obtain absolute regulation at little added cost by utilizing a VR-150 regulator diode.

One of the first concessions to cost and complexity in the design of the organ was to limit it to four octaves. Since the new direct-coupled generator does not require a buffer stage to utilize th output of the master oscillator, an additional triode stage was saved. Therefore, two dual-purpose 12AX7 tubes can produce four octaves compared to six triode sections producing five octaves in the older models. The master oscillator is an l-c Hartley type exhibiting ample stability while affording a rich vibrato when
desired by applying a low-frequency sine wave to the control grid in conjunction with the use of a relatively short r-e time constant in the grid-to-tank coupling circuit.

Printed circuits are utilized in this organ in an unusual manner to gain their benefits for a product that is manufactured in thousands rather than hundreds of thousands. The system in which only a part of the components on the printed circuit board are dip-soldered and the remaining components that determine the exact function of the circuit are added by hand-soldering has been discussed elsewhere.

Since few technicians can be expected to be familiar with electronic organs, ease of servicing was a major design objective. This objective has been achieved by unitized construction and plug-in harnessing. Servicing can be easily accomplished by dealers who maintain a small stock of replacement subchassis.

Pulse-Aging Gas-Diodes

EQUALIZING and stabilizing of the voltage characteristics of cold-cathode gas diodes by an inexpensive method is explained on these pages. The tube characteristics are improved by a process of aging in which pulsed voltages are applied simultaneously to a large number of tubes. Trials of the processed tubes in actual operating circuits show that these aged values are reasonably stable. The method promises to provide an inexpensive, easily available component for many computer circuits. It was developed by D. C. Friedman and W. D. Urban of the data processing systems laboratories, National Bureau of Standards, Washington 25, D. C. The work was sponsored by the Wright Air Development Center, Dayton, Ohio, and the Air Force Cambridge Research Center, Cambridge, Mass.

The cold-cathode gas diode has many qualities that would make it an excellent computer component. It requires little power, but it can handle large currents momentarily. It is small, light, rugged, cool in operation, and inexpensive. Life for normal indicator operation is over 10,000 hr. Its operation may be stated binary-wise in several ways, so that it provides the "yes-no" statement of a digital computer element.

However, four major defects in the operation of this component have thus far limited its use. Because it is manufactured as an indicator, only one characteristic—the maximum firing voltage—is controlled, and this characteristic may have a large tolerance. This variation leads to the first defect: in a batch of tubes, a wide range in firing and holding voltages is commonly found. Selection might be used to overcome this difficulty, except for the second defect: the characteristics of any one tube vary unpredictably with use. The other two major defects are associated with use and circuitry: the normally long deionization time limits speed of operation, and the need for a continuous path to maintain ionization makes selection circuits difficult to engineer. A means of overcoming the first two defects is discussed here.

It is, of course, possible to obtain special tubes that are stable and generally equal in characteristics. However, these tend to be costly. The aim of this investigation has been to devise a method to obtain high-quality gas diodes by inexpensive processing of low-cost indicator lamps. Therefore, the bulk of the work was done with NE-2 and NE-51 lamps taken from general stock.

The circuit for the equalizing process consists of a large number of tubes in parallel connected to a pulse power source through a common resistor as illustrated. Pulses are continually applied until the firing potentials and holding potentials of all the tubes rise to common terminal values. Further processing produces no additional change. In the stability check, all the tubes are subjected to identical conditions. Providing a separate resistor for each tube minimizes mutual interaction, while the power supply and environmental changes are common to all tubes.

The first characteristic potential to be considered is the firing voltage—the minimum voltage necessary to start conduction in a tube that has been off a long time compared to its deionization time. The second is the holding or maintaining voltage—the voltage drop across the tube when it is carrying its rated current.
For the NE-2, these are about 90v and 75v, respectively. For the NE-51, these values are approximately 5v lower. Both tubes are rated at 1/25w.

Since equalizing the tubes consists mainly of operating the tubes beyond their normal operating range, some means of obtaining pulsated operations was required. Two methods were used here. For very large overloads, a relay pulser was employed. The length of the pulse was determined by the break time of a set of relay contacts. When desired, this time could be lengthened by use of an RC circuit, but usually it was held to a minimum. The “off” time was set by a timing relay also operated with a variable RC circuit. Two relays were used to obtain “fail-safe” operation insofar as the tubes were concerned. For tests at higher duty cycles, full or half-wave 60cy voltage was used. To keep the over-all duty cycle low, a clock-driven switch was used to obtain 25- or 75% duty cycles over approximately 100sec periods. In all tests, bulb temperature was checked to make sure it did not rise significantly above ambient temperature.

A set-up was finally devised for equalizing the characteristics of 10 tubes at a time. This arrangement was based on the assumption that at some time during the life of the tubes, when used as indicators, the characteristic voltages must rise, since end of life is indicated by the voltages rising to the point where the tubes will not operate in the circuit. It was also assumed that stability could not be attained until the tube characteristics had started on this rise. The 10 tubes were connected in parallel as illustrated.

At first only one or two tubes would fire because they had much lower firing voltages than the others. However, since these drew a heavy current, they soon aged to the point where other tubes took up a portion of the burden. If the characteristic voltage of any tube should drop when processing started, that tube would carry an excess load and quickly raise its firing voltage back to the level of the others. In this way all 10 tubes were soon made to fire simultaneously. Since the current divided according to the conductances at the holding potential, the characteristic holding potentials tended to become equal because of unequal aging. Thus, equalization of both characteristic potentials was obtained automatically.

Many tubes can be equalized at the same time in this manner, as long as not too much current is drawn by a single or a few tubes. To prevent such an overload, a power supply with poor regulation was used to operate both tubes and relays. A high current load automatically lowered the duty cycle and the pulse voltage. Such protection was especially convenient when the sputtered cathode material formed a conducting path between the electrodes of a tube. In this case the poor regulation of the power supply permitted the path to be evaporated open again without damage to tubes or equipment.

Another method of processing is an automatic “drop-out” technique. Here the source supplying the tubes is a low-voltage pulse whose amplitude is set at

---

Results of aging tests of type NE-51 cold-cathode gas diodes. Processing was continued until the rate of change of characteristic voltage dropped appreciable.
G.E.'s Thru-Con Printed Circuit Boards have wiring patterns on two sides, positive connection through the board

Thru-Con Boards for printed circuitry lead to cost reductions, and product improvement in many industries

General Electric Thru-Con Printed Circuit Boards offer manufacturers of radio, television, and electronic equipment new opportunities to reduce production cost and substantially improve quality and performance.

G.E.'s Additive Method of Construction
Production techniques developed by G.E. provide two patterns on a single board with a positive through connection—without staking pins. Continuous copper plating through the holes insures positive solder filleting top and bottom, extreme strength, and trouble-free assembly.

Thru-Con In Many Industries
Widening usage in radio and TV receivers and street lighting controls has proven the advantages of printed circuits. G-E Thru-Con Boards not only offer manufacturing savings, they also make it possible to reduce parts inventories, shorten assembly and inspection time, and save in weight and product size.

Investigate G-E Thru-Con Boards
Your company may be able to profit by using printed circuitry and G.E.'s Thru-Con Boards. The combination of wiring patterns, circuit designs, sizes or shapes, is virtually limitless. Experienced G-E printed circuit engineers and technicians are ready to aid you in developing a printed circuit program. For a discussion of your problem and a sample G-E Thru-Con Board, just call or write today to:

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Progress Is Our Most Important Product

GENERAL ELECTRIC

CIRCLE 24 ON READER-SERVICE CARD FOR MORE INFORMATION
Accurate
Pocket Sized
Resistance
Decade

ADJUSTABILITY of this resistance-decade permits a resistance of 1 megohm to be approximated with an accuracy of 1 part in a million. Unique design permits the provision of a thermometer well for measurement of temperature rise of the 24 individual resistors. Knowing the temperature coefficient value of each resistance and the temperature rise (from a thermometer), minute resistance change due to current flow through the decade can be determined without having to disconnect the unit from its voltage supply circuit. The pocket-size unit has a range from a fraction of an ohm into the megohms but measures only 2-3/4" in diameter by 2-1/2" deep. It can be panel mounted.

The unit is adjusted by interlocking, shock and vibration proof, plug-in connectors instead of switches. Small size and flexibility of the decade, manufactured by Consolidated Resistance Company of America, Inc., 44 Prospect St., Yonkers, N.Y., is gained in part by the internal connections of the 24 resistors. The connection pattern is 1-3-3-2. This combination requires the least number of resistances and shorting connectors (jumpers) without becoming too difficult to adjust by unskilled operators. Binary codes and other connection schemes extend the range but complicate connections and computations. The model pictured is known as the 1000 Vari-Plug Resistance Decade and uses 1% to 0.01% resistors encapsulated in epoxy resin. Resistance adjustment can be made in 0.1 or 1 ohm steps in a few seconds.

By knowing resistance change due to temperature rise, as indicated by the thermometer, optimum wattage ratings providing maximum sensitivity for a specified accuracy can be determined. The unit can be used to help set fixed resistance values into analog computer circuits. The standard accuracies for voltage divider connections is 0.005% and 0.002%. For more data, turn to the Reader's Service Card and circle 25.
less cube and cost
WITH ADDED RELIABILITY

Cubic restrictions have brought about a whole new concept of wire termination. The AMP Taper Technique with AMP taper pins, tab receptacles, blocks and modified miniature components will help you take full advantage of small wire, small insulation and small space for your wire terminations.

Another example of AMP's Creative Approach to Better Wiring

Send today for your copy of our brochure, AMP's Creative Approach to Better Wiring.
TRANSISTORS actuate neon lamps in this clock to illuminate numerals which show time to a fraction of a second. The display can be read from considerable distance in daylight or darkness. The indication is in an unambiguous digital form. Timing is based on 60c/s line frequency (or a precision oscillator can be used for millisecond display).

First two columns of the clock built by Saunders & Co., 66 Westland Rd., Weston 93, Mass., show hours. The next two columns show minutes and the next two seconds; the last column shows fractions of seconds. Since the indication is by lamps, the time can be recorded on film (even in darkness) with extremely short exposures. Leads added to lamps will actuate external devices at preset times.

Only one lamp in each column is lit at a time. Each lamp is connected to an individual binary cell which is of a new type using single junction transistors. The binary cells are connected in sequence to form registers. Each register actuates one column of lamps. A single positive bit circulates in each register lighting each lamp in turn. The bit steps one place with each input pulse. As the bit returns from nine (or five in some registers) to zero, it pulses the next column. This forms ring counters of six and ten. The ring counter controlling the seconds column is pulsed by 60c/s. Seven such registers form the clock illustrated.

Binary cells tolerate large variations in all components, 60 low-voltage binary cells are used. Two transistors forming the pulse for each shift register make the total transistor compliment 74. The total power consumption is about 6w. For more details on this transistor clock, turn to the Reader's Service Card and circle 28.

Set designers assure their customers steady, clear pictures by careful component selection. Good-All backs that selection with reliable capacitors at economical cost. The enthusiastic acceptance of GOOD-ALL MARBELITE and SERAMELITE tubulars is a measure of the confidence designers have in these capacitors. Tens of millions are in use today in TV and Radio Sets of leading manufacturers.

MARBELITE
Marbelite capacitors are best known for their physical and electrical ruggedness. Good-All type 503-M provides solid plastic construction at surprisingly low cost. A miniature series is also available for applications in which space is limited.

SERAMELITE
The seramelite family of capacitors is housed in ceramic tubes with end-seals of a tough, dense plastic. Their performance under conditions of high temperature and humidity is outstanding. Various impregnants are available and Seramelite types with "Mylar" dielectric are becoming increasingly popular.

GOOD-ALL ELECTRIC MFG. CO. • GOODALL BLDG. • OGALLALA, NEBRASKA
CIRCLE 29 ON READER-SERVICE CARD FOR MORE INFORMATION
mercury batteries can add extra dependability to your products

TODAY, many products are providing greater dependability, thanks to the unique qualities offered by General Mercury Batteries. General Mercury Batteries have excellent shelf and operating life, have a high ratio of energy to size and they provide a constant source of voltage till exhausted. A nickel-plated steel can makes them resistant to the effects of humidity and corrosive atmospheres. General Mercury Batteries are available in “power packs” in an unlimited number of series, parallel or series-parallel combinations. These packs are made up of individual cells joined together by General’s exclusive surge-weld process. This method assures a safe, sound, lifetime connection.

These qualities are being used in many products with transistor or electronic circuits like Geiger counters, tachometers, guided missiles, pocket radios, hearing aids, and numerous test devices.

If you need dependable power in small space, you might find that our experience in developing mercury cells and “power packs” can be of valuable assistance. It’s at your disposal. Just write and tell us how we can help. We will be glad to send you free data.

DESIGNERS of control systems will find this inexpensive analog computer of great value in the rapid development of new systems. By offering the Model ES-400 in kit form, its price is greatly reduced. The computer can also be employed as an auxiliary to existing computer installations to speed analyses.

The large patchboard makes for ease of use and checking. Among the components brought out to the board are 30 coefficient potentiometers, 15 d-e amplifiers, two 10-turn potentiometers, four dual bias diodes, and two relays. Each of the 30 potentiometers can be set to an accuracy of better than 0.1% by means of a dividing network and a null meter mounted in the panel. The purpose of the diodes is to simulate non-linear functions such as backlash, dead-zone, limits, and stops. One use of the relays is to hold a problem in the midst of solutions, to enter new information, or for recording purposes. This instrument is available from Heath Co., Benton Harbor 15, Mich.

The amplifiers are three-tube units utilizing printed circuits. They may be mounted in the upper portion of the assembled computer, as illustrated, or on a standard relay rack. These low-drift circuits are linear from +120v to -120v. They will deliver 10 mills with a minimum open-loop gain of 50,000. Phase shift when connected as a unity inverter is one degree for 1200 cycles. The single power supply may be mounted in the computer cabinet or on a relay rack. The three dual initial-condition power supplies are mounted inside the cabinet.

A separate function generator, also in kit form, is available for use with the computer. Its break voltages may be varied from 0 to 100v. Frequency response varies with the function generated, but is generally flat to better than 1200cy. Generators built by other firms can be used with the computer as well. For more data, turn to the Reader’s Service Card and circle 31.
The 15 amplifiers are mounted in a thermally and electrically shielded portion at the top of the cabinet.

Analog Computer Kit
The NEW GRAY AUDOGRAPH...

...GETS A VOICE

IN A HURRY...

HUBBELL Interlock Sub-Miniature Plugs

Eliminate Soldering For Fast Installation Of Speaker Kit!

Now, one model takes the place of three in the new Gray Audograph line. These famous dictation machines are designed with built-in eyelets to receive Type "C" Interlock Plugs. When speaker-equipped models are ordered, specially designed speaker kits, wired with the Sub-miniature Plugs, are quickly and easily plugged in. Hubbell Interlock's exclusive automatic locking feature makes possible a solderless, low contact resistance connection from the speaker kit to the panel eyelets. The tiny Type "C" Plugs are also easily and quickly disconnected for maintenance or replacement of speaker if necessary. Our Development Laboratory will cooperate with your Engineers to adapt Interlock for your specific applications.

Sub-miniature Plugs: Cat. No. 601C31 • For Further Information, Write Dept. A

HARVEY HUBBELL, INC.

CIRCLE 32 ON READER-SERVICE CARD FOR MORE INFORMATION
Socket Adapter with Permanent Probe

CIRCUIT checking of compact equipment is aided by the "Rotoprobe". By removing a tube, plugging this adapter into its socket, and then inserting the tube in the device, the voltage values on all the tube elements can be obtained by simply rotating the device. A permanent cable carries the checking voltages back to the vacuum-tube voltmeter.

In critical tube locations on prototype gear under field test, the device could be installed permanently to speed evaluation. When used with one of the new automatic range-finding VTVM's now coming on the market, circuit checking is practically on an assembly line basis. As illustrated, the number of the connection under test is indicated. Three sizes of Rotoprobes are available: for 7- and 9-pin miniatures, and for octal-base tubes. The device is made by Vector Electronic Co., 3352 San Fernando Rd., Los Angeles 65, Calif.

As the unit is rotated, the spring contact moves off one connector before making contact with the next one, so there is no danger of shorting elements. All voltages are measured to ground. The body of the adapter is made of phenolic, and its socket connections are silver-plated beryllium copper. The cable is 3-1/2" long. Tests with the unit can be made blind—without even seeing the tube under test—as long as you can reach it with your hand. For more information on this lab aid, turn to the Reader's Service Card and circle number 33.

Mullard Tubes

Mullard Electronic Tubes—used throughout the world

Mullard is the Trade Mark of Mullard Ltd., and is registered in most of the principal countries of the world.

CIRCLE 34 ON READER-SERVICE CARD FOR MORE INFORMATION
MINIATURIZATION of portable test equipment and mobile control and communications gear is aided by the utilization of the small multi-deck rotary switches shown on these pages. These Series 7000 switches have a depth behind the panel of only 1.16” for the three-deck version. The units are also available in one- and two-deck models.

Outside diameter for all types including contacts is 1.16”. The wafers are made of impregnated glass melamine, which is humidity resistant and tough, without being brittle. Standard contact arrangements from one pole, 12 positions, to four poles, three positions are offered. All have positive indexing with a 1-1/2 in-lb torque. There is continuous rotation for single pole, and stops for multi-pole operation. The silver-alloy wafer contacts are double wiper for low contact resistance. Contact resistance is 0.005 ohms. They are self-cleaning. There are solder lugs on the connection ends of the wafer for ease in wiring. The current-carrying capacity of the contacts is 1amp at 50v, d-e. Current-breaking capacity is 250ma at 50v, d-e. These units are made by International Instruments Inc., P.O. Box 2954, New Haven 15, Conn.

Each switch is furnished with a standard, pointer-type block plastic knob, mounting washers, and a hex nut. Overall depth behind the panel of the single-deck type is 0.6”. The rotor contacts are also silver-alloy. Maximum panel thickness is 1/8”. Dielectric strength of the insulation is 1000v rms, minimum. For more data, turn to the Reader’s Service Card and circle 36.
Small Multi-Deck Switch

From top to bottom, the switch is made in three-, two-, and single-deck versions.

Inquiries are invited in the field of Research and Development

PHOTOGRAPHIC RECORDING EQUIPMENT FOR RESEARCH AND DEVELOPMENT

Pacific Laboratories designed and built the first photographic recording equipment exclusively for research and development data recording, starting with the Type V-10 Camera which was specifically designed for aircraft flight test. Since then, a continuous program of improvement, based on more in-use service and experience than any other organization in this field, has resulted in the development of photographic recording equipment for many other research and development requirements.

The high cost of setting up for tests makes imperative the utmost reliability in the recording equipment used. Complete facilities for manufacturing and assembly enable Pacific Laboratories to maintain close control of precision and quality which assure dependable performance.

Pacific Laboratories are specialists in photographic recording of electronic and radarscope presentations requiring single and double frame, 35mm recording, with pulse, continuous and motion picture operation.
Miniature Transponder

The miniaturized two-stage pre-selector is indicated by the color block. The plastic board is a terminal board and not a printed circuit board.

BY NOT ATTEMPTING to design a transponder that can duplicate all the functions and characteristics of existing transponders, the designers of the unit shown on these pages have produced a much more compact and inexpensive device. As a result, the transponder can be installed in aircraft, vehicles, or boats that could not carry the heavier models.

A transponder is a device that sends out a pulse signal when triggered by a signal from a ground radar. Its principle use is in airport operations where it prevents the ground radar crew from ever losing sight of approaching planes. This particular transponder could have great value in the near future when more and more private and executive planes are in operation, greatly complicating airport operations. A transponder can also be employed to identify the plane in which it is installed. The unit discussed here was developed by Radio Receiver Co., Inc., 240 Wythe Ave., Brooklyn 11, N. Y.

The first step in the miniaturization process was the decision to use subminiature tubes—of the reliable type—for the bulk of the transmitter and receiver design. One miniature tube, a 5763, produces over 20w of transmitted power as a pulse modulator. To gain further miniaturization, a power oscillator is employed instead of a crystal oscillator. Instead of the more sensitive superheterodyne-type receiver, a much cheaper crystal video receiver was designed. This receiver has 90db gain with a 2.5Mc bandwidth. Special receiver characteristics have been achieved by using cascaded linear feedback pairs incorporating negative capacity loops in combination with several non-linear feedback loops.

A thermistor is incorporated in the receiver circuit
The separate power supply chassis is mounted on top of the transponder. The device can also be made with an integral power supply.

varying the receiver gain with temperature to automatically compensate for the increase in noise of the crystal with decreasing temperature. If the noise level rose too high, the transmitter would fire randomly although the transponder is not being interrogated. The receiver can handle a wide variation in input signal without requiring a gain control and without loss of pulse reproduction fidelity. As the input signal level rises, pulse-stretching in the crystal-video receiver is kept to a minimum.

The vibrator power supply has an overall efficiency of 70%. Three supply voltages are required: -24v bias, 150B+, and +1250. The +1250v supply drain varies with duty cycle (the number of interrogations). By utilizing different half cycles of the vibrator, the B+ supplies do not interact and some regulation is gained.

The circuit contains provision to prevent overloading of the transmitter due to excessive interrogation by automatically counting down the number of replies to each interrogation. This transponder contains its own decoder, and provision has been made for external decoding when desired.

The developers of this device are to be commended not only for their skill, but for their daring in developing an instrument based on a concept that has not yet been approved by the cognizant government agency — the Air Navigation Development Board. This concept and the device itself must be approved before it can be sold and installed in civilian aircraft. It also has obvious military applications. This transponder represents another example of how electronic design and development engineers are changing the ways of the world.

MOLONEY ELECTRIC COMPANY
Power Transformers * Distribution Transformers * Step Voltage Regulators * Regulating Transformers * Load Tap Changing Transformers * Load Center Transformers * Unit Substations * Network Transformers * Constant Current Transformers * Capacitors * Transformers For Electronics
SALES OFFICES IN ALL PRINCIPAL CITIES * FACTORIES AT ST. LOUIS 20, MO. AND TORONTO, ONT., CANADA.
CIRCLE 38 ON READER-SERVICE CARD FOR MORE INFORMATION
43
Useful Plots of Transmission Line Relations

Essad Tahan
Air Associates, Inc.
Orange, N. J.

This article presents a number of the more frequently used transmission line equations in a graphical form for easy reference. The use of these graphs saves time and allows a clearer treatment of transmission lines.

**VSWR**—One of the most important measurable quantities in this type of work is the voltage standing wave ratio. In practice, a directional coupler or reflectometer may be used to measure the mismatch on a line. These devices are designed to couple into a line to measure the magnitude of the incident and reflected voltage waves. VSWR can be calculated from equation 1.

\[ \text{VSWR} = \frac{V_i + V_r}{V_i - V_r} \]  

(1)

where \( V_i \) = magnitude of the incident voltage

\( V_r \) = magnitude of the reflected voltage

and rearranging:

\[ \frac{V_i}{V_r} + 1 \]

\[ \frac{V_i}{V_r} - 1 \]

\[ \text{VSWR} = \frac{V_i}{V_r} + 1 \]

(2)

Now the reflection coefficient at the load end of the transmission line is equal to \( k \), where:

\[ |k| = \frac{V_r}{V_i} \]

(2a)

thus:

\[ \text{VSWR} = \frac{1 + |k|}{1 - |k|} \]

(3)

or

\[ \frac{1}{|k|} = \frac{\text{VSWR} + 1}{\text{VSWR} - 1} \]

(3a)

Equations 3 and 3a are of the same form and can be represented as:

\[ \rho = \frac{a + 1}{a - 1} \]

(4)

Fig. 1 is a plot of this equation. Two curves are plotted here. Upper curve A is used with the abscissa at the bottom of the graph, and the lower curve B used with the abscissa at the top of the graph. This plot has an interesting property in that either \( a \) or \( \rho \) can be made the ordinate and the other the abscissa to represent the following: (1) if \( \rho = 1/|k| \) \( a \) will be the VSWR on the line; (2) if \( \rho = \text{VSWR} \), then conversely \( a \) is \( 1/|k| \) or the ratio of incident to reflected voltages; (3) if \( \rho = 1/|k| \) \( a \) will be the value of impedance on the line at a \( V_{\text{min}} \) or \( V_{\text{max}} \) which is resistive.

These curves are useful for a VSWR, \( 1/|k| \) or \( V_i/V_r \), and \( z \) from 1.0 or 0 db to 100 db. To obtain accuracy the following ranges are set up for use with these curves.

Case a for VSWR's or \( z \)'s on line having values from 1 to 9, let \( 1/|k| \) be the ordinate of the curves and the VSWR or \( z \) the abscissa.

Case b for VSWR's or \( z \)'s on line having values from 10db to 100db, let \( 1/|k| \) = \( V_i/V_r \), be the abscissa and VSWR or \( z \) the ordinate.

Actually for any VSWR in excess of 1.25 or 1.9db, one can use the ordinate as VSWR and the abscissa will give the magnitude of the reciprocal of reflection coefficient directly such as in case b. After a few trials, one can automatically choose the ordinate and abscissa for the best accuracy and speed.

An example of each case discussed above will be presented:

**Example 1**—Consider a lossless transmission line having a VSWR equal to 10db. Find the reflection coefficient at the load.

Now since the VSWR is less than 10db, use curves as specified in case a. Locate the intersection of the vertical line from VSWR = 3.16 = 10db on the ordinate to curve B or point 1. Find \( 1/|k| \) from horizontal projection to the left ordinate, i.e., \( 1/|k| = 5.7 \)db which is equal to 1.92. Thus \( |k| = 0.521 \).

If one desires to use the curves as specified in case b, locate the intersection of the horizontal line from VSWR = 10db on the ordinate to curve A or point 2. Find \( 1/|k| \) from the vertical projection to the lower abscissa, i.e., \( 1/|k| = V_i/V_r = 1.92 \), and \( |k| = 0.521 \) which checks above value.

**Example 2**—What is the amount of power reflected on a line having a VSWR of 1.20?

By necessity, one must use the chart with the VSWR as the abscissa and \( 1/|k| \) as the ordinate. Proceeding as in example 1, the magnitude equals 21db or \( |k| = 0.09 \). Thus the power reflected equals \( (k)^2 \) or 0.0081 which equals 0.81%.

**Example 3**—What is the ratio of the magnitude of the incident to reflected voltage on a line having a 1.06 VSWR?

Using the VSWR as the abscissa and from curve A, \( V_i/V_r \), equals 30db.

VSWR Attenuation—Another useful relation is the VSWR at any Point d on the transmission line having a mismatch at the receiving end and an attenuation, \( o d \), between the point in question and the load. The equation is as follows:

\[ S_d = \frac{\frac{I}{k_r} + e^{\lambda o d}}{\frac{I}{k_r} - e^{\lambda o d}} \]

(5)
where

\[ S_d = VSWR \text{ at any point } d \text{ on the transmission line} \]

\[ k_r = \text{magnitude of reflection coefficient at the receiving end} \]

\[ ad = \text{total attenuation between the receiving end and} \]

\[ \text{point } d \text{ in nepers} \]

This equation is plotted in Figs. 2, 3 and 4 and its derivation is shown in the appendix. Examples illustrating the use of the charts are:

A few examples will be given to illustrate the use of the charts.

**Example 4**—If the load terminating a line or cable has a VSWR equal to 2, what attenuation is necessary to reduce the mismatch to 1.1? From the curves in Fig. 2 for \( S \), equal to 6db, locate the intersection of the vertical line from 1.1 on the abscissa and then project horizontally over to 8.4db. This is the necessary attenuation to reduce the mismatch at the load to 1.1.

**Example 5**—If the VSWR on a slotted line is 2.2, and if a cable is used to connect the line to the load, what is the actual VSWR of the load if the cable has 1.5db of attenuation? The VSWR from the curve in Fig. 2 is 10db or 3.16.

**Example 6**—What is the VSWR looking into a piece of RG 21/U cable having a total attenuation of 10db if it is terminated in a load having a 10db VSWR? Assume cable connectors have a unity VSWR. The input VSWR from Fig. 2 is 1.11.

The curves plotted in Figs. 2, 3 and 4 cover a range of VSWR at the load from 1.0 to infinity and cable or line attenuation from 0.1db to 30db which for all practical purposes covers all the cases encountered in use.

The curves shown in Fig. 2 have the following ranges:

\[ 1 \leq S_d \leq 2.45 \]
\[ 0 \text{ db} \leq S_r \leq \infty \]
\[ 0.1\text{ db} \leq ad \leq 100\text{ db} \]

and for Fig. 3:

\[ 1 \leq S_d \leq 100 \]
\[ 10 \leq S_r \leq \infty \]
\[ 0.1\text{ db} \leq ad \leq 10\text{ db} \]

Fig. 4 is a plot of the relation \( e^{ad} \) versus \( ad \) and is useful for calculations when it is desired to evaluate \( S_d \) by equation 5. This applies for cases where the actual VSWR at the receiving end, \( S_r \), is not plotted in Fig. 2. One example of each illustrates the use of Figs. 2 and 3.

**Example 7**—Find the VSWR looking into a length of

**ELECTRONIC DESIGN • November 1955**
RG 8/U cable having an attenuation of 1db when the cable is terminated in a short having an $S$, equal to 40db. From Fig. 3 project across on the line corresponding to $ad$ equals 1db until it intersects the curve for $S$, equal to 40db. The VSWR at a point $d$ or $S_d$ equals 8.

**Example 8**—Find the actual VSWR load if the $S_d$ on a slotted line is 2 and if a cable having a total attenuation of 0.5db is inserted between the slotted line and the load. Since the intersection of the horizontal projection from the ordinate $ad$ equals 0.5db and the vertical projection from $S_d$ equal to 2 does not occur at a plotted curve, one must calculate $S$, using equation 5, Figs. 1 and 4.

By rearranging equation 5:

$$\frac{1}{k_r} = e^{-2ad} \left[ \frac{S_d + 1}{S_d - 1} \right]$$

The value of $e^{-2ad}$ is obtained from Fig. 4 and when this plus the value of $S_d$ are substituted in equation 6, the result is $1/k_r = 2.67$. The VSWR of the load $S$, is quickly obtained from Fig. 1 as 6.9db or 2.22.

Also the efficiency of any specified length of a transmission line (TLE) can be calculated from Fig. 4 if $ad$ in db is known.

$$\frac{P_r}{P_s} = \frac{I_r^2}{I_s^2} = e^{-2ad} = \text{TLE}$$

where $P_r$ and $P_s$ is the power and $I_r$ and $I_s$ is the current at the sending and receiving end, respectively when the line is terminated in its characteristic impedance.

$$P.L. = 1 - \text{TLE} = \text{power loss}.$$  

See the appendix for the derivation.

**Example 9**—Find the efficiency of a 200' run of 50-ohm transmission line having a $3\frac{3}{4}''$ outer conductor for TV channel 13. For channel 13, $\alpha' = 0.155db/100'$; total attenuation ($ad$) = $2\alpha'd = 2 \times 0.155 = 0.310db$.

From Fig. 4, for $ad$ equal to 0.310db, $e^{-2ad}$ is found to be 0.93 or the transmission line efficiency is 93% and the power loss in the line is 7%.

**Example 10**—What is the efficiency of a 500' length of $15\frac{3}{4}''$ 50-ohm transmission line for channel 4? For channel 4, $\alpha' = 0.173db/100'$, and $ad = 5 \times 0.173 = 0.865db$. From Fig. 4 the efficiency is 82.5% and the power loss is 17.5%.
Thus, the attenuation at any point d on the line equals:

\[ \text{TOTAL ATTEN.} \]

where \( k_d \) equals the attenuation per unit length in nepers.

For a lossless line, \( \alpha = 0 \), the above equation reduces to:

\[ S_d = \frac{1}{k_r - 1} = S_r \]

Derivation of equations 7 and 8:

\[ K_r = k_r \frac{V_r^-}{V_r^+} = \text{Reflected Voltage} \]

\[ K_d = k_d \frac{V_d^-}{V_d^+} = \text{Incident Voltage} \]

Setting \( \gamma = \alpha + j\beta d \) where \( d \) is a positive number:

\[ V_d^- = V_r^- e^{\alpha d} e^{i\beta d} \]

\[ V_d^+ = V_r^+ e^{\alpha d} e^{-i\beta d} \]

Therefore,

\[ K_d = \left( \frac{V_r^- / V_r^+} \right) e^{\alpha d} e^{-i\beta d} \]

\[ k_d = \frac{V_r^- / V_r^+} e^{-2\alpha d} \]

thus

\[ k_d = k_r e^{-2\alpha d} \]

(since \( k_r = V_r^- / V_r^+ \))

Also the VSWR, \( S_r \), at the receiving end from equation 3 equals:

\[ S_r = \frac{1 + k_r}{1 - k_r} \]

Thus the VSWR at any point \( d \) on the line equals:

\[ S_d = \frac{1 + k_d}{1 - k_d} = \frac{1 + k_r e^{2\alpha d}}{1 - k_r e^{2\alpha d}} = \frac{1}{k_r e^{2\alpha d}} \]

The transmission line efficiency (TLE) is:

\[ P_r / P_s = I_r^2 / I_s^2 = e^{\alpha d} \]

and the power loss, \( PL \), equals:

\[ PL = 1 - \text{TLE} \]
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Centralab's New Molded Disc Ceramic Capacitor

Only one of its kind! The only molded, completely insulated, ceramic disc capacitor. Breakdown to ground in excess of 3000 V.D.C.

Strong! Unaffected by extremes of vibration; by ozone, salt water, or any known acid or solvent at room temperature.

Accurate! Thickness, diameter, and lead spacing are always exact. And leads are always on perfect center line—never offset. The answer for automatic assembly.

Dependable! New basic ceramic body. Capacitance characteristics are virtually flat over a wide temperature range.

Leads can't pull out! Lead strength is greater than the tensile strength of No. 22 wire.

Clearly labeled! Stamped with capacity, voltage rating, and tolerance.

Write for engineering bulletin EP-48, for facts and figures on Iso-Kap.

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for electronic components,
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Electronic-Kwiz No. 9

NEW THIS MONTH!

1st Prize—Two single electric blankets
Don't be fooled! You have a good chance to win. Simply answer this question in 50 words, more or less:

How do you feel personally about the matter of patent rights? Should they belong to the individual inventor—or to the company who employs him?

A leading editor will pick the winner of this month's major prize.

Mail your entry to us before November 30.

†Nothing to buy. Employees of Centralab and their advertising agency not eligible. Duplicate prizes awarded in case of tie. Entries become the property of Centralab—none can be returned.
Tiny Trimmer Potentiometer

TRIMMER potentiometers are getting smaller and smaller. The wire-wound unit described here can be cemented into a hole only 0.27" diam or mounted in a diode clip. It only weighs 1.1 gr (0.039 oz).

This high-resolution trimmer is also available in a version with a threaded body for panel mounting that weighs 2.2 gr. The lighter version (Type 101) can also be supported by its own leads like a resistor. These units have an adjustment knob at one end that can be turned with the fingers or by screwdriver. The knob can be turned 320°. The resistance of the standard unit is 4700 ohm, but special models with resistance from 330 to 3300 ohm can be ordered. This trimmer is made by Carter Manufacturing Co., 23 Washington St., Hudson, Mass.

These trimmers are particularly useful in aircraft and missile applications or in transistor circuits. They are housed in a tough thermosetting plastic. They dissipate 1/4w at 20°C. The leads are 1-1/2" long tinned single-conductor. The temperature coefficient of resistance of the winding is 0.002% per degree C, for resistance values over 100 ohm. For more data, turn to the Reader's Service Card and circle 40.

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Sure, you could pay less for an ordinary knob, but the premium price of the Raytheon Standard Control Knob is well worth the difference! Here's why:

Raytheon knobs conform to government specifications for material, high and extreme temperature, humidity, salt spray, vibration, impact and torque. They are handsomely designed and molded of "Tenite II." They have anodized aluminum inserts with dual Allen head set screws. Most important, Raytheon knobs offer the smartly turned professional look that adds so much to the fine appearance of your product. You put time, skill, money inside your equipment. You incorporate the finest circuitry; you select each component with care—your goal is quality in every detail. Naturally, this means quality outside, too. The right knobs, the finest knobs give the important finishing touch. They help convince your customers that yours is thoughtful, thorough craftsmanship.

Let us send you complete information on the finest control knobs available today. Write Dept. 6120, or see your electronic supplier.

OTHER FINE RAYTHEON STANDARD CONTROL KNOBS

Prices range from 69¢ to $3.10

Round Skirted Round Pointer Skirted Pointer Crank Knob

RAYTHEON MANUFACTURING COMPANY
Equipment Marketing Division
Waltham 54, Mass.

This unit is being cemented into the hole.
A PREDETERMINED COUNTER OF HIGH-SPEED VERSATILITY!

The "genius" of the LFE 502 lies in its ability not only to count a predetermined number of impulses, but also to use these pulses for control. So, when you buy the 502, you're buying both a Predetermined Counter and a control device in one compact instrument. Automatic sorting and packaging, control of motor speeds or machine tools, generation of precision delays, interval measurements — whatever counting and controlling task you assign the LFE 502, you can depend on this accurate, dependable, high-speed instrument to give you perfect satisfaction.

For specifications and more details about these new instruments, write for our free informative bulletins and the name of the LFE Engineering Representative nearest you. Inquiries on export sales should be addressed to Andrew S. Sauv, Inc., 50 Broad St., New York 4, N.Y.

LABORATORY FOR ELECTRONICS, INC.
75 Pitts Street, Boston 14, Mass.

CIRCLE 42 ON READER-SERVICE CARD FOR MORE INFORMATION

Push-Pull Volume Control Switch

Floating contact ring is engaged with terminal contacts as shaft is pushed in. U-shaped spring is pivot. Because ring floats, contact life is long.
VOLUME controls with push-pull on-off action are a sales feature which radio and TV set manufacturers can now offer to their customers. Once volume is adjusted for the desirable loudness, the listener can turn his set on anytime at the same volume simply by pulling the shaft. There is no need to wait for warm up, no readjusting. In addition to greater convenience to the set owner, the push-pull switch reduces mechanical wear and extends the life of the volume control.

Long switch life is achieved by the P. R. Mallory & Co., Inc., Indianapolis, Ind., by using a small floating contact ring made of a special alloy. The ring floats on its retaining pin, and every time the switch is used, the contact ring rotates. Thus, a new surface area makes the actual contact. Are erosion and wear is spread around the whole circumference of the ring and contact life is substantially increased. The floating ring-contact is moved radially to engage the terminal contacts by the pivoting actuating spring. This U-shaped spring serves as the coupling between the shaft and the contact. Of course, the volume control has longer life because it need not be rotated except for minor volume adjustments.

Controls with resistance values from 200 ohms to 10 megohms are available with the push-pull switch. For more information, turn to the Reader's Service Card and circle number 43.

**Here are 6 reliable precision switches for multiple circuit control**

Whether your requirement is a single switch to control one circuit or an assembly of switches to control many circuits you will find that MICRO SWITCH engineering keeps pace with your needs.

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CIRCLE 44 ON READER-SERVICE CARD FOR MORE INFORMATION
New Products

Extremely Small Transistors
Volume is 0.0087 cu. in.

These p-n-p fused junction germanium transistors which are one-quarter to one-third the size of former units have a volume of only 0.0087 cu. in. They are designated types 2N130, 2N131, 2N132 and 2N133. The first three are intended for use in audio or low radio frequency applications; the fourth is a low noise transistor for use in low level audio circuits. The average noise factor of the 2N133 is 6.5db and will not exceed a maximum limit of 10db. This is an improvement over older types having a maximum noise factor of 12db. Maximum ambient temperature is 85°C. These new transistors are electrically similar to and are designed to replace the CK 721 series. Raytheon Manufacturing Co., Dept. ED, 55 Chapel St., Newton 58, Mass.

CIRCLE 45 ON READER-SERVICE CARD FOR MORE INFORMATION

Deposited Carbon Resistors
Double Molded Insulation

This new 1/2w molded deposited carbon resistor is designed for applications that require a combination of precision, stability and small physical size along with the added benefits of double insulation.

The double insulation offers complete mechanical protection, longer load life, better electrical insulation, greater moisture resistance and performance that exceeds all electrical requirements of MIL-R-10509A. Electra Mfg. Co., Dept. ED, 4051 Broadway, Kansas City, Missouri.

CIRCLE 46 ON READER-SERVICE CARD FOR MORE INFORMATION

AN Connectors
Make Hermetic Seals

HS 2 (AN 3102) receptacles and HS 6 (AN 3106) plugs feature hermetic “Vac-Tite” glass-to-metal construction to insure leakproof performance under conditions of extreme heat and pressure. They are for use in severe instrumentation problems where the vacuum tightness and ar-reistance of glass are necessary during high-temperature operation. Shock and vibration proof, they are corrosion resistant, 100% moisture and pressure repellant, and equivalent to MIL-C-5015. Hermetic Seal Products Co., Dept. ED, 33 S. 6th St., Newark 7, N. J.

CIRCLE 47 ON READER-SERVICE CARD FOR MORE INFORMATION

Cathode-Ray Indicators
For Large-Size Displays

These two new units, 17" and 21" indicators, employ television-type cathode-ray tubes and are designed primarily for use in conjunction with low-frequency, laboratory-type oscillographs as well as other electronic amplifying equipment. The 17" instrument, the Type 343, mounts in the standard 19" rack-and-panel or rack cabinet. The larger screen unit, Type 345, is housed in a metal cabinet.

The coupling of the indicator to a master oscillograph is performed through the illustrated cathode-follower adapter (supplied with Types 343 and 345) which alters the impedance of the master oscillograph deflection-plate signals to a value suitable for transmission over lines up to 100' in length. Allen B. DuMont Laboratories, Inc., Dept ED, 760 Bloomfield Ave., Clifton, N. J.

CIRCLE 48 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic Counter
Measures Frequency, Speed, Etc.

The Model 512A is a portable, high-accuracy electronic counter that can measure frequency, speed, rpm, random events, weight, temperature pressure, acceleration, and many other phenomena. It provides direct numerical readings in c/s, rpm, or rps, from 1cy to 120kc. The period of count is either 1.10sec or 1sec and the count display time can be varied at will. The instrument uses conventional power line frequency for counting time base; or is available with a plug-in crystal time base for measurements of more precise accuracy. It includes three accessory power supplies of -150v d-e, +300v d-e, and a 6.3v a-c filament supply. Connections are also supplied for photocells and an external standard. Weight is 25 lb. Hewlett-Packard Co., Dept. ED, 275 Page Mill Rd., Palo Alto, Calif.

CIRCLE 49 ON READER-SERVICE CARD FOR MORE INFORMATION

Subfractional Motor
In 3" Diam Frame

This subfractional motor, in a 3" diam frame, is for instrument, recording unit, and office appliance applications. Most units will be of the single-value capacitor type, for single-phase operation. Efficiencies of the various ratings run over 30%, which is high for motors of this size; as a result, there is a lower temperature rise.

Units have nominal ratings for continuous duty of: 1800rpm and 3600rpm (synchronous) and 1700rpm and 3400rpm (induction). They are available in a variety of power ratings from 1/50hp to 1/200hp. Holtzer-Cabot Motor Div., National Pneumatic Co., Inc., Dept. ED, 125 Armory St., Boston, Mass.

CIRCLE 50 ON READER-SERVICE CARD FOR MORE INFORMATION
Uses Solid Thermosetting Compound

The "Royal Cub" paper-dielectric capacitor combines high temperature and high stability operation with mechanical toughness and long life characteristics, achieved by the use of "Polykane", a solid thermosetting compound. The capacitor operates over a −55° to +100°C range at full-rated voltage. Average capacitance-temperature variation is 5% from the 25°C value, insulation resistance at 25°C exceeds 4000 megohms-mfd, with power factor less than 1%. The capacitor is available in 100, 200, 400, 600, and 1000v d-c working, and capacitances from 0.001mfd to 1.0mfd, depending on voltage. Cornell-Dubilier Electric Corp., Dept. ED, Plainfield, N. J.

CIRCLE 51 ON READER-SERVICE CARD FOR MORE INFORMATION

Printed Circuit Cables
New Plastic-Copper Laminate

Unique, flexible printed circuit cables, made by an exclusive process of laminating the versatile plastic Kel-F with copper in thin sheets, are a new concept in multi-conductor cabling.

The new cables have excellent electrical and mechanical properties for operation over a wide range of environmental conditions. Complete encapsulation of the conductors in Kel-F ensures maximum protection against moisture. Glass cloth can also be included in the laminations for increased strength and high temperature stability.

These new cables are lighter and thinner than many conventional cables. They are adaptable to many types of connectors or terminations and are easily secured by clamps, rivets or cement. The design eliminates wiring errors.

Additional conducting and insulating layers can be added to the basic cable to provide a greater number of separate conductors. As many as three conducting layers are possible, depending on the flexibility required. Each layer is made slightly shorter than the layer below to expose all the conductor ends for solder connection. Stacked circuits have been built up to five layers and may go higher depending on the application. Sanders Associates, Inc., Dept. ED, Nashua, N. H.

CIRCLE 52 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW VLI (VERY LOW IMPEDANCE) DIODE

up to 300 ma at 1 volt with excellent stability and fast recovery time.

VLI DIODE CHARACTERISTICS @ 25°C

<table>
<thead>
<tr>
<th>Current</th>
<th>Max. Reverse Current</th>
<th>Max. Reverse Anode</th>
<th>Max. Working Current</th>
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<tr>
<td>ma min.</td>
<td>-10V -30V -50V -100V -150V Voltage ma</td>
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The new Sylvania V.L.I. Diode is a significant development for electronic equipment designers with applications for high current carrying diodes. For the first time, you can expect high forward conductance combined with stable, drift-free performance, and fast recovery time.

The new Very Low Impedance diode is the result of recent technological advances in the diode field by Sylvania research engineers. It's the ideal diode for demanding computer applications in clippers, clampers, and logical circuits. In fact, it's the only diode wherever you want high forward conductance with high back resistance—high current carrying capacity with fast recovery time—and high rectification efficiency. The V.L.I. diode is designed into the Sylvania sealed-in-glass package and is 100% inspected for a positive, protective seal.

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CIRCLE 53 ON READER-SERVICE CARD FOR MORE INFORMATION

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ELECTRONIC EYES ON THE MOVE

...made of magnesium

Now is the time to get complete details about Dow magnesium—

* It's light in weight, actually the lightest of all structural metals.
* It has high strength and rigidity which permits simplifying your design for even further weight reduction.
* Excellent weldability and formability are just two of the many plus values in fabricating magnesium.

From design to production is a long trip—take the first step with the right metal! Investigate magnesium. Complete engineering and fabricating facilities are available at Dow's Bay City Division as well as from other fabricators located throughout the country. THE DOW CHEMICAL COMPANY. Magnesium Sales Department MA 307E-1, Midland, Michigan.

Subminiature Capacitors
Complete Line, Down to 3v

The tiniest capacitor most suitable for any given application can be supplied by this company. Paper, metalized-paper, electrolytic, mica, ceramic, and all the film dielectrics such as mylar, teflon, polystyrene, etc., as well as types of impregnants are used as required to obtain the tiniest capacitor compatible with the overall specification characteristics required.

Miniatures and subminiatures are available in all capacities from 0.1 mfd to 500 mfd, and in capacity tolerances from 0.1 to 20%. Units are furnished in voltages from 3 to 1000v. Operating temperature ranges are available as specified from -65 to 200°F, without derating. Units have high insulation resistance, low power factor, high Q, moisture resistance, shock resistance, etc.

Capacitors can be supplied cased or uncased, flat or round, in ceramic, metal, or plastic types. Leads can be positioned radially, axially, for plug-in or any other required position. Leads in all types are plastic anchored and cannot be pulled out. Capcon, Inc., Dept. ED, 25 Willett St., New York 2, N. Y.

CIRCLE 54 ON READER-SERVICE CARD

Power Connectors
Meet Amended MIL-C-3767

These miniature armored connectors meet the requirements of the recently amended military specification MIL-C-3767 (Amendment No. 1). The 2-bladed Version, UP120M, and the 3-bladed UP121M conform to the new military standard drawings set forth in MS 91184 and MS 91185 respectively. Equipment manufacturers can therefore specify these components for electronic and electrical equipment referencing the foregoing specs. Plugs are rated for 125-15amp up to 250-10amp, and will accommodate cables from 0.125 to 0.450" diam. The grounding blade on the UP121M is removable. Automatic and Precision Manufacturing Co., Dept. ED. 252 Hawthorne Ave., Yonkers, N. Y.

CIRCLE 55 ON READER-SERVICE CARD

CIRCLE 56 ON READER-SERVICE CARD
Plastic Foam Cores
High Dielectric Constant

Ecofoam Hi Ki combines high dielectric constant and low weight for microwave lens systems, antennas, and the cores in sandwich type radomes. The material has an extremely low dissipation factor and is usable from -65 to 275°F. It is presently available as sheet stock which can be machine readily, or as custom molded shapes of exact dimensions. Dielectric constant for density of 5 lbs/cu ft is 1.1 to 4.0. For 10 lbs/cu ft, it is 1.2 to 7.0. Emerson & Cumming, Inc., Dept. ED, 860 Washington St., Canton, Mass.

CIRCLE 58 ON READER-SERVICE CARD

Behind Panel Meter
Features Large Scale

A new plexi-covered indicating instrument with a 6" x 2-1/2" dial face is especially useful where rapid, accurate readings must be made from a distance or where several scales must be combined in one instrument. It is designed for mounting behind the equipment panel. The SS56 meter with its 6" dial arc length is available as a moving coil permanent magnet type in all d-e ranges; nominal 2% accuracy. Although the plexiglass cover allows for exterior or edge lighting, the SS56 is also supplied with provision for internal scale illumination. Marion Electrical Instrument Co., Dept. ED, Manchester, N. H.

CIRCLE 59 ON READER-SERVICE CARD

Synchronous Motor
Has High Torque

This low-priced 430 series reversible synchronous motor measures only 2" x 2" x 2" in overall dimensions. It develops an exceptionally high starting and synchronous torque. Torque is 5in.-pounds at 1rpm at rated voltage of 115v. Speed range is from 1800-rpm to 10rph. Bristol Motor Div., Vocaline Co. of America, Inc., Dept. ED, Old Saybrook, Conn.

CIRCLE 60 ON READER-SERVICE CARD

NEW G-E APPLICATION APPROACH CUTS DESIGN TIME...

The Exact Vac-u-Sel* Rectifier You Need Can Now Be Chosen in Minutes...On-the-spot

This new application approach, recently developed by General Electric, assures you of getting the correct Vac-u-Sel rectifier to meet your exact requirements. Now you are assured of getting the full advantage from the long life and outstanding technical characteristics inherent in all the many sizes and types of Vac-u-Sel rectifiers. In addition, in practically all cases, the sales engineer can give you the exact identification and price of your stack on the spot, without the inconvenient delay involved in getting data from the factory.

CIRCLE 61 ON READER-SERVICE CARD

G-E SALES ENGINEERS are able to determine, on the spot, the exact Vac-u-Sel stack to suit your particular application.


GENERAL ELECTRIC
**Wafer Cell**

Gives High Power in Small Space

This "wafer cell" is designed to make possible a 30% increase in battery power and life, while eliminating traditional hand operations from cell manufacturing. It consists of a sandwich of artificial manganese dioxide mix between tiny disks of flat zinc and carbon electrodes. The carbon rod of round cell batteries has been replaced by a small piece of conductive carbon, and the whole sandwich is wrapped in an airtight pleated envelope and heat sealed. Welded or soldered wire connections between cells are eliminated by the use of silver wax; a dab of wax on the positive and negative sides of the cell permits the cells to be connected in series merely by being stacked in a column.

A 2" battery made from 13 cells in a single column develops 22-1/2v. Multiple cell stacks enable this firm to produce miniature high-voltage batteries for heavy-duty electronic applications. The U200 battery for example, provides over 300v in less than 20 cu in. Burgess Battery Co., Dept. ED, Freeport, Ill.

CIRCLE 63 ON READER-SERVICE CARD FOR MORE INFORMATION

**Timing Receiver**

For Missile Test Instrumentation

Designed especially for missile and aircraft test range instrumentation, the Model 2 "PCM" Timing Receiver is a highly sensitive, low-noise figure super-heterodyne designed for reception of pulsed signals in the 152-174Mc range. It accepts and reproduces pulses from 1-20μsec long. The receiver noise figure is 6db to 7db, and band width is 1Mc. This receiver is designed to operate completely unattended. Its fully automatic gain control, which maintains essentially constant output with input signals whose levels vary from 5μv to 10,000μv, and its frequency stability of ±0.005 percent, make manual adjustments unnecessary. It mounts in a standard 19" relay rack, and is 10-1/2" high. It requires a power supply delivering 100ma, 200v regulated d-c, and 6.3v a-c. West Coast Electronics Co., Dept. ED, 5873 Jefferson Blvd., Los Angeles, Calif.

CIRCLE 64 ON READER-SERVICE CARD FOR MORE INFORMATION
M E M O

FROM: THE ENGINEERING STAFF AT NJE

TO: DESIGNERS WHO USE HIGH-CURRENT REGULATED POWER SUPPLIES
(for computers, aircraft electromechanics, mobile electronics, etc.)

SUBJECT: What is Zero-Lag?

We got tired of defining response time...so we got rid of it. Here's how:

Response time is rarely a problem if vacuum-tube
series regulator techniques can be used. Correction for rapid load or line fluctuations is fast, and a small capacitor across the power supply output will "soak up" the small transient which occurs.

Above an ampere or two, however, the series regulator is pretty sad. Too hot. Inefficient. Too many tubes. Too much maintenance. It is especially sad at low output voltages.

We say this without prejudice...for we build all seven types of electronic power supplies, including dozens of special series-regulator output voltages every month.

But, when a customer comes to us for a recommendation, say, a 10-40 volt, 20-ampere unit to actuate a high-speed jet-engine valve...or a 150 volt, 60-ampere unit for a computer plate supply...if he needs freedom from transient lags, we recommend the only system we know that will meet his requirement economically -- NJE Zero-Lag.

Basically, our zero-lag system exhibits no lag because the voltage never leaves the regulated region.

Here's the circuit:

The trick is in the thyratron response speed, and in the value of C—which is often as much as a farad. (Don't let anyone ever tell you the farad isn't a practical unit—we have over 80 farads working in the field right now.)

If you have transient problems in the 0-500 volt, 0-100 ampere range—call or write us. The "lag" in our custom quotation department is about one week—but the lag in our power supplies is zero...absolutely zero.

MEMO - ELECTRONIC DESIGN - November 1955

PULSE HEIGHT ANALYZERS
With 0.2% Linearity

Two pulse height analyzers, Models 3300 and 3301, are of 100 and 256 channels counting capacity and use magnetic core memory circuits. They are based on the Argonne National Laboratory Model 101 design. Rates of accumulation of data may exceed 1,000,000 cpm, and input pulse rates of as much as 10 times this rate of actual accumulation can be tolerated without distortion of the spectrum.

Data accumulation is in the decimal mode, and permanent readout is by decimal printer and/or precision linear graph form by means of a Brown recording potentiometer. Even during the accumulation of data, the content of the memory is displayed in the form of an accurate linear plot of counts versus pulse amplitude on a cathode ray tube. This curve "grows" during the measurement interval.

Several different modes of operation of the analyzer are available, such as: in coincidence with the output of a separate single channel analyzer, or with a "window" effect to permit placement of all the channels into any region of the complete spectrum. Overall linearity is 0.2%. Radiation Instrument Development Laboratory, Dept. ED, 2337 W. 67th St., Chicago 36, III.

CIRCLE 65 ON READER-SERVICE CARD FOR MORE INFORMATION

SELENIUM RECTIFIERS
With Vacuum-Processed Plates

Two series of high-current low-voltage power rectifiers have been added to this firm's line. Designated as "XX" and "Z", they are available in 26v a-c ratings.

The "XX" cells measure 6" x 10" and are rated at 10amp d-c in single-phase half-wave and double half-wave circuits, or at 20amp d-c, single-phase bridge or single-phase center-tap circuits. Type "Z" cell's rating (and length) is about +30% greater. Bradley Laboratories, Inc., Dept. ED, New Haven, Conn.

CIRCLE 66 ON READER-SERVICE CARD FOR MORE INFORMATION
Vibrators
Withstands to 120g

Series 1600 and 1600g subminiature vibrators are 8-contact, 400cy units designed for either interrupter or self-rectifying (synchronous) operation. They are housed in cylindrical cases measuring 5/8" diam x 1-1/2" long, exclusive of prongs. The plug-in base fits a standard seven-pin miniature socket.

The Series 1600g vibrator has been specifically designed for operation under severe vibration, shock, and sustained acceleration such as encountered in missiles and other airborne devices. The total weight of its moving system is 8 milligrams. On the other hand, the force on the contacts when fully engaged is 250 grams. It shows no appreciable unbalance at a sustained acceleration at 50g, even along its most sensitive plane. It is expected that the amount of unbalance along this sensitive plane at an acceleration of 120g sustained will be low enough to permit normal operation. It can be driven at full amplitude with 450mw.

The Series 1600 vibrator is for use in the commercial field. Its high frequency and low driving power make possible the design of miniature power supplies for compact portable devices, such as electronic flash units, Geiger counters, walkie-talkies, etc. Vibration Research Laboratories, Inc., Dept. ED, 97 Lake Ave., Tuckahoe, N. Y.

CIRCLE 69 ON READER-SERVICE CARD FOR MORE INFORMATION

Alligator Clip
Only 1-1/16" Long

"Mini-gator" clips are only 1-1/16" long, with a nose of 11/64"OD and a weight of 1/20 oz. They are manufactured in both steel (cadmium plated) and solid copper. One piece insulators are available in both red and black. The vinyl plastisol insulators fit skin-tight, do not materially increase the clip's size, and cover it down to the nose to completely prevent shorts and shocks. Mueller Electric Co., Dept. ED, 15801 E. 31st St., Cleveland 14, Ohio.

CIRCLE 70 ON READER-SERVICE CARD FOR MORE INFORMATION
Moving Coil Forms
With Tolerances to ±0.001"

This line of moving coil forms for the instrument and electronics industries is produced by a new method which virtually eliminates cracked corners, incorrect temper, and failure to hold tolerances. The forms are available in aluminum alloy (25, 35, and 525) and in copper, with tolerances to ±0.001" and walls down to 0.003". Size range is from 5/8" OD down to smallest practicable (dimension refers to OD of tubing from which forms are made). Uniform Tubes, Inc., Dept. ED, Level Rd., Collegeville 2, Pa.

CIRCLE 71 ON READER-SERVICE CARD FOR MORE INFORMATION

Voltage-to-Digits Converter
5 Readings per sec

This compact analog-to-digital converter called the Type P Digi-Coder — converts any process variable that can be represented by an electrical signal into a form suitable for directly operating electric typewriters, digital printers, tape or card punches, lamp banks, or for initiating process control.

High speed, as many as five readings a second, plus high accuracy, ±0.15% full scale on all readings, makes the unit a versatile building block for data reduction and automatic control. It couples a self-balancing potentiometer to this company's Digi-Coder.

D-c input signals are amplified by a d-c chopper-type amplifier and then fed to a null-balancing potentiometer. The potentiometer servo mechanism supplies discrete shaft positions to the Digi-Coder section of the device. The output can be in decimal, binary, binary-decimal, teletype or any special digital code. In addition to coded output, visual readout is provided by dial pointer on a calibrated circular scale. The electrical analog input voltage span may be any d-c signal varying between 0-1mv up to 0-1v d-c. A 1sec full scale potentiometer is normally employed depending on the length of scale travel between readings, readouts at rates up to 5 per sec are possible. Fisher & Porter, Dept. ED, Hatboro 35, Pa.

CIRCLE 72 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic Design 
November 1955
"Vibration Isolation" has helped solve the increasing problem of mechanical vibrations in high fidelity reproduction of sound.

For years, sound engineers have been plagued by mechanical vibrations caused by movement of grips, dollies and other studio equipment. And the progressive development of the high fidelity microphone has increased the importance of eliminating the adverse effects of these disturbances.

Faced with this problem, design engineers of a leading manufacturer of microphones and related electronic equipment consulted with LORD engineers. LORD's 30 years of experience and knowledge in vibration control resulted in a bonded tube-form joint of live rubber which effectively isolated mechanical vibrations from the microphone head.

"Vibration Isolation" is the answer to only one of the many problems presented to and solved by LORD engineers. If you are interested in producing tape recorders, microphones and other types of reproduction equipment, LORD engineers are ready to consult with you. Let them help you produce equipment of the most exacting professional standards with LORD rubber bonded products.

Monitoring Indicator
Can Replace Bulky Oscilloscopes

The Type 360 Indicator contains a 3" flat-faced cathode-ray tube, accelerating-voltage supply, vertical amplifier with a sensitivity of 0.05v/div, and a calibrated vertical attenuator.

It can be operated from any source of the proper voltages and waveforms, although it was designed to work with the company's power supply and waveform generator.

A type 360 can take the place of a bulkier oscilloscope in single monitoring applications, or several can be used along with other instruments as building block in complex sequence-control and monitoring systems. Features include d-c to 500kc vertical-amplifier passband; four calibrated sensitivities from 50mv/div to 50v/div, with a 10:1 attenuator for continuously variable sensitivities from 50mv/div to 500mv/div. A horizontal gain control permits sweep calibration. Adapted to rack mounting, the unit has a weight of only 9 lb. Tektronix, Inc., Dept. ED, P. O. Box 831, Portland 7, Ore.

Toroid Coil
For Printed Circuits

This "Postage Stamp" Toroid Coil configuration was designed specifically for use in printed circuitry. Its tinned No. 20 AWG wire leads are spaced in accordance with the standards recently proposed the RETMA Automation Committee.

The unit consists of a subminiature molybdenum permalloy toroid core with a winding having a residual hole as small as 1/16" diam. Windings are impregnated with a special compound, and the finished coil is enclosed in a tough epoxy plastic. Overall dimensions are: 13/16" x 13/16" x 3/8" thick. It is available in any inductance up to 1hy. The useful frequency range covers 1500cy to 150ke, dependent upon inductance value. The unit is capable of withstanding temperatures from -55° to +125°C, plus extreme environmental conditions.

Hyco, Inc., Dept. ED, 11423 Vanowen St., North Hollywood, Calif.
Portable Power Supply
Regulated, Lightweight Unit

The 302C is a regulated, portable, low-cost power supply. With a weight of only 12 lb, it features excellent regulation over a wide voltage range with less than 3mv ripple.

A dual-scale meter, stand-by switch, pilot light, and fuse protection are standard accessories. Extra power, over 400v at 90ma, can be obtained for intermittent periods. To double voltage output, two units may be operated in series, or any number may be paralleled to increase current capacity. A separate bias output is also provided. Recovery time is better than 15-millisecond.

Three outputs may be obtained: 0-350v d-c at 80ma, continuously variable, with regulation less than ±0.05%; 0-150v d-c at 5ma, continuously variable, regulation less than ±1%; or 6.3v a-c at 500ma, unregulated, center-tapped. Input is 105-125v 50-60cy 150w max. Allied Engineering Div., Allied International, Inc., Dept. ED, South Norwalk, Conn.

CIRCLE 139 ON READER-SERVICE CARD FOR MORE INFORMATION

Tubular Capacitors
For Printed Circuits

Type 89P "Autocon" one-ended case solid dielectric paper tubular capacitors are designed for printed wiring board assemblies. They are enclosed in a pre-molded cylindrical shell of non-flammable thermostetting plastic with the capacitor section securely sealed against the entrance of moisture by a plastic resin end seal bonded to the phenolic housing. The two short, straight leads which issue from the end seal are held at a closely controlled distance from each other.

An index key molded in the phenolic housing adjacent to the outside foil lead facilitates identification of the lead for automatic insertion by machinery or hand operators. In addition, three stand-off feet raise the end seal and shell proper above the printed wiring board, avoiding moisture and dust traps. The feet also permit the use of double-sided wiring boards without causing low resistance shorts between top-side conductors through accumulated dust around the circumference of the capacitor. Sprague Electric Co., Dept. ED, 347 Marshall St., North Adams, Mass.

CIRCLE 140 ON READER-SERVICE CARD FOR MORE INFORMATION

FORMICA Research perfects sensational new cold punching laminate

Brings 1,000,000 megohms resistance value, precision and translucency to printed circuitry....

Research, an important part of the exclusive new Formica 4-point service, has just perfected a new cold punching paper base laminate offering 1,000,000 megohms insulation resistance and valuable new translucent properties.

Known as XXXP-36, the new grade brings greater accuracy to printed circuitry. Because of its cold punching qualities, XXXP-36 requires no heat cycle. Therefore, the base laminate is not subject to dimensional change as in grades which must be heated before punching. This means that with Formica XXXP-36, you can now produce printed circuits with new and higher standards of accuracy.

XXXP-36 translucency can be doubly useful. Make this simple test: hold it to the light. You can see (1) the smooth, homogenous structure, the total absence of resin pockets, voids and imperfections that dissipate the insulating properties of ordinary paper base laminates...and (2) how perfectly the circuit on one side registers with that on the other. New XXXP-36 is ideal for terminal boards and tv insulators requiring high I.R. Formica's engineering skill can help you find new materials for new products and processes. For complete information on the new XXXP-36, or on the new "Formica-4" service, use coupon below.

The Formica Co., 6462 Spring Grove Ave., Cincinnati 32, Ohio.

Make the Formica Translucency Test. Send for a sample XXXP-36 printed circuit. Fill out and mail coupon today.

FORMICA®—the most famous name in laminated plastics—Engineered for industry, Beauty Bonded for the home.

Gentlemen:
[ ] I'd like a sample XXXP-36 printed circuit and complete information on this new grade
[ ] Send bulletin showing how I can take advantage of the new "Formica-4" laminated plastics service.

Name ____________________________ Title ____________________________
Company ____________________________
Address ____________________________
City ____________________________ Zone ____________ State ____________

CIRCLE 141 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1955
LAMBDA again is the FIRST CHOICE of engineers who specify POWER SUPPLIES

Once again, Lambda Power Supplies have been rated in top position by engineers in the electronics and allied industries.

Engineers know on the basis of their own experience as well as their observation in other plants that Lambda Power Supplies are precision equipment, dependable and built for heavy duty.

The Lambda catalog offers a greater variety of power supply models than ever before. Stock units are available that can handle almost any electrical or mechanical situation. Where circumstances require, units also may be modified quickly and inexpensively.

Send for your copy of the comprehensive Lambda Catalog of Power Supplies for Laboratory and Industry. If you have a special power supply problem, we will be glad to make recommendations.

LAMBDA OPENS MOST MODERN PLANT...DEVOTED EXCLUSIVELY TO POWER SUPPLIES

To meet the record demand for precision-engineered, factory-assembled power supplies, Lambda has constructed this new manufacturing plant at College Point, New York. The substantial increase in production capacity permits Lambda to ship models from stock under ordinary conditions; assures you of quick delivery.

LAMBDA Electronics Corp.
FIRST in Preference • FIRST in Quality • FIRST in Sales
11-11 131 STREET, COLLEGE POINT 56, NEW YORK
CIRCLE 80 ON READER-SERVICE CARD FOR MORE INFORMATION

Transducer Pressure-to-Frequency Type

Series P400 Pressure-to-Frequency Transducers are manufactured in absolute (illustrated), differential, or gage types for measuring pressure in non-corrosive liquids and gasses. The P400 incorporates a temperature controlled variable inductance pressure pickup and an FM oscillator mounted together in the same case.

Mechanical displacement of a diaphragm by the applied pressure produces a proportional inductance in a closely spaced coil-core structure. This inductance change is then converted to proportional frequency by the FM oscillator contained in the transducer and is supplied at constant amplitude across the output terminals. The variable inductance pickup is housed in a small oven which is thermostatically controlled. The Series P400 were specifically designed to be used with standard FM/FM telemetering equipment. They can be supplied on any standard subcarrier frequency between 1.7kc to 70kc, and with deviations at ±7-1/2% or ±15%. Datran Engineering Corp., Dept. ED, 3613 Aviation Blvd., Manhattan Beach, Calif.
CIRCLE 81 ON READER-SERVICE CARD FOR MORE INFORMATION

Frequency Meters Accurate to ± 1/4cy

The "Arga" Expanded-Scale Frequency Meter is for fast, accurate monitoring of frequency. Offered in two models, it was designed originally for making production inspection measurements on the frequency regulation of motor and engine-driven generating units, but has found many other applications, particularly where a permanent record of frequency is required.

Input voltage harmonics of 5%, or changes in input voltage of ±10%, will not cause errors in frequency indication greater than ±1/2cy for the Model 401, or 1/4cy for the Model 601. The Model 401 has a base frequency of 400cy, and a span of ±25cy. The Model 601 has a base frequency of 60cy, and a span of ±6cy. Shasta Div., Beckman Instruments, Inc., Dept. ED, P. O. Box 296, Station A, Richmond, Calif.
CIRCLE 82 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1955
Miniature Axial Blowers
In A-C and D-C Models

This firm offers miniature axial blowers for 60cy, 400cy, or d-c. They consist of a motor and a die-cast aluminum fan mounted in a die-cast aluminum housing. Special provisions can be made so that the a-c blower will meet the radio noise requirement of MIL-I-6181. The housing on all blowers provides environmental protection to MIL specs.

These blowers are available with air flow in either direction and also for operation on other frequencies. A high-speed version (up to 50efm) is available where long life requirements are not of essence. Globe Industries, Inc., Dept. ED, 1784 Stanley Ave., Dayton 4, Ohio.

CIRCLE 83 ON READER-SERVICE CARD FOR MORE INFORMATION

TW Tube Amplifier
With 2-8kMc Ranges

The Model 25 Traveling Wave Tube Amplifier permits 2-4kMc or 4-8kMc operation with two readily interchangeable TW tubes. The gain over both bands is at least 30db, and the maximum power output is at least 10mw. Noise figure is typically 25db.

Provision is made for both amplitude and phase modulation of the unit from external sources. R-f outputs ranging from square waves to fractional microsecond pulses may be achieved with appropriate modulating waveforms of modest amplitude. Similarly, phase modulation over bandwidths of several tens of megacycles is readily accomplished. If desired, both types of modulation may be applied simultaneously.

Input requirements are 105-125v, 50-1000cy. Dimensions are 4-7/8" x 7-5/8" x 19-9/16" deep, and weight is 35 lb. Provision is made for mounting in an A1-D shock tray for mobile or airborne use. West-labs, Inc., Dept. ED, P. O. Box 1111, Palo Alto, Calif.

CIRCLE 84 ON READER-SERVICE CARD FOR MORE INFORMATION

CHOOSE YOUR 2° SERVO

These high performance 400 cycle servos conform dimensionally with Bu Ord specs in many models. Greater efficiency, minimum air gaps and extremely high torque-to-inertia ratio is attained by precision manufacturing. 60 cycle units can be made available.

<table>
<thead>
<tr>
<th>Type Number</th>
<th>Size</th>
<th>Length</th>
<th>Mounting</th>
<th>Minimum Stall Torque in oz.</th>
<th>No Load Speed Minimum</th>
<th>Power Input at Stall Total Watts</th>
<th>Rated Voltage</th>
<th>Special Features</th>
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<tbody>
<tr>
<td>1916</td>
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<td>2½&quot;</td>
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Many of the above units can be supplied with gear train to your specifications.

Other servos to your requirements.

Write for further details, giving type number.

Other products include Actuators, AC Drive Motors, DC Motors, Motor-Gear-Drives, Fast Response Resolvers, Servo Torque Units, Synchros, Reference Generators, Tachometer Generators, and Motor Driven Blower and Fan Assemblies.

CIRCLE 85 ON READER-SERVICE CARD FOR MORE INFORMATION
For prompt action on your switching problems, send us a brief description and rough sketch of the switch you need.

**Cold Punching Laminate**

For Printed Circuit Boards

An electrical grade phenolic laminated plastic, Grade XXXP-471 Phenolite, which can be punched at room temperature is particularly suited for copper clad printed circuits where automatic processes require close registration of punched mounting holes. Permitting punching at temperatures as low as 68°F, the new grade assures precise dimensions of holes and hole spacings as no distortion from heating arises.

The cold punching laminate is available in the same thickness range, tolerance, and sheet sizes as the company’s other XXXP grades. Its properties of high insulation resistance and low electrical losses, match or exceed values of these properties for the company’s hot punching grades. Also, copper clad bond strength and hot solder dip properties of the new product are comparable to other copper clad grades in the line. National Vulcanized Fibre Co., Dept. ED, 1055 Beech St., Wilmington 99, Del.

**Deposited-Carbon Resistors**

Used in Matched Pairs

Pure crystalline carbon is deposited on a ceramic insulator by a patented method of thermal decomposition of a hydro-carbon. Higher resistance values are attained by spiral-cutting through the coating. The resistance element is protected either by multiple layers of insulating, moisture-resistant varnishes separately baked on, or by hermetic sealing in an impervious steatite shell. On special order, a plated brass shell with glass end-seals can be provided.

“Fixtohm” resistors meet standard tolerances of ±5% and down to 1%. They are extremely stable, small, and reproducible, with excellent high-frequency characteristics and negative temperature coefficient. Campbell Industries, Inc., Dept. ED, 3806 St. Elmo Sta., Chattanooga 9, Tenn.
Magnetic Storage Matrix
In Kit Form for Mock-Ups
These components for magnetic storage system mock-ups include a complete set of all of the magnetic elements including driver transformers, matrix switches, and the actual matrices to mock up several different circuit arrangements for evaluation. Also introduced in this set of storage elements is the M16X16X4-1 storage array which in conjunction with the MS16X16-Si matrix switch is an entirely new arrangement of a digital magnetic storage system. In this system only the selected cores of the particular word being interrogated are disturbed by the readout current pulse. This gives essentially noise-free operation. Valor Electronic Components Co., Dept. ED, 5808 Marilyn Ave., Culver City, Calif.
CIRCLE 115 ON READER-SERVICE CARD

Parabolic Antennas
Made From Spun Aluminum
An economy line of spun aluminum type parabolic antennas for the 890-960 and 1700-2110 Mc ranges in 2, 4, and 6' sizes is available from this company. They feature highly efficient dipole feed, mounted and adjustable to either horizontal or vertical polarization from the rear of the parabola. Gain, beamwidth, and patterns are identical to those data previously published for spun dishes of the same diameter. Prodelin Inc., Dept. ED, 307 Bergen Ave., Kearny, N.J.
CIRCLE 116 ON READER-SERVICE CARD

High-Q Ferrite
For Rod Antennas
This high-Q ferrite, designated as "M" material, is the answer to most antenna rod problems. The magnetic properties of this material are initial permeability at 1 Mc of 125; maximum permeability of 450; saturated flux density of 3300, and a residual magnetism of 1050. National Moldite Co., Dept. ED, Hillside, N.J.
CIRCLE 117 ON READER-SERVICE CARD

Greatly enlarged facilities now produce high quality, pace-setting AlSiMag Alumina ceramics in quantity lots. Complete range of up-to-the-minute Alumina compositions now permit you to design to higher temperatures and higher strengths. Advantages include improved electrical characteristics at elevated temperatures—beyond the melting point of most metals. Higher tensile and impact strengths. Greater resistance to corrosion and abrasion. Smoothness of texture. Close dimensional tolerances. Custom formulations for special needs.

- An outline of your requirements, enclosing a blueprint or sketch, will bring you full details.
Wincharger
dynamotors
help power
the nation's
defense

Battery-operated VTVM
Covers 20cy to 1Mc

The Model D-21 is a portable voltmeter covering frequencies from 20cy to 1Mc. Battery powered, it is contained in a 5" high plastic case and weighs only 30 oz complete. It offers stability at all operating temperatures from 0° to 120°F. Accuracy is ±5%. It is designed specifically for measurements where a-c is not available, or where use of battery-powered equipment is more convenient.

The D-21 is transistorized, and has printed circuits for maximum ruggedness, dependability, and uniformity. Peak sensitivity is 0 to 1mv and any of 12 decade (10db) ranges may be switched on the front panel. A 10 megohm input impedance on all ranges prevents disturbances to circuits under test. The front panel meter reads direct in db from -20bd to +2db, or volts from 0 to 1v or 0 to 3v (voltage calibration is linear). Output terminals are provided for use with monitoring devices having input impedances of 10,000 ohms and higher. Alto Scientific Co., Dept. ED, 855 Commercial St., Palo Alto, Calif.

Delay Line
For Color TV

An inexpensive, distributed-constant delay line, the Type T30036 is designed for use as a compensating delay in the luminance channel of color TV receivers. It has a high impedance of 4300 ohms and uniform response to 4Mc. Phase characteristics also are linear within 5%. Total delay is 0.9μsec, and rise time is only 0.1μsec.

The unit is enclosed in an aluminum can 1-3/8" square x 3-1/8" high, exclusive of terminals. Modifications can be made for quantity users. Shallercross Manufacturing Co., Dept. ED, Collingdale, Pa.
Band-Pass Filters
With Wide Adjustability

These variable electronic band-pass filters have a gain of unity in the pass band; gain drops outside the pass band at a rate of 24 db/octave. The use of peaking reduces the attenuation at the corner frequencies by 8 db and permits a band width as narrow as one octave without attenuation in the center of the pass band.

Both the high and low cut-off frequencies are independently adjustable from 0.02-2000cy in the 330-A and from 0.2-20,000cy in the 330-M. This provides maximum flexibility of adjustment of both the band center frequency and the band width. By using two electronically regulated supplies, the internal hum and noise is reduced to less than 100µw in both units. Calibration accuracy is ±5%. Size is 17" x 8" x 12" overall. Krohn-Hite Instrument Co., Dept. ED, 580 Massachusetts Ave., Cambridge 39, Mass.

CIRCLE 96 ON READER-SERVICE CARD FOR MORE INFORMATION

Preamplifier
Trims Pickup Outputs

The Model 2614 is a probe-type preamplifier for use with piezoelectric pickups which permits the user to "trim" the self-generating pickup output sensitivity to an even or "standard" value so that direct reading of physical parameters such as acceleration, force, and pressure is possible with standard vacuum tube voltmeters. An input selector switch gives a choice of three input conditions: 100 megohms for use with this company's vibration pickups, extending the low frequency range of piezoelectric pickups to 2ey; 1000 megohms with d-e isolation for general uses; and 22 megohms for special shock pickups, and fast recovery from overloads. Amplifier gains of 1, 3, and 10, with stability of 1% or better, a frequency response from 2ey to 15,000cy, and an output of 5v into 2500 ohms (source impedance 50 ohms), make this unit valuable for all measuring installations and convert standard vacuum tube voltmeters into direct-reading meters. Size is only 2-1/2" x 5-1/8" x 1-5/8". Endevco Corp., Dept. ED, 180 E. California St., Pasadena, Calif.

CIRCLE 97 ON READER-SERVICE CARD FOR MORE INFORMATION

That's why the SYSTEM ANALYZER CORP. Chose Tech Laboratories Tap Switches for $200,000 Electronic "Brain"

With more than 2100 tap switches incorporated in the design for their huge analog computer, engineers at the System Analyzer Corp., Nokomis, Illinois, made exhaustive tests to check the efficiency and operating life of many types. Of all those tested, Tech Laboratories Type 2C and 2A Tap Switches were the only ones that met every requirement. After 1,000,000 complete cycles of operation, they showed approximately the same contact resistance as at the beginning.

Designed primarily for analyzing electrical power networks — as large as the power system of an entire city — the electronic "brain" handles mathematical problems with as many at 220 unknowns, 400 times faster than the work can be done manually. It is easy to understand why dependability is a major factor in the selection of its components.

WRITE FOR FULL INFORMATION


circle 98 on reader-service card for more information

TECH LABORATORIES, INC.
Manufacturers of Precision Electrical Resistance Instruments
PALISADES PARK, NEW JERSEY

CIRCLE 98 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN  •  November 1955
80 MILLION SOLD!

TRU-OHM is Now the World's Largest Producer of Wire-Wound Resistors!

Chicago . . . From Tru-Ohm's general sales office. Since starting just a few short years ago, TRU-OHM PRODUCTS has grown phenomenally to ten times its original capacity. Having just produced its 80,000,000th wire-wound resistor, Tru-Ohm is now the world's largest growing and largest producers of wire-wound resistors.

Special size resistors: Tru-Ohm's highly skilled factory trained technicians turn out large varieties of special resistors. Complete data of these special size resistors is available.

High Quality, Speedy Delivery Sets Record

Over 50,000 square feet of the most modern manufacturing facilities, including a brand new furnace, enable volume production ... assure faster delivery, finer quality, better prices. And TRU-OHM EXPEDITES FOR YOU ... ships on time.

Inquiries Invited. You can get the complete story of Tru-Ohm's tremendous growth and why, by writing to 2800 N. Milwaukee Ave., Chicago 18. Let Tru-Ohm's experts solve your resistor and rheostat needs

Resistor No. 80,000,000. One of many wire-wound resistors which are turned out by the thousands daily.

For Original Equipment or Replacement Needs

A complete line of resistors as well as a complete line of power rheostats are now produced for the finest industrial manufacturers in the world ... for replacement applications... sold through parts jobbers.

Power Supply
For Transistor Work

This compact d-c power supply is especially engineered to power resistors, and is also used in designing transistor circuits and in development work on transistors. It is a closely regulated, dual-voltage supply, with both outputs contained in a single chassis suitable for rack mounting or bench use. Cabinet size is 5-1/4" x 19" x 14" deep.

Each output supplies 0-100v d-c continuously variable (without switching), and 0-100ma maximum. No derating of output current is necessary. Voltage is adjustable to 1/10v variations by means of "Heli-pots" equipped with "Duodials". Ripple is below 1.5mv rms for any voltage or load within the ratings. Recovery time, 0 to full load, is 0.5millisece; full load to removal, 0.25millisecond. Drift, after 1-hour stabilization time, is less than 0.1% in an 8-hour period.

Dressen-Barnes Corp., Dept. ED, 250 N. Vinedo Ave., Pasadena 8, Calif.

Electrolytic Capacitors
For Transistor Circuitry

These tiny hermetically-sealed aluminum electrolytic capacitors, known as "Lytli-Lyties", are designed as moderately priced highly reliable units. They are valuable for use in transistorized pocket radio receivers, wireless microphones, personal style wire recorders, and similar equipment. Ultra-low leakage current assures minimum drain and long battery life when the capacitors are used in filtering applications across a battery.

The units are available in a wide range of ratings from 1mf to 100mf and in standard working d-c voltages of 1, 3, 6, 10, 12, and 15v. Sizes range from 3/16" diam x 1/2", to 3/8" diam x 3/4". Their construction lends itself to mechanized assembly on printed wiring boards. Maximum operating temperature is 65°C. Sprague Electric Co., Dept. ED, 347 Marshall St., North Adams, Mass.
Mercury Switch
Produces Pulse Action

In this pulse switch, establishment of a temporary contact as the mercury flows past the electrodes is simplified by mounting the glass part within a sturdy cartridge. An instantaneous pulse of many amperes is provided. Metallic contacts protrude concentrically on both sides of the cartridge, and serve both as conductors of electricity as well as the means by which the switch is supported between uprights. They also make possible simple mechanical rotation of the cartridge.

The pulse switch can be turned, tilted or driven by a motor or other means of rotation, whereby electrical contact is established for one pulse every 180°. The rate of fall of the mercury droplet can be influenced to some extent by tilting the axis of rotation.

The unit has many uses in electro-magnetic counters and other relay-operated devices, flashing aircraft beacons, and as a negative speed-governor. Tensitron, Inc., Dept. ED, Harvard, Mass.

CIRCLE 102 ON READER-SERVICE CARD FOR MORE INFORMATION

Log Count Rate Meter
Covers Four Cycles

The Model 500 Log Count Rate Meter offers the wide range and reading accuracy of a logarithmic device with the stability and precision of a linear rate meter. Its principal applications counting, reactor control, continuous sampling, area monitoring, and in other situations where wide range pulse counting is required.

The log function is generated only by R-C elements eliminating the need for tube selection. Accuracy of the unit is ±3% over the entire meter deflection range, with stability ranging from 1% for 1 hour to 8% for 24 hours. For maximum reading accuracy a 1% long scale meter is employed and provision is made for the use of an external recorder. Input sensitivity is 0.25 volts, negative. The standard instrument has a range of 1 to 10,000 counts per minute in four cycles, but the unit can also be supplied with any full range from one to five decades. Operation is from a 117 volt, 60 cycle supply and consumes 100 watts. Devtron Engineering Associates, Dept. ED, 1 Winslow St., Redwood City, Calif.

CIRCLE 103 ON READER-SERVICE CARD FOR MORE INFORMATION

RMC
DISC CAPS
CERAMIC CAPACITORS

specify RMC type JL DISCAPS

If your applications require a capacitor with uniform characteristics and exceptional stability over an extended temperature range, Type JL DISCAPS will provide the best answer. Control of production processes from basic powders to finished DISCAP is your assurance of absolute uniform quality.

Maximum capacity change between -60° C and +110° is only ±7.5% of capacity at 25° C. Type JL DISCAPS with a standard working voltage of 1000 V.D.C. are manufactured in capacities between 220 MMF and 5000 MMF.

Plug-in Leads

Type JL DISCAPS as well as temperature compensating, and by-pass types are manufactured with plug-in leads for printed circuit applications. Leads are No. 20 tinned copper (.032 diameter) and are available up to 1½" in length. Plug-in DISCAPS will provide worthwhile savings on printed circuit assemblies.

Write today on your company letterhead for expert engineering help on any capacitor problem.

CIRCLE 104 ON READER-SERVICE CARD FOR MORE INFORMATION
New E-I Frequency Counter has true digital in-line read-out!

Here's the answer to your need for an accurate, easy-to-use, events-per-unit-time meter. No other counter has so many convenient features, or is so easy to read. Even the most inexperienced personnel can become proficient in its use in just seconds! Human error and reading ambiguities are virtually eliminated.

**SPECIFICATIONS — MODEL 250**

**In-Line Events-per-unit-Time Meter and Counter.**

- **Display:** 5 in-line digits, 1" high numerals. Display held constant during sampling cycle.
- **Accuracy:** ±1 digit
- **Frequency Response:** 10 cycles to 100 kc
- **Sensitivity:** 0.2 volts rms
- **Input Impedance:** 10 megohms
- **Time Base:** 1 second, crystal controlled. (0.1 and 10 seconds optional)
- **Controls:** Power on-off, sensitivity, re-cycle time, manual time base, manual reset button.
- **Printer Operation and Remote Read-Out:** Optional
- **Power:** 115 volt, 60 cycle
- **Mounting:** Rack or bench
- **Other standard models and Timers, Universal Counter-Timers available.**

**E-I "Closes the Loop"**

Now, by adding digital, in-line frequency counters to the E-I line of digital instruments, we are able to offer complete system engineering and system solution. Your phone call or letter will start our engineers thinking about your problem.

**Fundamental Parameters**

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<th>AC</th>
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<td>DC Digital Voltmeters</td>
<td>AC-DC Digital Voltmeters</td>
<td>AC-DC A Digital Ohmmeter</td>
<td>AC-DC A Digital Frequency Counters</td>
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<tr>
<td>X-Y Recorders</td>
<td>Automatically gives digitized data in both visual and printed form</td>
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| E-I Instruments |
|-----------------|-----------------|
| DC Digital Voltmeters | AC-DC Digital Voltmeters |
| Digital Ohmmeter | Digital Frequency Counters |

**Important new features found on no other counter!**

**Easy-to-read digital in-line read-out**

- Gives readings in simplest possible form. Eliminates reading errors.

**Constant reading during sampling**

- Reads out instantly at end of sampling. No lost readings. No hold adjustments. No annoying sampling changes or "dead-times."

**Decimal coded contacts give simple, direct, print out**

- No intermediate equipment required. No "dead-time" during print out. Operates all types of printers.

**Read-out may be remoted and miniaturized**

- If space is restricted or if used in console-type equipment, the read-out and controls may be remoted on a standard 1¾" rack panel. ½" and 1" high numerals are available.

This four-channel bridge balance, the Type 8-110, is designed to provide a control link between resistance-bridge transducers and recording or indicating devices such as direct-writing or photographic oscillographs, chart recorders, analog-to-digital conversion systems, and ordinary meters. It is for use in direct recording of the output of a wide variety of pickups without the use of amplifiers.

The unit can be "stacked" with this firm's 5-117 Recording Oscillograph, or with other 8-110 units. Up to four 120 ohm to 350 ohm strain-gage bridges or strain-gage-type pickups may be connected to the instrument. Voltage across each bridge can be adjusted individually and continuously from the level of the supply voltage, 20.0v d-c max, down to 0v. Consolidated Engineering Corp., Dept. ED, 300 N. Sierra Medre Villa, Pasadena, Calif.

CIRCLE 106 ON READER-SERVICE CARD FOR MORE INFORMATION

**Power Supply**

**Miniature Tubeless Unit**

A miniature, encapsulated power supply that contains no vacuum tubes and is capable of withstanding the most stringent military environmental specifications, the Model CP is only 2-5/8" x 3-1/16" x 4-1/4" long. Originally designed for this firm's line of miniature vacuum tube voltmeters, it is finding use with packages of one to three-stage tube circuits.

The supply operates from a 115v, 60cy or 400cy line, and provides two unregulated outputs: 150v d-c at 6ma as a plate supply, and 6.3v a-c (center-tapped) at 0.6amp as a filament supply. Ripple is kept below 1mv at 400cy, and 5mv at 60cy. The case is completely isolated from all the circuit terminals. Trio Laboratories, Inc., Dept. ED, 3293 Seafood Ave. Wantagh, L. I., N. Y.

CIRCLE 107 ON READER-SERVICE CARD FOR MORE INFORMATION

**ELECTRONIC DESIGN • November 1955**
When the gun failed, they used a tablespoon

HE LEARNED acting the hard way, barn-storming frontier towns by barge and stagecoach.

Once a Texan even suggested the troupe tour through Indian country, carrying their stage weapons for protection. Joe Jefferson declined. He said he shivered when he imagined himself facing a hostile Indian and armed only with a stage pistol whose tendency to misfire had several times "compelled our heavy villain to commit suicide with a tablespoon."

By the 1860's, Jefferson was America's favorite actor. They loved him everywhere for his genius at making people happy. And his sunny outlook still sparkles in the spirit of America. Like Jefferson, Americans still know how to travel a hard road and smile when the going's roughest.

These confident Americans are the real wealth of our nation—the real reason why our country's Savings Bonds rank among the world's finest investments.

That's why, to save for your goals in life, you cannot find a surer, safer way than United States Savings Bonds. Invest in them regularly and hold onto them!

It's actually easy to save money—when you buy United States Series E Savings Bonds through the automatic Payroll Savings Plan where you work! You just sign an application at your pay office; after that your saving is done for you. And the Bonds you receive will pay you interest at the rate of 3% per year, compounded semiannually, for as long as 19 years and 8 months! Sign up today!

Safe as America—U.S. Savings Bonds

The U.S. Government does not pay for this advertisement. It is placed in cooperation with the advertising agencies of the United States Publishers of America.

D-C Servo Motor

For Aircraft Applications

The miniature d-c servo motor SBBY13DJ7 is capable of resisting a high potential of 1500V and of responding to field currents of 0.0075amp. Suitably for aircraft applications on blowers, actuators, tuners, and similar devices, the motor will operate equally well at sea level or at 30,000' and within temperature limits of -65° to 165°F. It is also used as a prime mover in gun direction computer systems, electronic devices, and can be modified for other aircraft and missile applications.

Weighing less than 8 oz, the motor may be wound as a straight shunt machine when required. It is reversed by a small, dpdt relay. The motor draws maximum armature current of 0.8amp from a 28v line. It is rated 0.002hp at 6500rpm, and can be geared to speeds as low as 130rpm. General Electric Co., Specialty Component Motor Dept. ED, Schenectady 5, N.Y.

CIRCLE 109 ON READER-SERVICE CARD FOR MORE INFORMATION

Limit Switch

Can Control Two Circuits

The ILS is a small-size, heavy-duty limit switch designed for control of two independent circuits. It features sealed construction and high electrical capacity, plus adjustability.

The switch has a roller-arm actuator which can be field-adjusted through 360° with positive locking in any position. Actuation can be clockwise, counter-clockwise, or in both directions. The actuator head may be removed in the field and faced at any of four positions at 90° angles. Contact arrangement is two-circuit, double break.

Electrical rating of the unit is 10amp at 120v, 240v, or 480v a-c; pilot duty rating is 0.2amp at 115v d-c, 0.1amp at 230v d-c, and 0.04amp at 550v d-c. Operating force is 3 lb max, full overtravel force is 6 lb max, and release force is 1/2 lb min. Pretravel is 20° max, differential travel is 12° max, overtravel is 30° min. Micro Switch, Dept. ED, Freeport, Ill.

CIRCLE 110 ON READER-SERVICE CARD FOR MORE INFORMATION

Eccosorb CH

Microwave Absorber for Darkrooms

Eccosorb CH is a series of broadband absorbers reflecting less than 2% of the energy incident upon its surface. It is composed of enmeshed, rubberized fibers and made in sheets of 2 feet by 2 feet in various thicknesses. Eccosorb CH is light weight and flexible. It is easily mounted and its natural, white surface color gives good light reflection.

Free Space Rooms are easily and economically built for indoor antenna measurements. Reflections are eliminated for all practical purposes. You can build your own microwave dark room or we offer you a complete Free Space Room ready to use. Emerson & Cuming engineers design and build special types for unusual conditions. Send us your specifications.

Another absorber, ECCOSORB HF comes in rods, sheets or molded shapes in various volume resistivities for waveguide terminations and similar uses. If you have a problem write for information on . . .

Plastics for Electronics

Emerson & Cuming, Inc.

869 Washington Street, Canton, Mass.

Sales Representatives

KANSAS CITY
ENGINEERING SERVICES COMPANY
4550 Main Street, Kansas City 11, Mo.
Jefferson 7765
ST. LOUIS
ENGINEERING SERVICES COMPANY
6635 Delmar Blvd., St. Louis 5, Mo.
VO 3-9661
NEW YORK
M. RAYMOND KALLMAN
P. O. Box 104, Rocklyn, L. I., New York — Rocklyn 3-6511

CIRCLE 111 ON READER-SERVICE CARD FOR MORE INFORMATION

PLASTIC FOAMS
LAMINATING AND IMPREGNATING RESINS
PLASTIC-FIBER GLASS LAMINATES
HIGH DIELECTRIC CONSTANT PLASTICS
METALIZED PLASTICS
ELECTRONIC ENCAPSULATING RESINS
LOW LOSS ROD AND SHEET STOCK
MICROWAVE ABSORBERS
Power Supply Test Set
Has Load Modulator and Recorder

This Power Supply Test Set includes the Model 901 Power Supply Regulation Analyzer, the Model 910 Power Supply Variable Load, the Model 920 Line Voltage Adjuster, and a recording potentiometer. These units are available separately.

The regulation analyzer measures applied d-c voltage, percentage change, and rms ripple on the applied d-c voltage of regulated and unregulated power sources. The voltage test range is 1.018v to 1.112v. Three ranges are provided for measuring percent regulation from 0.002% to 10%. Eleven ranges for measuring rms ripple are provided.

The variable load consists of an electronic load and a resistor load, covering 0-600v, 0-600ma. Provision is made for automatically modulating either the resistor load or the electronic load 10sec on and 10sec off. The line voltage adjuster provides for adjusting the line voltage for any fixed input voltage in the range 95v to 135v. The recording potentiometer is included for measuring regulation and stability characteristics. Repeo Laboratories, Dept. ED, 131-38 Sanford Ave., Flushing 55, N. Y.
CIRCLE 86 ON READER-SERVICE CARD FOR MORE INFORMATION

Transformer Unit
A Portable Lab Supply

With three-phase 230-250v 60cy input, this portable laboratory power supply transformer unit has two output ranges: 211-640v 31-amp, in 10v steps, and 100-295v 66amp, in 4v steps. Adjustment is by eight fine steps and eight coarse steps with overlap. Taps are changed on three phases simultaneously. It is designed for continuous duty at the rated output, and includes a heavy-duty 115v cooling fan. Parallel 100amp capacity output jacks are provided. The case measures 13-3/4" x 29" x 42" high. The Strong Electric Corp., Dept. ED, 140 City Park Ave., Toledo 2, Ohio.
CIRCLE 87 ON READER-SERVICE CARD FOR MORE INFORMATION
ELECTRONIC DESIGN GIVES HIGH "Q"
...AND CLASS "A" APPLICATIONS!

* New materials assure high "Q".
* All essential properties equal or superior to existing film wires.
* Positive uniform soldering. No stripping or cleaning necessary.

Phelps Dodge Sodereze represents a new advance in ready-to-solder magnet wire. It's a typical Phelps Dodge development designed to keep pace with industry's growing need for wires that handle easily, reduce over-all cost and satisfy a variety of operating conditions.

Phelps Dodge Sodereze offers a unique combination of improved chemical and mechanical properties with the advantage of high "Q". The versatility of Phelps Dodge Sodereze not only permits its use wherever solderable wires have been proven practical but suggests new applications, particularly in the finer sizes, to replace conventional wires.

Any time magnet wire is your problem, consult Phelps Dodge for the quickest, easiest answer!

**Trigger Generator**
An All-Magnetic Unit

The 414-A, an all-magnetic trigger generator, is engineered to trigger hydrogen thyratrons by using saturable reactors instead of electronic tubes. It is a capacitor-type pulser in which electrical energy is stored through a-c resonant charging, although it operates at a much lower power level. Rapid discharge of the capacitor through the reactors releases pulse powers. Acting as static magnetic switches, the reactors are similar in construction and appearance to transformers. The unit, which replaces approximately four electron tubes, has various applications in commercial radar and laboratory testing, as well as in digital and other computers.

Because it is a line-type pulser using a-c rather than d-c power, its pulse repetition rate is that of the line frequency. Input is 12.5v ±10% 400cy. Output is 200v peak min, 275v peak max, into 600 ohms resistive load. Pulse rise time is 1μsec, 20% to 80% amplitude. Pulse width is 4μsec at 50% amplitude. The simple circuitry is hermetically sealed in a can 1-7/8" x 1-13/16" x 3". Weight is 14 oz. Magnetic Research Corp., Dept. ED, 200-202 Center St., El Segundo, Calif.

**Deflection Yoke**
Controls Spot in CRT Tube

This deflection yoke is designed for accurate control of the spot position in a cathode ray tube intended for radar application. It has a linearity accuracy in the azimuth direction of better than 1/4%.

Linearity in the range direction is better than 1/2".

In the yoke, orthogonality, or the angle between azimuth and range directions, is held to an accuracy of 1/10°. A cylindrical iron core surrounds the windings for shielding purposes. The entire assembly is pressed into a phenolic cylinder, then completely impregnated and sealed to prevent entrance of moisture. Dimensions are 1-1/2"ID, 3-1/8"OD, and 3-3/4" long. Windings can be made to suit practically any specified requirement. Standard Coil Products Co., Inc., Dept. ED, 2085 N. Hawthorne Ave., Melrose Park, Ill.
Kearfott Servo Motor-Generators are characterized by low rotor inertia, low time constants and high stall torque. Motor-Generator combinations provide ½ to 3.1 volts per 1000 R.P.M. with an extremely linear output over a speed range of 0—3600 R.P.M. and useful output up to 10,000 R.P.M.

### CHARACTERISTICS

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MOTOR</th>
<th>GENERATOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAMPING</td>
<td>STALL TORQUE</td>
<td>NO LOAD SPEED</td>
</tr>
<tr>
<td>SIZE 10</td>
<td>.35 OZ. IN.</td>
<td>6000</td>
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<tr>
<td>SIZE 10</td>
<td>.30 OZ. IN.</td>
<td>8500</td>
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<td>SIZE 11</td>
<td>.63 OZ. IN.</td>
<td>5900</td>
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<tr>
<td>SIZE 15</td>
<td>1.5 OZ. IN.</td>
<td>5000</td>
</tr>
<tr>
<td>SIZE 18</td>
<td>2.4 OZ. IN.</td>
<td>5000</td>
</tr>
<tr>
<td>SIZE 18</td>
<td>3.0 OZ. IN.</td>
<td>9600</td>
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<tr>
<td>RATE</td>
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<td>SIZE 15</td>
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<tr>
<td>SIZE 18</td>
<td>2.4 OZ. IN.</td>
<td>4700</td>
</tr>
<tr>
<td>SIZE 18</td>
<td>3.0 OZ. IN.</td>
<td>8400</td>
</tr>
</tbody>
</table>

*INTEGRATOR

| SIZE 15 | .70 OZ. IN. | 6300 | 400/1 | .1% |
| SIZE 15 | 1.25 OZ. IN. | 4500 | 400/1 | .1% |
| SIZE 18 | 1.35 OZ. IN. | 7200 | 400/1 | .1% |
| SIZE 18 | 2.4 OZ. IN. | 5300 | 333/1 | .05% |
| SIZE 18 | 3.0 OZ. IN. | 8000 | 333/1 | .05% |

*Integrator Tachometers are temperature stabilized

Send for Bulletin describing Servo Motor-Generators of interest to you.

ENGINEERS

Many opportunities in the field of Precision components are open. Write for details today.

Kearfott Company, Inc., Little Falls, N. J.
Sales and Engineering Offices: 1378 Male Avenue, Clifton, N. J.
Midwest Office: 188 W. Randolph Street, Chicago, Ill. South Central Office: 615 Dunston Drive, Dallas, Texas
West Coast Office: 233 N. Vine Avenue, Pasadena, Calif.

CIRCLE 119 ON READER-SERVICE CARD FOR MORE INFORMATION
Capacitive Probe  
Rated 60kv Peak

Model JP-325 High Voltage Probe utilizes a vacuum capacitor voltage divider rated at 60kv peak. The output of the divider is padded with a ceramic capacitor and is fed into three feet of RG-58 A/U cable so that the overall division ratio is 325:1. The input resistance is above 1012 ohms, and the input capacitance is 4mmfd.

Internal resonances are above 200Mc so that the high frequency response is limited by that of the meter or oscilloscope with which this probe is used. The low frequency response is determined by the input shunt resistance of the measuring instrument. With 10 megohms shunt resistance, the probe will be linear at frequencies down to 60cy. If it is possible to operate directly into the vertical deflection plates of an oscilloscope so that the shunt resistance is above 100 megohms, then the probe frequency response is flat down to 5cy. With this probe it is therefore possible to calibrate an oscilloscope at low frequencies and subsequently use it at frequencies up to 50Mc or with pulses as short as 1µsec without the necessity of recalibration. Jennings Radio Mfg. Corp., Dept. ED, P. O. Box 1278, San Jose, Calif.

CIRCLE 120 ON READER-SERVICE CARD FOR MORE INFORMATION

Wide-Band Amplifier  
With Gains of 10 and 100

The Model 854A Amplifier provides a choice of two fixed voltage gains, 10 and 100, over the frequency range of 10cy to 1Mc. It is useable to higher frequencies with some slight sacrifice in uniformity of response (±1db, 5cy to 2Mc at a gain of 100).

The circuit used introduces distortion of less than 1% when operating into recommended loads. Equivalent input noise is 20µv with gains of 100, and 80µv with gain of 10. Output voltage is a maximum of 10v into a minimum load of 3000 ohms. The input impedance is 1 megohm shunted by approximately 15mmfd. The unit is also available in standard relay rack mounting (3-1/2" x 19"). Shasta Div., Beckman Instruments, Inc., Dept. ED, P. O. Box 296, Station A, Richmond, Calif.

CIRCLE 121 ON READER-SERVICE CARD FOR MORE INFORMATION

ENCAPсуSLATED RESISTORS  
FOR MECHANIZED PRODUCTION

"A" SERIES

Designed for use in printed wiring circuits, terminals conform to specifications proposed by RETMA for components to be used in automatic assembly equipment.

The "A" Series precision wire-wound resistors are encapsulated in a tough epoxy resin for protection against extreme humidity, mechanical and thermal shock. The plastic is filled with heat conducting mineral which dissipates the heat and equalizes "hot spots" in winding. Sealed-in terminal connections are welded.

CIRCLE 122 ON READER-SERVICE CARD

Specifications:
Military: Performance characteristics satisfy all requirements of MIL-R-93A and JAN-R-93.
Temperature Coefficient: ±0.0002% per degree C.
Operating Temperature: -65°C to +125°C.
Resistance Accuracy: Tolerances to ±0.1%
Wattage Range: From .25 watt to 1.0 watt.
Dimensions: (Miniature type 83 illustrated) ¾” dia. x ¼” long.
Resistance Range: 1.0 ohm to 50 meg.
Send for Bulletin PH for data on other physical sizes and wattage ranges.

Representatives in Principal Cities

HYCOR
Company Inc.

Subsidiary of International Resistance Company
11423 Vanowen Street
North Hollywood 4, Calif.
**Fluid Epoxy Resin**

*Has 8 Day Pot Life*

Epocast 13 is a new fluid epoxy resin mixed with an appropriate amount of hardener and will have a pot life of eight days, making it particularly useful to assembly operations where numerous pours are to be made. No amine hardeners are employed and the material is relatively toxic-free. Curing temperatures are 200 to 250°F. This economical casting resin is useful for potting and encapsulation of electrical components. It is available in kit quantities, allowing for an easy volumetric resin-hardener mix. Furane Plastics Inc., Dept. ED, 4516 Brazil St., Los Angeles 39, Calif.

**CIRCLE 123 ON READER-SERVICE CARD**

**Mylar-Dielectric Capacitors**

*Extra-Rugged Types*

In the form of metal-cased, glass-sealed, hermetically sealed tubulars, these capacitors utilize Mylar dielectric. Over a million capacitor hours of life test have been analyzed before release of this line. Sizes chosen are the minimum consistent for high dependability and long service life at maximum rated conditions. High insulation resistance, low dielectric absorption, and satisfactory operation at temperatures up to 150°C are included with small size. Aerovox Corp., Dept. ED, New Bedford, Mass.

**CIRCLE 124 ON READER-SERVICE CARD**

**Environmental Test Unit**

*Has Temperature-Humidity Control*

This environmental test equipment has control from –80 to 200°F and 20-90% relative humidity. Accuracy of control was held to ±1-1/2%. The control system followed a predetermined cycling time. The cabinet has openings or ports for easy insertion of cable, etc.; electrical terminals are provided inside a specially designed rack for pressure and tensile testing. Webber Mfg. Co., Inc., Dept. ED, 2740 Madison Ave., Indianapolis, Ind.

**CIRCLE 125 ON READER-SERVICE CARD**

**CIRCLE 126 ON READER-SERVICE CARD**

Shown here are a few examples of the Franklin C. Wolfe Company’s “O-Seal” family of static sealing designs. Whatever your static sealing problem you can depend upon these seals for safer, surer, effective sealing. In fact, we maintain a free design and consultation service to help engineers “Seal the whole assembly at the design stage.” This service is used by some of America’s greatest industrial firms and designers. Perhaps it can be of service to you, too. Why not ask us about it? Our nation-wide group of field representatives is ready to serve you.


**FRANKLIN C. WOLFE CO., INC.**

3644 Eastham Dr. Culver City, Calif.

"Sealing Design Specialist"
these INDUSTRIAL JOBBERS offer A COMPLETE LINE of PYRAMID capacitors and rectifiers

In your design development and your pilot production even minutes can be important. For your convenience the jobbers listed at the right carry in stock a complete assortment in adequate quantities of Pyramid's line of highest quality electrolytic and paper capacitors, both commercial and MIL-C-25B types, metallized paper capacitors and a complete range of Kool-sel selenium rectifiers, the first new design in over 20 years.

PYRAMID ELECTRIC CO.
1445 Hudson Boulevard, North Bergen, New Jersey
Varnish for Printed Circuits
Resilient Coating is Good Seal

A new varnish designed especially as a protective insulating coating for modular assemblies, printed circuits, and printed circuit components is far more flexible than conventional coatings. The No. 642 Printed Circuits Varnish can be baked or air-dried to a tough, resilient coating that completely seals the laminate and component leads against arcing-producing moisture. A 2-1/2 mil coating of this water-white varnish withstands 1250 after 72 hours exposure at 100% relative humidity. This highly arc-resistant varnish will not support tracking nor will it char. It is completely free from aging characteristics or discoloring and may be readily thinned with Xylol or its equivalent. The Insl-X Sales Co., Dept. ED, 26 Rittenhouse Place, Ardmore, Pa.

CIRCLE 127 ON READER-SERVICE CARD

Airborne Inverter
Light Weight, High Output

The 41 lb aircraft inverter, Model SE-24-1, is rated at 2250v at 35,000’ (44°C). The inverter has electronically controlled carbon piles which regulate power for shunt and exciter fields and both voltage and frequency modulation are low. The output power is ideal for sensitive servo systems. The unit measures 13.1/4” long by 9-1/4” high by 7-1/8” wide. Leland Electric Co., Dept. ED, 1501 Webster St., Dayton, Ohio.

CIRCLE 128 ON READER-SERVICE CARD

Battery Megohmmeter
Has 500v Test Voltage

Model 2030 Portable Megohmmeter measures leakage resistance from 5 megohms to 10,000,000 megohms in 5 ranges with an accuracy of ±3%. A regulated 500v supply is incorporated in the instrument for supplying test potential. The instrument is entirely self-contained, safe, and rapid to use. Freed Transformer Co., Dept ED, 1715 Weirfield St., Brooklyn 27 N.Y.

CIRCLE 129 ON READER-SERVICE CARD
Cast Plastic Sheets

Have Low Dielectric Constant

The unique casting process employed by this company differs from the more common processes (extrusion, injection, compression) in that it starts out with a liquid monomer instead of with solid plastic molding powders. The basic raw material is actually poured into the mold as a liquid. This technique results in a finished product of superior mechanical, optical, and fabricating properties.

At the present time, cast plastic sheet material is available in thicknesses from 0.040 to 1" and in the following materials: CR-39, a thermosetting cast resin; acrylic; polystyrene; and Polycast 1, 2, 3, and 4. These latter types have various crazing and abrasive qualities and Polycast 4 is an ultra high frequency material for use in electronics. It has low dielectric constant and power factor. Polycast Corp., Dept. ED, 69 Southfield Ave., Stamford, Conn.

CIRCLE 131 ON READER-SERVICE CARD

Telemetering Transmitter

For High-Power Data Transmission

This XT-1 telemeter transmitter is basically a crystal controlled, phase modulated transmitter that accepts low level modulating signals between 900cy and 100,000cy and provides wide-band, frequency modulated output with less than 1% distortion. Particularly economical for use where large channel capacity is required, the XT-1 telemetering transmitter makes available a channel capacity greater than most non-crystal controlled telemetering transmitters. It has a power output of more than 8.1/2w over the band from 215 to 235Mc. The unit weighs only 60 oz and occupies only 144 cu in, and withstands the vibration and temperature encountered in aircraft and missile applications. West Coast Electronics Co., Dept. ED, 5873 W. Jefferson Blvd., Los Angeles 16, Calif.

CIRCLE 132 ON READER-SERVICE CARD

G-E EXPLOSION-PROOF MOTOR FOR AUTOMAT-IC PILOT SYSTEM is rated 1/10 hp, 7500 rpm, 27.5 volts d-c. Duty cycle: continuous at 20% load with additional 80% load applied 15 seconds on, 15 seconds off. Emergency duty cycle: 20 minutes continuous full load after motor operating temperature has been stabilized at normal duty cycle.

G-E aircraft motor specialists help solve drive problem on new Collins automatic pilot

E. H. Fritze, Control Engineer, Collins Radio Co. (pictured above) says: "In the development of a new automatic pilot system, we were faced with an electric-drive problem. When two other suppliers failed to meet our requirements, we called in General Electric.

"In conferences between our engineers and G-E aircraft-motor specialists brought in by our local G-E Sales Engineer, we arrived at a solution to our problem. Sample motors were delivered in three weeks, saving us considerable engineering time and expense. We find service like this very valuable," Mr. Fritze concludes.

EXTENSIVE TESTING BACKS SERVICE

When G.E. develops a new aircraft or armament motor, extensive environmental testing facilities are called into play. For example, the G-E motor for Collins was subjected to, and passed an insulation test, vibration test, shock test, and an accelerated life test. Such testing assures conformance with your most exacting requirements.

G-E SERVICE FOR YOUR DEVELOPMENT

If you have a development that calls for an aircraft or armament motor, the same fast, effective service provided the Collins Radio Company can be yours from General Electric. Just contact your local G-E Apparatus Sales Office early in your planning. Or write giving full details to Section 704-57, General Electric Company, Schenectady, N.Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC
Hetherington Aviation and Industrial Products
High quality push-button and snap-action switches in the 15-50 ampere range
Special switch box assemblies
Aircraft control stick grip assemblies
Indicator lights
Switch-indicator light combinations
Trim tab control switches
Auto pilot, tank or missile, canopy release, seat ejector or seat positioning switches
Bomb or rocket firing mechanisms
Microphone circuit switches
Audible signal silencers
Limit switches . . . and many others

This little beryllium device is the heart of Hetherington push-button and snap-action aircraft-type switches. Its unique, patented design and sturdy construction assure faster, more positive switching action in less space with less weight—and with a life cycle exceeding military requirements. It is a No. 1 "secret" of Hetherington's success in matching or surpassing exacting specifications—military or civilian—for switch dependability in the 15 to 50 ampere field.

HETHERINGTON, INC., Sharon Hill, Pa.
(West Coast Division: El Segundo, California)
Power Supplies
Have Zero Recovery Time

A group of high-current regulated supplies announced by this firm exhibits the unusual characteristic of zero recovery time from a line or load transient. Designed around a fast-response thyatron rectifier, a "stiff" filter, and a large output storage capacitance, these units have been successfully used in computers, telemetering systems, and aircraft-control applications in which the power supply must be extremely steady.

In the "Zero-Lag" system, the voltage never leaves the regulated region. Standard regulation is 0.5% against static line changes of 20%, static load changes of 100%, dynamic line changes of 10%, and dynamic load changes of 25%. Standard ripple is less than 0.1%. There is no practical limit to size, although the system is most economical in the region from 4-160v, and 4-100amp.

There are 30 stock models, illustrated is Model Z-33, 16-40v, 0.30amp, 0.5% regulation, 0.1% ripple. NJB Corp., Depta ED, 345 Carnegie Ave., Kenilworth, N. J.

CIRCLE 136 ON READER-SERVICE CARD FOR MORE INFORMATION

Crystal Accelerometer
For 10-30,000cy Range

The M-191 accelerometer is a low-cost, lightweight, stable, linear accelerometer which employs an ADP crystal in its construction and is designed for use over the frequency range of 10cy to 30,000cy. The dynamic range is 0.001g to 1000g. This unit is 5/8" diam x 1-5/16" high, weighs 1 oz, and mounts through a tapped hole in the base. An 18" length of special low-noise, coaxial, flexible cable equipped with "Mierodot" connectors is supplied.

The accelerometer is sensitive only to the vector component of the vibration lying along its axis. Its sensitivity per unit acceleration (g) is independent of frequency over the entire operating frequency range. It is effectively equivalent to a primary standard, uniformity being such that all units may be interchanged without individual calibration. Massa Laboratories, Inc., Dept. ED, 5 Fottler Rd., Hingham, Mass.

CIRCLE 137 ON READER-SERVICE CARD FOR MORE INFORMATION

HIGH POWER FERRITE CIRCULATOR

by CANOGA

The Canoga ferrite Circulator is a four port non-reciprocal hybrid junction, which, when used for stabilizing the operation of high power magnetrons, is connected as a Double Termination Load Isolator. The Circulator may also be used as a combination isolator-duplexer. In this application, it replaces the dual T-R duplexer assembly commonly used in broadband systems. A simplified model uses a single termination, with decreased isolation.

LOAD ISOLATOR SPECIFICATIONS

<table>
<thead>
<tr>
<th>Frequency</th>
<th>8300-9800 mc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolation</td>
<td>30 db min.</td>
</tr>
<tr>
<td>Insertion Loss</td>
<td>Less than 0.6 db</td>
</tr>
<tr>
<td>Input VSWR</td>
<td>Less than 1.25:1 over the band</td>
</tr>
</tbody>
</table>

Power Handling Ability:
- Average Power: 300 watts
- Peak Power: 250 kW

Cooling: None required
Length of Unit: 8.5 inches
Weight: 2 pounds
Magnetic Field Supply: Permanent magnet

Write For Complete Details and Applications

CANOGA CORPORATION
Radar Systems, Receivers, Test Equipment, Antennas, Waveguide Components
5953 SEPULVEDA BLVD. VAN NUYS, CALIFORNIA

CIRCLE 138 ON READER-SERVICE CARD

ELECTRONIC DESIGN • November 1955
Pulse Amplifier

Variety of Output Impedances

Pulses at high power levels, with many different characteristics of duration, duty ratio, and impedance level, can be produced by the Type 1219-A Unit Pulse Amplifier. Although designed primarily as a companion instrument for the Type 1217-A Unit Pulser, the amplifier can be driven by any available source of either positive or negative pulses to produce pulses of current with magnitudes ranging from 600ma to 200ma, depending upon duty-ratio. This pulse of current can drive internal loads to give either positive or negative voltage pulses, or can be used to drive a load external to the instrument.

The internal load resistors, extending from 50 ohms to 570 ohms, are chosen to terminate a wide variety of transmission lines in their characteristic impedances. The open-circuit output pulse voltage is between 10v and 250v, depending upon the impedance and the available current. The maximum pulse duration is dependent only on the tolerable ramp-off. For a 10% drop the pulse duration is 10,000μsec for positive pulses and 4000μsec for negative pulses. The amplifier is only 10-1/2" wide and weighs 8-1/2 lb.

CIRCU 77 ON READER-SERVICE CARD FOR MORE INFORMATION

DPDT Relay

Weighs Only 1 oz

This sensitive subminiature dpdt relay is for jet aircraft, guided missiles, and other airborne applications. It is hermetically sealed and dry nitrogen filled, is only 0.656" diam x 1.500" long, and weighs only 1 oz.

The relay is available in contact ratings to 5amp resistive (10amp special) at 28v d-c or 115v a-c. It is manufactured in accordance with MIL-R-5757B and satisfies test requirements of MIL-R-6106A. It functions over an ambient of -65° to +125°C.

The unit will withstand vibration of 10g minimum at 10-500cy and withstand 50g minimum shock. Life at rated load is 100,000 operations (minimum). Electro-Mechanical Specialties, Inc., Dept. ED, 6819 Melrose Ave., Los Angeles 38, Calif.

CIRCU 78 ON READER-SERVICE CARD FOR MORE INFORMATION

Save!

with

Magnetic Focusing of Picture Tubes

...a typical STACKPOLE Ceramagnet use

Stackpole Ceramagnet rings used as the "heart" of magnetic picture tube focusing units in television sets, spell these advantages:

- Lower material costs by comparison with electrostatic focusing. (Material savings alone run from 50c to $1 in actual instances.)
- Faster, easier, more accurate factory focusing of sets.
- Lower incoming inspection costs because of consistently high quality of magnetic tubes.
- Superior, stable focusing over entire face of large tubes.
- Magnetic focusing readily adapted to use of increased second anode voltages. Less affected by voltage changes.
- Longer tube life.
- Easy service adjustment when tube replacement becomes necessary.

Photo shows unique magnetic focusing unit made by Glaser-Sferes Corporation, Belleville, N. J. It uses a single Stackpole Ceramagnet ring 3/4" in diameter x ½" thick.

CIRCLE 79
new star of the magnetic firmament!

Ceramagnet, the unique new Stackpole ceramic magnet, material excels in high resistance, repelling, aging and other essential characteristics. Its cost—well below that of conventional magnetic materials—opens important new engineering horizons wherever positive, highly permanent attracting, repelling or even "cushioning" might be utilized.

Ceramagnet units can be supplied in almost any desired shapes or sizes. Send details of your application for recommendation and samples.

Electronics Components Division
STACKPOLE CARBON COMPANY
St. Marys, Pa.
One or a Million...

How expensive are your design ideas?
How accurate are your prototypes?
How quickly can you swing from pilot to production?

Do your design changes run up cost because of prototype "unreliability"? In orders of one or one million, I-S BeCu® springs measure up to one single standard of performance. This allows you to check your design against production tolerances and tests — without the expense of ordering production quantities. Our "Short-Run" department was set up expressly to handle pilot runs and small production requirements as regular output — instead of treating them as costly "special orders".

I-S Short-Run = Same High Performance — Lower Cost

Two Other Important Advantages

(1) Our ability to produce a better spring faster and usually at a lower cost.

(2) The specialized ability of our engineers to cooperate with your designers in developing your "problem" springs.

Like many other leading manufacturers, you will find that these I-S facilities can make significant improvements in your manufacturing processes and in your product. And they most likely will save you money! One thing is certain . . . it costs nothing to compare — it may cost considerable, not to!

Instrument Specialties Co., Inc.

Instrument Specialties Co., Inc.
270 BERGEN BOULEVARD, LITTLE FALLS, NEW JERSEY
Telephone Little Falls 4-0280
BeCu® = Beryllium Copper, Micro-Processed

For more information on BeCu® Springs, write today to reserve your copy of our newest catalog—No. 8; for Electronic Components, ask for No. 8-A.

Circle 142 on Reader-Service Card for More Information
JAN Tube Shield Replacement
Cooling and Vibration Protection

This new heat dissipating TR series tube shield, designed for direct replacement of JAN-type shields, enables existing equipment to be converted without extensive modification. When this shield is used, up to 50% reduction of the bulb temperature reached when tube is enclosed in a standard JAN shield is attained. Tube life, and therefore, reliability is improved.

They are directly interchangeable with the JAN shield and fit standard JAN 7 and 9 pin miniature sockets similar to the TS102P01, TS103P01, etc. Other benefits offered by the new TR shield, in addition to lowering of bulb temperature, vibration dampening and longer tube life, are its light weight, greater amount of shield-to-bulb contact with patented liner design, excellent electrostatic shielding properties, positive-attaching design and moderate price. National Electronic Research Corp., Dept. ED, 177 W. Magnolia Blvd., Burbank, Calif.

CIRCLE 143 ON READER-SERVICE CARD FOR MORE INFORMATION

Corona Detector
Can Provide Visual Readings

This detector determines the presence of corona in high-voltage rotating apparatus. It consists of a probe mounted on the end of an insulating pole, a control unit, and cables. It is connected to a standard oscilloscope for a visual corona reading. The equipment is inexpensive, portable, safe, and easy to use, and it is designed to help prevent damage, shutdown, and material spoilage.

The probe is essentially a small capacitor. When placed near a corona source, the variations in charge result in corresponding variations in the voltage on the electrodes of the probe. These variations are applied to a resonant circuit and cause it to oscillate momentarily. These pulse-type oscillations are then amplified and appear on the oscilloscope as a corona indication. Sunshine Scientific Instrument, Dept. ED, 1810 Grant Ave., Philadelphia 15, Pa.

CIRCLE 144 ON READER-SERVICE CARD FOR MORE INFORMATION

SANDELS
Model 2 Phase Comparator

...can be used as a modulator, demodulator or switch

This compact, rugged comparator is hermetically sealed in an inert gas and packaged for mounting in a standard octal socket. Two full-wave bridge rectifiers are used to obtain a high degree of stability and balance.

As phase sensitive comparators, these units can be used to measure the amplitude or phase of an input signal with respect to a reference signal. As demodulators, DC output can be obtained either single-ended or push-pull with respect to ground. Suitable for all military applications.

SPECIFICATIONS
Frequency Response: 0 to 5000 CPS;
Max. Reference Voltage: 120V. RMS;
Max. Output Voltage: ± 50V. DC;
Dynamic Range: 60db; Load: Max. 200K ohms, Min. 20K ohms; Input Impedance: Approx. 200K ohms with 200K ohms load and 1:1 transformer.
Size: 1" dia. x 5"; Weight: 2 ozs.

Write for data sheets to Dept. ED-11

CIRCLE 145 ON READER-SERVICE CARD

ELECTRONIC DESIGN • November 1955
Illumination Device
For Shadow-Free Photos

The "Type B Hinelight", through use of a graded circumferential tube light arrangement which places the camera lens inside the light source, reduces shadow in complex electronic and mechanical assemblies to the vanishing point. The feature is particularly important when such things as wired devices and other subjects of irregular or complex construction are to be photographed.

It is especially valuable in the preparation of engineering reports, government manuals, instruction books, visual training and assembly guides, and patent applications. Any high-quality, back-focusing view camera, Land Polaroid camera, or 35mm equipment may be used with the lighting system. The unit illustrated, with appropriate camera and stand, can be supplied as a complete, ready-to-operate assembly if required. Hinelight Corp., Dept. ED, 2500 John St., Fort Wayne, Ind.

CIRCLE 147 ON READER-SERVICE CARD FOR MORE INFORMATION

Dual Switch
Operated by Single Lever

The 6AS13 is a single-actuated dual switch designed for a wide range of control and electronic applications. A low-force, double-pole switch with the ability to switch two isolated circuits at the same time, it consists of two basic switching units operated by a single roller-lever actuator. Operating point of one switching unit is field adjustable to provide either simultaneous actuation or a definite sequence of operation.

The 6AS13 is available with a variety of lever lengths, either straight or formed levers, with or without a roller. Positions of levers can be varied to left or right. A second spdt switching unit can be added.

Basic switching units are listed by UL at 15amp 125v, 250v, or 460v a-c; 1/2amp 125v d-c; and 1/4amp 250v d-c. Other basic switching units can be used to provide higher electrical capacity for d-c circuitry, or for special circuit applications. Micro Switch, Dept. ED, Freeport, Ill.
If your manufacturing operations include potting, sealing, impregnating, laminating, bonding or tooling...

Easy to use

EPON® RESIN

can give improved mechanical and electrical properties...

plus faster processing

Because of their excellent mechanical and dielectric properties, Epon resins are important materials in electrical and electronic manufacture. Epon resins combine high strength with low shrinkage on curing and extreme dimensional stability.

For potting, sealing and impregnating, Epon resins permit safe enclosure of delicate components, maintain high insulation resistance under extremes of temperature and humidity, and are resistant to chemicals.

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

Solvent-free Epon resin adhesives, curing with contact pressure alone at room temperature, form powerful bonds between glass, metal, wood or plastic.

Because of dimensional stability and impact resistance, Epon resins play the key part in making plastic tools such as forming dies, jigs, patterns, templates and fixtures.

Write for "Epon Resins For Structural Uses." Your letterhead request will bring you a sample for evaluation.

(Epon resins are the epoxy polymers manufactured exclusively by Shell Chemical Corporation.)

SHELL CHEMICAL CORPORATION
CHEMICAL PARTNER OF INDUSTRY AND AGRICULTURE
380 Madison Avenue, New York 17, New York

CIRCLE 74 ON READER-SERVICE CARD FOR MORE INFORMATION
Standards of Excellence . . .

Panel Meters
Have External Magnet Movements
Rectangular 5-1/2" panel instruments are available in three types: d-c, r-f, and a-c rectifiers. Each of the three types can be supplied with external magnet meter movements, or shallow or deep core magnet meter movements.

The 4-1/2" instruments are available in the same three meter types and can be supplied with either the shallow or deep core magnet movements. Instruments can be supplied with sensitivities as low as 10uamp. All practical ranges can be supplied. Simpson Electric Co., Dept. ED, 5200 W. Kinzie St., Chicago 44, Ill.

CIRCLE 153 ON READER-SERVICE CARD

Copper for Printed Circuits
Is Rolled and Hard Tempered
Hard tempered rolled copper especially designed for use with printed circuit wiring boards is available in both 0.0015 and 0.0027 gauges. The Rolled Printed Circuit Copper weighs 1 oz or 2 oz per square foot, depending upon the gauge and is supplied in widths up to 38" in standard 350 lb coils. It is of uniform gauge and density throughout because of the rolling process used in its fabrication. Revere Copper and Brass Inc., Dept. ED, 230 Park Ave., New York 17, N. Y.

CIRCLE 154 ON READER-SERVICE CARD

Pulse Transformer Kit
Inductances of 0.5 to 50mh
The kit, No. 100Z1, contains five laboratory-type pulse transformers especially chosen to cover a wide range of practical applications, with primary inductance values from 0.5 to 50mh, and turns ratios as high as 8:1. Each miniature transformer has multiple windings, permitting the engineer to select the characteristics best suited to his application—whether in push-pull driving, blocking oscillator, pulse gating, pulse amplifier, or impedance matching circuits. Sprague Electric Co., Dept. ED, 347 Marshall St., North Adams, Mass.

CIRCLE 155 ON READER-SERVICE CARD

The measure of quality in a publication is the readership it achieves . . . Your electronics advertising will be read in Electronic Design.

Hayden Publishing Company, Inc.
19 East 82nd Street, New York 21, N.Y.
Fluorocarbon Parts

- meet exacting specifications...
- cut assembly costs

Profit from precision parts, fabricated from duPont Teflon, Kellogg Kel-F, Bakelite fluorothene resins and other plastics—by United States Gasket Company.

Quality controlled "from powder to part," they assure uniform electrical, chemical and physical characteristics of the highest quality. Uniform density and dimensional stability permit superior accuracy and dependability in the finished part.

Come to USG for all your requirements—Fluorocarbon sheets, tape, tubing, cylinders, rods, bars, beading, electrical spaghetti—as well as molded and machined parts to your own specifications.

Write for catalog No. 300.

UNITED STATES GASKET COMPANY
CAMDEN I, NEW JERSEY

CIRCLE 156 ON READER-SERVICE CARD FOR MORE INFORMATION
Wire Grid Resistor
Dissipates Heat Rapidly

In this high current, electrical resistor, the resistance units are formed of sturdy, self-supporting wire screen. The wires are of Nichrome wire, and the wire screen is brazed to large copper terminals.

Because the resistance wire is virtually suspended in free air, with no other obstruction to impede the flow of cooling air, the heat dissipating capacity is very high. The construction provides a compact, lightweight unit.

The basic mechanical design, with the wire screen in a V shape, permits expansion and contraction with only minor forces exerted on the insulators. The insulators are ceramic, maintained under slight compression so they cannot vibrate. The resistor is produced in complete grid bank assemblies, either open or enclosed, in 31 standard current capacities from 32amp to 126amp. Schaefer Bros. Co., Dept. ED, 1059 W. 11th St., Chicago 7, Ill.

CIRCLE 157 ON READER-SERVICE CARD FOR MORE INFORMATION

Backward Wave Oscillators
Voltage-Tuned Units

A series of four backward-wave oscillators features electronic tuning across the units' respective frequency ranges. Tuning is accomplished by varying or sweeping a single voltage without any complementary mechanical adjustments. The frequency band may be traversed at microsecond rates. This type of oscillator should find its greatest use as a swept signal source for microwave instrumentation and testing, as a swept local oscillator in superheterodyne receivers, and as a master oscillator in variable frequency transmitters.

The characteristics of these four tubes span the frequency ranges of 2.0-4.0kMc, 3.75-7.0kMc, 7.0-140kMc, and 12.4-18.0kMc, with power outputs of approximately 1000mw, 100mw, 50mw, and 10mw respectively. The tuning voltage in all cases is within the range of 300-3300v. Huggins Laboratories, Inc., Dept. ED, 711 Hamilton Ave., Menlo Park, Calif.

CIRCLE 158 ON READER-SERVICE CARD FOR MORE INFORMATION

IN ALL JAN SIZES
ALL ANGL
Barry Mounts

Built to handle the new jobs — too tough for MIL-standard mounts — the complete ALL-ANGL line lets you choose the JAN size best suited to your needs — for sure protection against shock and high-frequency vibration in all directions.

Complete information about ALL-ANGL Barry Mounts is given in our free engineering data sheets. You'll find load-deflection curves, transmissibility curves, load-versus-natural-frequency curves, and tables of load ranges — for practical solutions to the shock and vibration problems you meet in designing for jets and missiles.

Now Available

Miniature ALL-ANGL mounts, JAN-size 0, for loads up to 3 pounds per isolator. Data Sheet #455 gives dimensions and performance curves that show how you can use these Barry Mounts.

Ready Dec. 1, 1955

JAN-size 1 ALL-ANGL mounts for loads from 1 to 10 pounds per isolator. Data Sheet #1255 giving details of load ratings, dimensions, and performance curves also available December 1.

Ready Feb. 1, 1956

JAN-size 2 ALL-ANGL mounts for loads from 2 1/2 to 40 pounds per isolator. Data Sheet #2156 will be available Feb. 1 with load, dimension, and performance data.

Write us today — we'll send the first data sheet at once and the others as soon as they are printed.

When your problem is protection thru all flight attitudes, your answer is the ALL-ANGL. For recommendations, call your Barry Sales Representative.

BARRY CONTROLS
INCORPORATED
715 Pleasant St. Watertown, Mass.

CIRCLE 159 ON READER-SERVICE CARD

ELECTRONIC DESIGN • November 1955
Aircraft Relay
For Overvoltage Protection

This relay can be supplied for incorporation into any aircraft a-c electric system or panel. It is patterned after the ordinary fluorescent tube starter, but can handle a-c and d-e power simultaneously. It is normally used in conjunction with a slave relay, a transformer, and two resistors for obtaining the desired voltage level and time delay characteristics.

The overvoltage relay is sensitive to the peak voltage and can be used at any a-c supply frequency where the ratio of peak to rms is greater than 1.3:1. Contacts are rated 0.5amp and 28v. The time voltage characteristic is repeatable within 10% of the original time after an elapsed time of 10sec following operation. It will hold time-voltage limits over a temperature range of -55° to +120°C (sea level). There are no resonant frequencies up to 500cy. Size is only 0.383" diam x 2.38" long, and weight is 0.177 oz.

Jack & Heintz, Inc., Dept. ED, 17600 Broadway, Cleveland 1, Ohio.

CIRCLE 161 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Clutch
Delivers High Torque

The Model C-130, a small but powerful electromagnetic clutch, is for instrumentation, servomechanism, control, and automation applications where there is need for a simple disconnect. It measures only 1-5/16" diam x 2-5/8" long, weighs 5-1/2 oz, has a torque output of 7 in-lb, and has a power consumption of only 3w. Price is low.

The clutch has a high speed of response: in the neighborhood of 10millise to 15millise. In addition to on-off clutch service, it may be used as a high-speed non-chattering brake, and for slip applications for restricted periods of time. The construction allows for considerable misalignment between the driving and driven members. Dial Products Co., Dept. ED, 7 Bergen Court, Bayonne, N. J.

CIRCLE 162 ON READER-SERVICE CARD FOR MORE INFORMATION
LIGHTNING RESPONSE . . . SEALED IN GLASS

The magnetically actuated reeds in this tiny Revere GLASWITCH make contact in just 1 millisecond . . . at rates up to 400 cycles per second. Hermetically sealed in an inert, dry atmosphere, with lightning fast snap action, both shelf and contact life are extremely long. Smaller than a cigarette, the GLASWITCH can be located anywhere . . . in any position . . . even in explosive atmospheres . . . individually or in multiples for multi-contact use.

Whenever you need faster, more positive response . . . where extreme sensitivity is a must . . . where light weight is important . . . investigate the Revere GLASWITCH. Write today for complete specifications and suggested uses.

CHARACTERISTICS:

Type—Single pole single throw—normally open—snap action
Enclosure—Hermetically sealed glass tube containing inert dry atmosphere
Operating Time—1 millisecond
Operating Rate—Up to 400 cycles per second
Contact Surfaces—Electroplated Rhodium
Contact Resistance (measured terminal-to-terminal)
   Closed Circuit—0.050 ohms maximum
   Open Circuit—500,000 megohms minimum
Contact Ratings
   D.C. Loads at 28 volts
      0.5 amps resistive
      0.5 amps inductive (L/R—0.026)
   A.C. Loads at 115 volts, 60 cycles
      10 watt lamp load
Ambient Temperature Range—-85°F to +500°F

METHODS OF ACTUATION:

A moving permanent magnet or controlled external electromagnetic field are all you need . . . and the sky's the limit on imagination!

* Trademark

Revere CORPORATION OF AMERICA
WALLINGFORD, CONNECTICUT A subsidiary of Neptune Meter Company
CIRCLE 163 ON READER-SERVICE CARD FOR MORE INFORMATION
Federal's **new germanium rectifier stacks**—

**a mighty handful of DC power!**

Smallest, lightest, most rigid... rated up to 565 volts DC and up to 6 amps...1 to 12 fins

(Over 100 standardized combinations)

The 1N91, 1N92, and 1N93 germanium rectifiers used in these new stacks assure at least 20% lower reverse leakage current than RETMA standards.

Once in a while a new design is so good that it sets entirely new standards for an electronic component. The new Federal germanium stacks are like that. Here are seven of their most important advantages over existing types... advantages that mean a **better rectifier for your equipment**:

- **SPACE-SAVING**—The stacks average one-third shorter in length.
- **LIGHTWEIGHT**—Light, strong plastic side strips are used instead of heavy axial assembly bolts and insulators.
- **RIGID CONSTRUCTION**—Interlocking of fins and strips builds a "tight" structure unaffected by vibration.
- **BETTER HEAT DISSIPATION**—Full area of the fin is available for cooling.
- **TERMINAL LUGS ELIMINATED**—Terminals are stamped out as part of the fin corners, so that wires may be soldered directly to the fin.
- **NO PROTRUDING BUS BARS**— Corners of fins are clipped out for passage of bus bars connecting non-adjacent plates.
- **FULLY INTERCHANGEABLE**—Electrically and mechanically interchangeable with types now on the market.

For detailed information, ask for "Federal Germanium Power Stacks" booklet. Phone NUtley 2-3600 or write to Dept. F-235.

---

**Microwave Rotary Joint**

*Provides Increased Safety*

Although nominally rated at 250-kw, the Model H-250 R-X-Band Rotary Joint does not break down until approximately 700kw. A maximum vswr of 1.10 is maintained over the 8.5-9.6kMc band, and variations of vswr and phase with rotation are negligible.

The rotating element consists of a small package readily modified to fit the mechanical requirements for a particular antenna application. Construction permits attachment of special waveguide configurations directly to the joint, thus avoiding the extra flanges or blind solder joints. Shown are two variations of the basic rotary joint designed to solve a particular user's problem.

The joint can be supplied with either a pressure or weather seal or both. Preloaded ball bearings are used, and full 360° rotation is provided. Litton Industries, Components Div., Dept. ED, 336 N. Foothill Rd., Beverly Hills, Calif.

CIRCLE 165 ON READER-SERVICE CARD FOR MORE INFORMATION

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**Quartz Spring Kit**

*For Experimental Work*

This engineering kit contains five precision quartz springs for experimental use. Fabricated of fused quartz to thicknesses finer than a human hair, these helical springs are especially suitable for use in complex mechanical systems and exacting instrument applications. Load maximums range from 5gm to 50mg, with maximum extension of 5cm throughout. All springs are supplied with hook and attachments. They are regular stock items available in production quantities.

High resistance to temperature variations, an extremely low coefficient of expansion, and excellent chemical stability make fused quartz particularly suitable in applications where dimensions must be accurately maintained. The material also offers elasticity far exceeding that of conventional spring materials, plus high strength and sensitivity. Houston Technical Laboratories, Dept. ED, P. O. Box 6027, 2242 Branard, Houston 6, Tex.

CIRCLE 166 ON READER-SERVICE CARD FOR MORE INFORMATION
Medium Power Transistors
Up to 750mw at 25°C

These new transistors are designed for high power dissipation with linear operation over a wide collector current range. They are hermetically sealed with vacuum to ensure reliability under the most severe operating conditions. Efficient thermal connections provide greater power dissipating at elevated temperatures (up to 750mw dissipation at 25°C). Maximum dissipation ability of 2N85, 2N86, and 2N87 medium power transistors is obtained by chassis mounting.

These transistors are intended for Class A or B output or driving stages, and will provide high output with a minimum of distortion. Approximately 1.5w output can be obtained from a pair of 2N86 medium power transistors operated in push-pull Class B, even at temperatures up to 70°C when mounted on an aluminum chassis for heat dissipation. Transitron Electronic Corp., Dept. ED, Melrose 76, Mass.

CIRCLE 167 ON READER-SERVICE CARD FOR MORE INFORMATION

Silicon Rectifiers
40amp with Cooling

Silicon rectifiers capable of handling up to several kilowatts of power have been announced by this firm. These diodes have a typical forward voltage drop of only 0.7v at a current of 8amp and a cell temperature of 190°C.

At present, four voltage classifications are available: 50v, 100v, 150v, and 200v. They have a forward current rating of 8amp with natural convection cooling at 25°C. Higher current ratings up to 40amp can be achieved with forced cooling. Applications include such diverse fields as magnetic amplifiers, rotating rectifiers on the shafts of brushless generators, welders, plating lines, and power packs. Westinghouse Semiconductor Dept. ED, 356 Collins Ave., Pittsburgh 6, Pa.

CIRCLE 168 ON READER-SERVICE CARD FOR MORE INFORMATION

Midland's part in color television is frequency control to the most critical standards of accuracy, stability and uniformity. We supplied many of the first crystals used in color TV and pioneered in the development of frequency control circuits. As the sets multiply, we're geared to the increasing demand.

Midland makes crystals by the millions for frequency control in land, sea, and air communications. Makes them to ANY specifications, but ONE standard of quality. Be sure you get it.

Midland MANUFACTURING COMPANY, INC.
3155 Fiberglas Road • Kansas City, Kansas

WORLD'S LARGEST PRODUCER OF QUARTZ CRYSTALS

CIRCLE 169 ON READER-SERVICE CARD FOR MORE INFORMATION
COSTLY DESTRUCTION TESTS DEMAND THE RELIABILITY OF A FAIRCHILD OSCILLO-RECORD CAMERA

Of course, you can always get another piece of equipment to test, set up your instruments, repair your personnel, relandscape the grounds and start all over... but it's really easier and less expensive to get the data the first time. Barring a cataclysm like the one above, the Fairchild Oscillo-Record Camera is your best bet for getting accurate records of the test data you want... the first time.

Since Fairchild built the first camera specifically designed for oscilloscope recording, more Oscillo-Record cameras have been used than all other continuous motion oscilloscope recording cameras combined. The Oscillo-Record camera has several design features which contribute to its outstanding reliability and trouble-free operation in obtaining accurate test data. It is ruggedly constructed; its sprocket film drive eliminates slippage, even at high speeds. Rigid, top-of-scope mounting safeguards it against accidental upsetting, maintains the camera in focus at all times and leaves oscilloscope controls unobstructed. Other features include the electronically-controlled continuously variable film speed which permits the selection of the exact rate of film transport for optimum performance.

For any wave pattern... continuously varying, stationary or single transient, at all speeds from 1 to 3600 inches per minute, (7200 in/min on special order) the Fairchild Oscillo-Record camera is the reliable means of photographing scope patterns. Industrial Camera Division, Fairchild Camera & Instrument Corp., 88-06 Van Wyck Expressway, Jamaica, L. I., N. Y., Dept. 120-25N.
Contact Meter-Relay
Has Front Adjust Contacts

The Model 255-C ruggedized meter-relay, with shock-mounted movement and sealed metal case, is available with high limit, low limit, or both high and low limit contact arrangements. Sensitivity ranges are from 0-20μamp to 0-50amp, or 0-5mv to 0-500v. External shunts or multipliers are required for higher ranges, and rectifiers or thermocouples are used for a-c or r-f.

Single contacts can be set for operation from full scale to within 1% of the zero point, double contacts to within 2% minimum spacing. The platinum alloy contacts can be adjusted from the front and have a life exceeding 10,000,000 operations; they are provided with a locking feature to assure a positive “make.” Standard contact rating is 5-25ma, 75-125v d-c, but other ratings can be supplied. Meter accuracy is ±0.2%, and contact repeatability is 1%. The unit is interchangeible with the regular 2-1/2" round case meter. Assembly Products, Inc., Dept. ED, Chesterland, Ohio.

CIRCLE 171 ON READER-SERVICE CARD FOR MORE INFORMATION

10-440Mc Signal Generator
With Multi-Purpose Modulation

This multi-purpose, self-contained signal generator, USM-16, is designed for use where extreme accuracy is required. It provides multi-purpose modulation including CW, AM, FM, PM, and sweep. Over its range of 10-440Mc, it can be tuned to within less than 1000cy of the desired frequency, with reference to a two-stage temperature-controlled crystal calibrator, without charts or auxiliary equipment.

Automatic frequency and level control assure stability at any desired frequency with drift, after warm-up, held to less than ±0.002% in 8 hours at room temperature. The unit has an output of 0.1μv to 0.224v (−127 to 96dbm) into a 50 ohm load with the selected output remaining constant over the full frequency range. The output level and modulation percentage or deviation are shown on direct-reading meter. Byron Jackson Electronics, Dept. ED, 492 E. Union St., Pasadena, Calif.

CIRCLE 172 ON READER-SERVICE CARD FOR MORE INFORMATION

TELESYN®
400 CYCLE RESOLVERS
from FORD INSTRUMENT

• STANDARD RESOLVERS in Sizes 15, 23 and 31
• RESOLVER SYSTEMS incorporating size 23 or 31 resolvers, network box and amplifier.
• and SPECIALS designed to the particular application.

Ford Instrument’s Telesyn Resolvers - precision-built for the extreme efficiency and accuracy of the Company’s computers and control systems - are available to meet your own quality requirements.

FREE - Fully illustrated data bulletin gives specifications and performance information. Please address Dept. ED.

FORD INSTRUMENT COMPANY
Division of Sperry Rand Corporation
31-10 Thomson Ave.
Long Island City 1, N. Y.

Ford Instrument’s standard components

CIRCLE 173 ON READER-SERVICE CARD

ELECTRONIC DESIGN • November 1955
NEW...the 400 cycle vernistat* a.c. Potentiometer you asked for!

The 400 cycle Vernistat is an a.c. potentiometer-type voltage divider that combines high linearity and low output impedance. It is essentially a non-dissipative element adaptable to high temperature operation. Size and mounting dimensions are designed to the BuOrd specification for a size 18 synchro.

Here are the details:
- high linearity, inherent in the design principle, is maintained over the life of the unit.
- low output impedance eliminates need for isolation amplifiers in many applications.
- high output current capability.
- low phase shift—less than 90 seconds, depending on model.
- can be coupled with synchros, resolvers and other components—as well as ganged.
- nonlinear functions can also be generated.

Class 5 ball bearings, centerless ground shaft, and an aluminum housing machined to close tolerances combine to make the Vernistat a precision instrument. Shaft seals will be supplied where they are required by environmental conditions.

check these specifications:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Linearity Tolerance</td>
<td>±0.05%</td>
</tr>
<tr>
<td>Minimum Output Voltage</td>
<td>±0.01%</td>
</tr>
<tr>
<td>Output Impedance</td>
<td>less than 130 ohms</td>
</tr>
<tr>
<td>Input Voltage</td>
<td>130 V max</td>
</tr>
<tr>
<td>Input Impedance</td>
<td>up to 75,000 ohms</td>
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*Trademark

vernistat division
PERKIN-ELMER CORPORATION
Norwalk, Connecticut

Control
For Motor-Alternator Sets

The “VF” line of controls is made up of compact, inexpensive, integrated single packages for the precise regulation of both voltage and frequency of motor-alternator sets and inverters. Presently available in two models, VF-60 for 60cy outputs, and VF-400 for 400cy, the control permits conversion from any d-e source voltage to any a-c output voltage, within the ratings of the controlled machine. Units can be built for any power frequency.

Standard units regulate both output voltage and frequency to within ±2%. Special models, which control voltage and frequency to within ±1/4%, are available for military and other exacting applications. The control permits operation of a-c equipment on vehicles, airplanes, ships, and in remote locations, with high reliability. Electric Regulator Corp., Dept. ED, 314 Pearl St., Norwalk, Conn.

CIRCLE 175 ON READER-SERVICE CARD FOR MORE INFORMATION

Geared Motor
For Radial Thrust Loads

An open-type geared motor designed for over-hanging or radial thrust loads, this unit offers ruggedness, quietness, and dependability. It uses double-supported gear shafts running in sintered-bronze bearings, heavy-duty gears and output shaft, and helical pinion and gear in the first step. Bearings are assured long life lubrication through extra-large oil wicks.

A wide selection of base motors is available: synchronous or non-synchronous unidirectional, or non-synchronous reversible. These units offer starting torques up to 75 lb-in and gear ratios from 4:1 to 30,000:1, and they should be of value to manufacturers of recording instruments, timers, office machines, and appliances. Barber-Colman Co., Small Motors Div., Dept. ED, Rockford, Ill.

CIRCLE 176 ON READER-SERVICE CARD FOR MORE INFORMATION

If you need a special component, send a brief statement of your specifications addressed to Bulletin Board, Electronic Design, 19 E. 62nd St., New York 21, N. Y. Include your complete address.
Giannini digital data handling and recording systems can be adapted to many additional processes that require rapid and/or continuous recording of precise information. Utilizing simple, reliable electro-mechanical instruments, Giannini systems have been chosen for applications requiring extreme reliability and accuracy. Write us concerning your data handling problems—Literature available upon request.
Target...

RELIABLE CIRCUIT MINIATURIZATION

NEW ASTRON ET ELECTROLYTICS
SAVE SPACE AND WEIGHT
...PERFECT FOR PRINTED CIRCUITRY

THEY'RE A HIT! Astron's newest capacitor design puts miniaturization directly in your sights...now it's possible to reduce overall equipment size, significantly-without impairing quality. New ET Electrolytics, available in industry's widest range of values, incorporate Astron's exclusive "SM*** Safety Margin Construction for the extra stamina to withstand surge voltages, ripple currents and high temperatures.

TINY, BUT TOUGH. ET Electrolytics offer a new designing approach whether you're working with printed circuitry, miniature tubes or transistors because here's a unique capacitor that matches their compactness. Long life...dependable 85°C operation and good capacitance stability result from meticulously controlled production techniques. Surgically-clean assembly of specially etched high purity foil..."regulated" electrolyte formulas for long life under varying conditions...positive hermetic sealing in metal cans for absolute environmental protection.

NEW ET ELECTROLYTICS utilize low-resistance terminal tab construction and exhibit exceptionally low current leakage over their entire operating range. Multiple production tests and 100% final inspection are your guarantee against costly rejects.

EVER BEEN ON A SPOT for chassis space? You'll want full engineering and application information-please request Bulletin AB-22.

The Model No. 10 is a miniature sensitive relay suited for both commercial and military applications where either spdt or dpdt relays meeting high shock, temperature, vibration, and minimum space requirements are needed. It has a 10g standard vibration immunity and a 100g non-operating shock resistance. Units are hermetically sealed and conform to MIL-R-5757 B.

Contacts are silver, rated 2amp 28v d-c, and 115v a-c; 100,000 operations is the life expectancy at rated resistive loads. Operating power is 40mw for dpdt, and 20mw for spdt. The unit contains a high-efficency double-coil magnetic circuit with a resistance up to 12,000 ohms, with a maximum dissipation of 1w. Size is (approx) 1" x 1 1/2 x 2" long. Magnadyne Co., Dept. MS, 84 S. Water St., Port Chester, N. Y.

CIRCLE 179 ON READER-SERVICE CARD FOR MORE INFORMATION

Instrument Knobs
Collet-Fitting Types

The "Dalohm" Type K-1 and K-2 precision collet-fitting instrument knobs are interchangeable among the different knob sizes and accommodate all shaft sizes from 1/8" through 3/8". The knobs fit concentrically on the shaft and can be positioned accurately and easily. They are made of east aluminum or thermosetting plastic. Dale Products, Inc., Dept. ED, Columbus, Nebr.

CIRCLE 180 ON READER-SERVICE CARD FOR MORE INFORMATION

Total Hour Indicators
For 60cy or 400cy Equipment

The Model 7008 Running Time Meter indicates up to 10,000 hr on a dial-type face. It weighs less than 6 oz and has a power drain of approximately 2w. It is hermetically sealed in accordance with MIL-I-7793 (AER) and meets military shock (25g) and vibration requirements. Haydon Manufacturing Co., Inc., Dept. ED, Torrington, Conn.

CIRCLE 181 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1955
Power Supplies
In Six High-Voltage Models

The HV and HVA Series of power supplies, each in 60kv, 100kv, and 200kv models, are announced by this firm. Input is 115v a-c; max continuous current output is 1ma, positive or negative polarity.

The HV Series permits, through use of a suitable variable transformer, a-c primary voltage to be varied independently of the filament voltage. A powerstat and an associated meter are available, mounted on the unit if desired. The HVA Series consist of a basic HV Supply and a separate a-c control, each housed in a completely enclosed cabinet.

Reversible polarity, 0-230v a-c, and additional current output are available on special units. Microtime Laboratories, Dept. ED, 7247 Atoll Ave., N. Hollywood, Calif.

CIRCLE 182 ON READER-SERVICE CARD FOR MORE INFORMATION

Nylon Fastenings
In Strengths to 15,000psi

The "Nylogrip" line of nylon fastenings currently includes screws, nuts, and bolts in a wide range of types and sizes. These fasteners are self-locking, non-corrosive, and insulating, and although they weigh less than one-half as much as aluminum fasteners, they have tensile strengths up to 15,000 psi and can withstand continuous heat up to 300°F. Nylogrip Products, Dept. ED, 449 Watertown St., Newton 58, Mass.

CIRCLE 183 ON READER-SERVICE CARD FOR MORE INFORMATION

Lock Nut
Seals Against Water, Dust

The addition of a sealing compound to "Palnut" Washer Type Lock Nuts provides a complete seal around threads and nut seat when tightened, to prevent entrance of water, dirt, and dust. A single one of these units does the job of an ordinary nut, lock washer, flat washer, and sealing washer. High speed assembly is achieved with standard power tools. The nuts are available in Nos. 8-32, 10-24, 12-24, and 1/4"-20. The Palnut Co., Dept. ED, 61 Cordier St., Irvington 11, N. J.

CIRCLE 184 ON READER-SERVICE CARD FOR MORE INFORMATION

Transitron electronic corporation
melrose 76, massachusetts

A newly modernized second plant of 250,000 square feet is being equipped at Wakefield, Massachusetts.

If you're in search of real opportunity, you'll find your professional horizons unlimited at Transitron. In a few short years this young company has carved out a leading position in the field of semiconductors. It is now undergoing further expansion into a second plant of 250,000 square feet.

Here is your chance to work with stimulating, congenial associates in an atmosphere of progress — informal and free of red tape. You'll be located in pleasant, suburban Boston, in the heart of one of America's technical centers — where cultural and educational advantages are found for you and your family. And you're only an hour's drive from New England's vacationland!

So, if your experience is any of these fields:

SOLID STATE PHYSICS  ELECTRICAL ENGINEERING
METALLURGY  SALES ENGINEERING
MECHANICAL ENGINEERING  PRODUCTION ENGINEERING

... there is an unparalleled opportunity for you right now with Transitron. Salaries are attractive; vacation, insurance and retirement benefits are liberal and your opportunities for professional growth are unlimited.

A letter to Transitron with your resume will receive our prompt attention, and will be held in strictest confidence. Transitron Electronic Corporation, Telephone: MElrose 4-9600.
PERFORMANCE - GUARANTEED

Magnetic Shields

COST NO MORE -

WHY TAKE LESS?

You're time and money ahead with Performance-Guaranteed Magnetic Shields. For our shields are guaranteed to meet the requirements of your circuit to mutually agreed upon shielding specifications. Dry hydrogen annealed, as required . . . of MuMetal, A.E.M. 4750, or whatever commercially available material is most suitable . . . fabricated or drawn . . . painted or lacquered to match any shade, or unfinished. Write for the industry's most complete catalog, MS-104, today.

MAGNETICS inc.

DEPT. 26-ED, BUTLER, PA.

Ionization Gage Controls
Are Highly Stable and Linear

Nos. RG-2 and RG-3 Ionization gage controls measure pressures from Imicon to 2 x 10^-5 mm Hg. High stability and linearity are provided by a new type of circuit using an ion current amplifier employing 100% negative feedback, similar to those used in "electrometer" amplifiers. The high stability of the circuit makes it suitable for attachment to a recorder. Auxiliary recording equipment is available, or a packaged unit can be supplied.

Type RG circuits are designed to be used with the Type RG-75 "Non-burnout" gage; the circuit also may be used with other gage tubes. The controls are available either with or without a circuit for controlling two thermocouple gages. Units are supplied either in a cabinet or on a panel for rack mounting. Operation is from 110v 60cy. Vacuum Electronic Engineering Co., Dept. ED, 86P Denton Ave., New Hyde Park, N. Y.

CIRCLE 186 ON READER-SERVICE CARD FOR MORE INFORMATION

Woven Heat Elements
In Rubber and Plastic

Woven heat elements are available from this firm for a wide variety of applications in aircraft as well as in industry generally. Various materials are used for insulating these tailor-made units. Neoprene rubber is employed where medium heat (200°F) is required, such as for deicing propeller blades and aircraft wings, or as battery, antenna, and rocket tube heaters. Silicone rubber has excellent stability and flexibility for long periods through a temperature range of -60°F to 500°F; some of its present uses include gyroscopes, servomechanisms, temperature sensing elements, and heaters for missiles.

This firm is also incorporating heating units within Fiberglas-reinforced plastic; this permits a heater to furnish its own structural support which will withstand the most severe environmental conditions. Safeway Heat Elements, Dept. ED, Middletown, Conn.

CIRCLE 188 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1955
Linkable chassis units, pre-punched socket plates offer endless lab setups!

SPEED THE JOB and cut chassis costs with Speed-Chassis, the versatile and inexpensive breadboard assembly with the interchangeable, pre-punched socket arrangements. Chassis is pre-assembled with control holes on both ends. Has four insulated tie-point strips and one grounded tie-point strip. Dust cover and panel available to make successful breadboard assemblies permanent. Units can be mounted on relay rack.

SIZE: 5" wide, 5¼" deep, 16½" long. Half-size (8¾" long). 20 styles of plates stocked; 17 different, punched, 3 sizes of blanks.

A few examples of the many possible arrangements
Stocked by leading jobbers everywhere

SPECIFIC PRODUCTS
14515 DICKENS STREET
SHERMAN OAKS 8, CALIF.

CIRCLE 189 ON READER-SERVICE CARD

Time Delay Relay
Permits Electrical Interlock

An electrical interlock in a circuit which allows push-button control can now be obtained by use of an instant action auxiliary switch in the Model NEL "Agastat" time delay relay.

Time delay is pneumatically-controlled and provides a readily adjusted and accurate timing interval from 0.1sec to 10 or more minutes. Measuring 2-1/2" x 3-3/8" x 4-1/2", the relay is easily mounted. Affixed to the front is a normally closed double-throw micro-switch.

The relay is available for all a-c and d-c voltages, in spdt double-break, and dpdt single-break models. It is rated 15amp at 115v 60cy a-c. A’G’A Div., Elastic Stop Nut Corp. of America, Dept. ED, Elizabeth, N. J.

CIRCLE 190 ON READER-SERVICE CARD FOR MORE INFORMATION

Instrument Cases
Of Drawn Aluminum

This firm is tool
ed for a standard line of drawn alu
minum instrument cases. The first one
available, the ZIC-2, is 11" wide x
7-3/4" high, with
depth varying as ordered, from 4" to 8-1/4". The
cover of the ZIC-2 is recessed to protect knobs and
dials to be installed, and all cases have four dimples
on the bottom. Zero Manufacturing Co., Dept. ED,
1121 Chestnut St., Burbank, Calif.

CIRCLE 191 ON READER-SERVICE CARD FOR MORE INFORMATION

Diode Clip
Holds Pigtail Leads

This spring-loaded clip securely holds fra
gilo diode pigtail leads from 0.005" to 0.035" diam.
It is made of brass and is fin
ished in 0.0002" bright alloy plate. When mounted, it is
11/32" in overall height. The mounting stud is
7/32" long, hexagonal with a 2-56 thread. Cambridge
Thermionic Corp., Dept. ED, 445 Concord Ave.,
Cambridge 38, Mass.

CIRCLE 192 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 193 ON READER-SERVICE CARD
GENERAL ELECTRIC ANNOUNCES . . .

NEW, faster, smaller micro-miniature relay

LIGHT WEIGHT, SMALL SIZE: Weighs only .35 ounces and measures .34" x .781" x .81". This tiny relay utilizes balanced armature and simple design, giving you quality and more reliable operation at a consistently high level.

HIGH CONTACT RATING: For low contact resistance and long life, fine silver is used . . . contact rating is 2 amps resistive load at 30 V d-c or 115 V a-c . . . contact arrangement is 2PDT.

FAST OPERATION: With rated voltage on coil, operating time is 1.5 milliseconds. By adding series resistance in coil circuit or by applying high voltage pulse to coil . . . pickup time will be less than 1 millisecond!

LOW OPERATING POWER: 300 milliwatts for standard model . . . 150 milliwatts for current sensitive model.

HIGH SHOCK: VIBRATION RESISTANT: G.E.'s balanced armature and high tip forces withstand shock of over 50 g's and vibration of 10-55 cp's at .12" maximum excursion and 55-500 cp's at 20 g's acceleration.

HIGH TEMP OPERATION: This new micro-miniature relay gives you continuous and efficient operation at ambient temperatures of 125° C.

G.E.'s line of aircraft-type relays will help solve your space-weight problems.

Contact your G-E Apparatus Sales office for more application information.


MAIL THIS COUPON FOR G-E RELAY DATA . . .
Solenoid
For Limited Space Uses

This compact solenoid is now available for limited space applications requiring high power and rugged performance. The shading coil is embedded in the plug for greater efficiency and high seated pull. It operates in any position and is supplied as standard with solder terminals or can be furnished with flexible leads. Dormeyer Industries, Dept. EDN, 3418 N. Milwaukee Ave., Chicago 41, III.

CIRCLE 289 ON READER-SERVICE CARD FOR MORE INFORMATION

Rectifier
Selenium Cartridge Type

This selenium rectifier, Type 60-6979, is for use in instruments requiring high transient peak currents for capacitor charging (such as strobe flash units). It is a single-phase full-wave bridge selenium rectifier delivering 9.6ma average current, 190ma peak pulse current at 495v d-c capacitive load. It is 3-1/8" long x 3/8" OD, and is supplied with 3-1/2" radial pigtail leads. International Rectifier Corp., Dept. ED, 1521 E. Grand Ave., El Segundo, Calif.

CIRCLE 290 ON READER-SERVICE CARD FOR MORE INFORMATION

Microwave Test Unit
For S-Band and X-Band

This Standing Wave Introductor is made for S-Band and X-Band operation, has high power, and has been tested up to 500kw on S-Band frequencies. It allows a duplication of settings and has the ability to reset each time at reliable check points. Microtronics, Inc., Dept. ED, 9 Porete Ave., North Arlington, N. J.

CIRCLE 291 ON READER-SERVICE CARD FOR MORE INFORMATION

Ultra-High Regulation Power Supply
Model UHR 225

For the most exacting d-c regulation, the Krohn-Hite Model UHR-225 Power Supply provides unsurpassed performance. It is low priced and compact (7¾" wide x 10" high). It has 0.002% regulation and 100 microvolts ripple over the entire operating range (150-500 volts and 0-200 MA). For line voltages between 105 and 125 volts, full rated current can be drawn continuously with a substantial margin of safety. The internal impedance is less than 0.02 ohms for d-c and low frequencies and less than 0.1 ohm for frequencies as high as 100 kc. Transient response is 0.001 millisecond. Typical ten-hour drift is 500 ppm. In addition to the d-c output, there are two independent 6.3V a-c outputs, each rated at 5 amps. Price, $250.00 f.o.b. factory.

For Further Details Write

KROHN-HITE INSTRUMENT CO.
Dept. ED, 580 Massachusetts Ave., Cambridge 39, Mass.

CIRCLE 292 ON READER-SERVICE CARD FOR MORE INFORMATION

in this book... over 7,000 STAINLESS STEEL FASTENINGS

RIGHT-OFF-THE-SHELF for immediate delivery

* Avoid costly production and experimental delays! * Brand new edition of Star Catalog now available.

Write, wire or phone for your copy today!

Star Stainless Screw Co.
663 Union Blvd., Paterson 2, N. J. Telephone: Little Falls 4-2308

CIRCLE 293 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1955
Rectilinear Potentiometer
In Sliding and Leadscrew Types

This precision miniature rectilinear potentiometer is designed for miniature printed circuitry applications, transistor applications, commercial, or military applications. It can be supplied as shown in the picture with sliding motion wiper, or as a sealed lead-screw type, with a nominal 50 turns covering 90% of the usable resistance length. Both models are available in resistance ranges from 100 ohms nominal to 10,000 ohms, and with Teflon-insulated lead wire. Size is 7/8” x 3/16” x 5/32” high, and 7/8” x 7/16” 5/16” high, respectively. Hubbard Scientific Laboratories, Inc., Dept. ED, 1292 E. 3rd St., Pomona, Calif.

CIRCLE 199 ON READER-SERVICE CARD FOR MORE INFORMATION

Instant Solder Gun
Weighs Only 8 oz

The “Instant Solder Gun” is soldering hot in a few seconds, without the use of a heavy transformer or fragile thermostats, and it weighs only 8 oz. A special alloy “Lifetime Tip” is provided.

The heating element is in the tip. It is rated at 150W and available for 120V. It operates identically on d-c as well as a-c. Hexacon Electric Co., Dept. ED, 299 W. Clay Ave., Roselle Park, N. J.

CIRCLE 200 ON READER-SERVICE CARD FOR MORE INFORMATION

Teflon Terminals
Mounted by Press Fit

The X-2182 series of push-in insulated terminals utilizes the properties of Teflon, both as a holding material and as an insulator. The terminals permit a press-fit into mounting panels of 1/16” to 1/8” thickness, with secure seating that keeps them shake-proof and firmly attached. The units feature high terminal pull strength in any direction. Cambridge Thermionic Corp., Dept. ED, 445 Concord Ave., Cambridge 38, Mass.

CIRCLE 201 ON READER-SERVICE CARD FOR MORE INFORMATION
Plastic Film Capacitors
Take -65° to +165°C Temperatures

High-temperature "XC" plastic film dielectric capacitors feature high insulation resistance, low power factor, and low dielectric absorption. Operating temperature range is from -65° to +165°C. Minimum insulation resistance at 25°C, measured with an applied potential of 100v and an electrification time of 2 minutes, is 75,000 megohms, but need not exceed 200,000 megohms.

The capacitors are hermetically sealed and also meet moisture resistance and vibration specs of MIL-C-25A. In addition to tubular types, other case styles such as bathtubs and rectangular are available. Capacitors are built to withstand a d-c voltage equal to 200% of the rated voltage for 1 minute at 25°C.

The Gudeman Co., Dept. ED, 340 W. Huron St., Chicago 10, Ill.

CIRCLE 205 ON READER-SERVICE CARD FOR MORE INFORMATION

Ammeters, Voltmeters
Moving-Iron Vane 0.2% Accuracy

These "AEG" (Allgemeine Elektrizitäts- Gesellschaft) moving-iron instruments are of the 0.2% precision class. Both ammeters and voltmeters are available in a variety of ranges (and in multi-range units) from 30/60ma to 6 amp, and 15/30/75v to 150/300/450/600v.

Frequency range of all ammeters is d-c and 15-300cy; of voltmeters is d-c and 15-100cy. Units are available with temperature compensation for frequencies to 400cy. Power consumption is low, and the instruments are easily read. Donald C. Seibert, Importer, Dept. ED, Box 281, Wilmington, Del.

CIRCLE 206 ON READER-SERVICE CARD FOR MORE INFORMATION

If you need a special component, send a brief statement of your specifications addressed to Bulletin Board, Electronic Design, 19 E. 62nd St., New York 21, N. Y. Include your complete address.
Impedance Comparator
Permits Rapid Testing

Impedance Comparator Model 1010 gives percentage deviation of impedance directly in both sign and magnitude on a zero-centered meter. Three full-scale ranges are provided: ±5%, ±10% ±20%. The impedance limits are: resistance, 5 ohms to 5 megohms; capacitance, 50 mmfd to 20 mmfd; inductance, 100 µh to 80h. Operating frequencies are 1000cy or 10,000cy. The Industrial Test Equipment Co., Dept. ED, 55 E. 11th St., New York 3, N. Y.

CIRCLE 210 ON READER-SERVICE CARD FOR MORE INFORMATION

Glow-Tip Switches
Can be Located in Dark

Every switch in this firm's "Quiet Light" switch line ("Lifetime", "Interchangeable", and "Junior") can now be supplied with a radioactive luminous button situated in the tip of the operating lever. These "Glow-Tip" buttons will glow continuously, since unlike fluorescent-type materials, radioactive luminous material is not dependent upon daylight to build up luminous properties. The Arrow-Hart & Hegeman Electric Co., Dept. ED, Hartford, Conn.

CIRCLE 211 ON READER-SERVICE CARD FOR MORE INFORMATION

Dynamic Balancer
Takes Diameters to 20"

A fully electronic dynamic balancer, Model 5V-6 will handle any rotating body from 4 oz to 100 lb, yet is simple enough that operation can be learned in less than an hour. A bench model, it needs very little space and a minimum of fixturing. Within its weight-handling range, it will balance such units as fans, armatures, blowers, pulleys, crankshafts, drums, propellers, and impellers. Micro Balancing, Inc., Dept. ED, Herricks Rd., Garden City Park, N. Y.

CIRCLE 212 ON READER-SERVICE CARD FOR MORE INFORMATION

Quick shipment of prototype radar transformers

Once you've told us what you want, work begins at once. We've pooled design engineers and a team of skilled assemblers in a separate section...organized to deliver prototype oil-filled units for your radar experimental or system development projects in a hurry. Small orders are also filled in our high-speed model shop to avoid production-line delays. There's no waiting around for completion of larger projects. You're assured fast shipment on all orders.

Progress Is Our Most Important Product

GENERAL ELECTRIC

SEND ME YOUR NEW RADAR COMPONENT BULLETIN

General Electric Co., Section 8434-2
Schenectady 5, New York

Name:
Address:
City:
State:

CIRCLE 213 ON READER-SERVICE CARD FOR MORE INFORMATION
High-temperature operation. Exhaustive tests have shown that these units are capable of operation up to 200°C with no detectable aging in their characteristics.

In rectifier efficiency. Forward voltage drop reaches only 0.85 volts at 40 amperes, 190°C junction temperature. Efficiency is over 99%. Ratings up to 200 volts maximum peak inverse are available in four classifications: 50, 100, 150 and 200 volts.

In compact design. Westinghouse silicon power rectifier (shown actual size above) takes only 1/50th the volume of the comparable selenium rectifier.

Write today for your free application Facts Folder describing the full range of silicon power rectifier characteristics. These rectifiers are available for immediate delivery. Call your local Westinghouse sales office, or write: Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pa.
Terminals
Insulated with Plaskon Alkyd

Miniature and standard sizes of Plaskon Alkyd insulated terminals are available from this firm. The terminals, with fiberglass fillers, give high mechanical strength, are and flame resistance, and dielectric qualities. Compared with ceramic insulators, the load life is greatly improved, there is more resistance to moisture, and the terminals have improved temperature characteristics as well as ability to dissipate heat. Leree Div., Lynn-Deatrick, Inc., Dept. ED, 501 S. Varney St., Burbank, Calif.

CIRCLE 215 ON READER-SERVICE CARD FOR MORE INFORMATION

Rotary Switch
A 30-Point 6-Level Unit

The Type E-RVF is a 30-point, 6-level rotary switch available with either two rows of contacts per level or one row of contacts and one common ring contact. Each wiper consists of two flat bifurcated springs, providing double contact surfaces at each level. These surfaces are in the form of “feet” at the end of each wiper spring. They make contact at the “heel” and break with a snap action at the “toe”.

North Electric Co., Dept. ED, Galion, Ohio.

CIRCLE 216 ON READER-SERVICE CARD FOR MORE INFORMATION

Temperature Probes
Provide High Outputs

High resistance (20,000 ohms) temperature probes, when used with this firm’s “TMF” bridge network, provide 5v output signals (without amplification) for as little as 150° temperature change. Probes are available in varied configurations for measuring fluid, surface, structure, air, hydraulic line, cylinder head, and subminiature component temperatures. Arnoux Corp., Dept. ED-4, Box 34628, Los Angeles, Calif.

CIRCLE 217 ON READER-SERVICE CARD FOR MORE INFORMATION

Coat inside walls of CRTs with a dispersion of ‘dag’ Colloidal Graphite in de-ionized water to retard secondary emission and adsorb gases. The resulting film also acts as an electrical conductor and a ray-focusing material.

A ‘dag’ dispersion in lacquer, sprayed onto exterior tube surfaces, dries in one to two minutes and produces a smooth, black, adherent, conductive coating on any type of glass. Once thoroughly dried, the film is resistant to removal by water.

You’ll find a surprising number of ways to use ‘dag’ dispersions described in our free booklet on ‘dag’ Colloidal Graphite for electronics and electrical applications. Write for Bulletin No. 453-P12.

Dispersions of metalloids dissolve are available in various carriers. We are also equipped to do custom dispersing of solids in a wide variety of carriers.

ACHESON COLLOIDS COMPANY
PORT HURON, MICHIGAN
...315A ACHESON COLLOIDS LTD.
LONDON, ENGLAND

CIRCLE 218 ON READER-SERVICE CARD
In 1956

ELECTRONIC DESIGN will reach your desk 24 times

Audio Oscillator
A Wide-Range Lab Unit

The Model 301A Audio Oscillator is a compact, reliable, wide-range general-purpose laboratory audio oscillator. Covering the range from 10cy to 1.0Mc in five steps, the oscillator is packaged in a unit only 9-5/32" x 7-5/32" x 8-11/16". Hum level is less than 0.1% of rated output; and distortion is less than 1%. Shasta Div., Beckman Instruments, Inc., Dept. ED, P. O. Box 296, Station A, Richmond, Calif.

CIRCLE 220 ON READER-SERVICE CARD FOR MORE INFORMATION

Aluminum Inserts
For Molded Plastics

A line of standardized aluminum inserts for molded plastics is offered by this firm. Holes are tapped to maximum depth for overall length with Class II threads (to meet ASME specifications) in sizes from 4-36 to 12-24. The outside knurl is extremely coarse, affording exceptional holding power against high torque. Yardley Precision Products Co., Dept. ED, 48 E. Afton Ave., Yardley, Pa.

CIRCLE 221 ON READER-SERVICE CARD FOR MORE INFORMATION

Radio Noise Filter
Weighs only 7/8 oz

This small, lightweight, dual Pi noise filter for actuator motors consists of four 0.5mfd capacitors and two 0.5mh toroids, and is rated at 2amp 200v d-c. It is only 7/8" x 7/8" x 9/16" in size, and weighs 7/8 oz. The unit brings noise level far below MIL-I-6181 requirements throughout the frequency spectrum. The dielectric is epoxy resin, for operation at 300°F. Electronic Specialty Co., Miniature Components Div., Dept. ED, 5121 San Fernando Rd., Los Angeles 39, Calif.

CIRCLE 222 ON READER-SERVICE CARD FOR MORE INFORMATION
PRECISION ATTENUATION TO 3000 mc!

six-position TURRET ATTENUATOR featuring PULL-TURN-PUSH action

FREQUENCY RANGE: dc to 3000 mc.
CHARACTERISTIC IMPEDANCE: 50 ohms.
CONNECTORS: Type "N" Coaxial female fittings each end.
AVAILABLE ATTENUATION: Any value from 1 db to 60 db.
VSWR: 1.2 max., dc to 3000 mc/s, values from 10 to 60 db. As value decreases below 10 db, VSWR increases to not over 1.5.
ACCURACY: ± 0.5 db.
POWER RATING: One watt sine wave power dissipation.

SINGLE "IN-THE-LINE" ATTENUATOR PADS and 50 ohm COAXIAL TERMINATIONS
This new group of pads and terminations features the popular Type C and Type N connectors, and permits any conceivable combination of the two styles. For example, the two connector types, either male or female, can be mounted on the same attenuator pad, with or without flanges, so that it may serve as an adapter as well as an attenuator. Frequency range, impedance, attenuation, VSWR, accuracy and power rating are as designated above. Send for free bulletin entitled "Measurement of RF Attenuation."

STODDART AIRCRAFT RADIO Co., Inc.
1644 J Santa Monica Blvd., Hollywood 38, California • Hollywood 4-9294

CIRCLE 223 ON READER-SERVICE CARD FOR MORE INFORMATION
RUGGED • ACCURATE • TUBELESS
MAGNETIC AMPLIFIER DC SOURCES
(MA-NOBATRONS*)
Sorensen MA-NOBATRONS* have been designed for industrial applications and unattended installations where the utmost in maintenance-free service is required.

SPECIFICATIONS

<table>
<thead>
<tr>
<th></th>
<th>MODEL MA65</th>
<th>MODEL MA 640</th>
<th>MODEL MA 2850</th>
</tr>
</thead>
<tbody>
<tr>
<td>INPUT</td>
<td>105-125VAC, 1Ø, 60 cycles</td>
<td>190-230VAC, 3Ø, 60 cycles 4-wire wye.</td>
<td></td>
</tr>
<tr>
<td>OUTPUT</td>
<td>6VDC, adj. ±10%</td>
<td>4.5-7.7VDC, adj.</td>
<td>33-32VDC, adj.</td>
</tr>
<tr>
<td>LOAD RANGE</td>
<td>0-3 amperes</td>
<td>0-40 amperes</td>
<td>0-50 amperes</td>
</tr>
<tr>
<td>REGULATION</td>
<td>±1.0% for any combination of line and load conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RECOVERY TIME</td>
<td>0.15 seconds under worst conditions</td>
<td>0.3 seconds under worst conditions</td>
<td>0.5 seconds under worst conditions</td>
</tr>
</tbody>
</table>

Contact your local Sorensen representative, or write for further information. If you have special requirements in magnetic amplifier DC sources, write or call the Applications Engineering Department, and your problem will receive prompt attention.

SORENSEN & COMPANY, INC. • 375 FAIRFIELD AVE., STAMFORD, CONN.


CIRCLE 224 ON READER-SERVICE CARD FOR MORE INFORMATION
Directional Couplers
Cover 225-4000Mc

Four new models of wide-band coaxial directional couplers are valuable for microwave power monitoring and measurement, or as fixed attenuators. Available in 20db or 30db coupling values, each coupler covers the complete range of the most widely used bands: 225-460Mc, 460-950Mc, 950-2000Mc, and 2000-4000Mc. The coupling variation over the frequency range of each coupler is less than 1db, while the directivity is higher than 20db over the full band. The vswr of the primary arm is less than 1.15 in all models. The Narda Corp., Dept. ED, Mineola, N. Y.

CIRCLE 225 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Rectifiers
Parts Under Constant Pressure

Cells range in physical size from 1” x 1” to 5” x 6” and, with convection cooling, are rated from 0.180amp to 10.0amp per cell on a single-phase full-wave bridge basis. These ratings are in accordance with the latest NEMA approved specifications for standard applications.

Featured is a “solid stack” assembly in which all mounted parts are under constant pressure provided by end springs. Union Switch & Signal, Div. of Westinghouse Air Brake Co., Dept. ED, Pittsburgh 18, Pa.

CIRCLE 226 ON READER-SERVICE CARD FOR MORE INFORMATION

Coupling
Uses Collet Principle

This coupling utilizes a modified collet principle for instant locking and unlocking. When engaged, it is free to swivel, yet has 80% of the plug shoulder in complete contact with the collet fingers. This new unit has been in constant service during two years of testing on pneumatic and fluid applications.

Double-valve and straight-thru couplers are available on special order, R. S. Coreoran Co., Dept. ED, P. O. Box 1404, Joliet, Ill.

CIRCLE 227 ON READER-SERVICE CARD FOR MORE INFORMATION

But why MEN over 45?

Our doctors still don’t know why, but if you are a man over 45 you are six times as likely to develop lung cancer as a man of your age twenty years ago. They do know, however, that their chances of saving your life could be about ten times greater if they could only detect cancer long before you yourself notice any symptom. (Only 1 in every 20 lung cancers is being cured today, largely because most cases progress too far before detected.)

That's why we urge that you make a habit of having your chest X-rayed every six months, no matter how well you may feel. The alarming increase of lung cancer in men over 45 more than justifies such precautions. Far too many men die needlessly!

Our new film "The Warning Shadow" will tell you what every man should know about lung cancer. To find where and when you can see this film, and to get lifesaving facts about other forms of cancer, phone the American Cancer Society office nearest you or simply write to “Cancer”—in care of your local Post Office.

American Cancer Society

ELECTRONIC DESIGN • November 1955
Power Supply
Rated to 20amps at 125v

The Model “GF” Universal D-C Power Supply converts a-c to as much as 125v d-c, continuously variable. Rated for loads up to 10amp continuous and 20amp intermittent, the unit is filtered to less than 1% a-c ripple at 10amp. Special forced-air cooling increases rectifier life and the margin of continuous operational safety. Electro Products Laboratories, Dept. ED, 4501 N. Ravenswood Ave., Chicago 40, Ill.

CIRCLE 230 ON READER-SERVICE CARD FOR MORE INFORMATION

Crystal Holder
For Use with Tripolar Diodes

The miniaturized crystal holder, SL-101, is for use with the new Sylvania Tripolar crystal diodes, types 1N358, 1N369, and 1N369A. The holder incorporates a broad-band bead, which provides a minimum bandwidth of 1 to 12.4kMc. When it is terminated in a matched load, the maximum vswr is 1.6 over the specified frequency range. Input is a type N male connector; the output is a 50 ohm “Microdot” receptacle. Sage Laboratories, Inc., Dept. ED, 38 Guinan St., Waltham 54, Mass.

CIRCLE 231 ON READER-SERVICE CARD FOR MORE INFORMATION

Mercury Vapor Rectifier
For High Voltage Uses

The high-voltage mercury vapor rectifier tube, type 6693, is designed for high and medium voltage rectification. The tube will deliver 9amp up to 12kv in a full-wave, 3-phase power supply. Three tubes, in a 3-phase half-wave power supply, will deliver 6kv at 9amp, using only one filament transformer. Difficulties due to oxidation of the base contact surfaces have been eliminated. Amperex Electronic Corp., Dept. ED, 230 Duffy Ave., Hicksville, L. I., N. Y.

CIRCLE 232 ON READER-SERVICE CARD FOR MORE INFORMATION

To fit numerous applications, Bourns has 200 designs of miniaturized, high-performance sensing instruments on file. These designs are either standard types, or variations made to meet special electrical and environmental specifications. The pressure potentiometer designs range from ½ to 10,000 p.s.i. Linear motion units provide travels of ½” to 30”, and you can choose from a wide variety of resistance ranges.

The instrument you need may be among these Bourns designs — ready for production from parts in stock. Or one of the designs now on our boards may meet your specs. If not, we will gladly consider developing the instrument you require. Send us your specifications — your problem may already be solved.
Dynamic Pickup
For Low Pressure Measurements

This unit measures either gage or differential pressure in the ranges 0.00-
0.05 psi and 0.00-1.00 psi. High accuracy and resolution characteristics make
the pickup particularly suitable for sensitive airflow measurements, vacuum
equipment studies, precision altimeters, and medical research equipment. Special construction
minimizes acceleration sensitivity. Dynamic Instrument Co., Inc., Dept. ED, 28 Carleton St., Cam-
bridge, Mass.

CIRCLE 235 ON READER-SERVICE CARD FOR MORE INFORMATION

Phenolic Coil Form
For Printed Circuitry

This phenolic coil form, Type SPC, is for printed
circuitry. It is available in
two diameters with four ter-
minals each, and can be dip
soldered after mounting.

The coil form comes com-
plete with threaded slug. The
terminal collar is securely
fastened to the form. The
unit mounts through four
holes, as required by the number of terminals. When
mounted, the smaller unit is 3/4" high x 0.219" diam,
and the larger unit is 3/4" x 0.285" diam. Cambridge
Thermionic Corp., Dept. ED, 445 Concord Ave., Cam-
bridge 38, Mass.

CIRCLE 236 ON READER-SERVICE CARD FOR MORE INFORMATION

Drafting Machine
Offered at Low Cost

This accurate, Swedish, drafting machine is offered at a low price. It is con-
structed of cold-drawn steel tubing and accurately ma-
chined steel and plastic parts. It
sets and holds any angle. The protractor head reads from 90° through 0° to 45° with automatic
quick-set lock every 15°; the head also locks easily at any desired angle between the 15° stops. Walpole Co.,
Dept. ED, 419 Babylon St., Boston 16, Mass.

CIRCLE 237 ON READER-SERVICE CARD FOR MORE INFORMATION

Need a complete complement
of High Voltage Capacitors
for developmental color TV?

Leaders for over two years
in experimentation with component parts for color TV,
Jeffers Electronics has developed this first complete com-
plement of high-voltage capacitors.

Drawings and additional technical information furnished on request. Complete kits of high-voltage capacitors listed
below available at nominal cost.

Each kit includes the following units:

<table>
<thead>
<tr>
<th>No. per kit</th>
<th>Capacity</th>
<th>Voltage Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10,000 MFD</td>
<td>6KV</td>
</tr>
<tr>
<td>1</td>
<td>2,000 MFD</td>
<td>30KV</td>
</tr>
<tr>
<td>1</td>
<td>500 MFD</td>
<td>30KV</td>
</tr>
<tr>
<td>1</td>
<td>1,000 MFD</td>
<td>10KV</td>
</tr>
<tr>
<td>1</td>
<td>1,200 MFD</td>
<td>12KV</td>
</tr>
</tbody>
</table>

* Typical quantities proposed

Other Divisions: Speer Resistor
International Graphite & Electrode

CIRCLE 238 ON READER-SERVICE CARD FOR MORE INFORMATION

NOW READY

MINIATURIZING?
Use these field-tested and proven MIL-I-27 type designs.

MICOTRAN TRANSFORMER CATALOG

LISTS HUNDREDS OF MINIATURE
TRANSFORMERS AVAILABLE
AS STOCK ITEMS!

- No sampling expense, no wasted time
- Eliminate redesign of production equipment
- Designed for guided missiles, airborne equipment, surface
  transistor amplifiers, high
  temperature applications

SEND NOW for the brand new
MICOTRAN Catalog.
Gives detailed information about
available stock items. Handles
realistic, field-proven items.

IMMEDIATE DELIVERY OF
key Industrial Distributors

MICOTRAN 84-11 Blvd., Rockaway Beach, N. Y.

CIRCLE 239 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1955
Variable Delay Network
Works Between Matched Impedances

Unlike tapped delay lines which must be terminated in a high impedance at the selected tap, the No. 300 Series Variable Delay Network provides a variable delay between matched impedances. Available in ranges of 2μsec and 2000μsec, the network affords flexibility in obtaining long delays, with time delay proportional to angular rotation of the control shaft. ESC Corp., Dept. ED, 534 Bergen Blvd., Palisades Park, N.J.

CIRCLE 242 ON READER-SERVICE CARD FOR MORE INFORMATION

Mechanical Assemblies
Vacuum-Tight Units

This firm's line of mechanical assemblies, which is comprised of specially designed hermetic "Vac-Tite" seals for economy and mounting security, has been expanded and now includes color-coded terminal plates, locking safety seals, attached bracket seals, unit headers, and terminal strips. These units have integrally glassed assembly terminals which eliminate the need for soldering terminals to enclosure covers. Hermetic Seal Products Co., Dept. ED, 33 S. 6th St., Newark 7, N.J.

CIRCLE 243 ON READER-SERVICE CARD FOR MORE INFORMATION

Law Pass Filter
Suppresses Radiation Above 40Mc

This low pass filter suppresses radiation of all frequencies above 40Mc, thereby removing a major cause of TVI. It uses a constant K circuit, and is designed for coaxial cable (52 to 72 ohms).

There is negligible insertion loss; and 35db or more attenuation above 50Mc. It will handle up to 200w of r-f power. American Electronics Co., Dept. ED, 1203-05 Bryant Ave., New York 59, N.Y.

CIRCLE 244 ON READER-SERVICE CARD FOR MORE INFORMATION
here's how to get the fast, precise answers you need for:

- Audio Frequency Waveform Analysis
- Ultrasonic Waveform Analysis
- RF, VHF and UHF Spectrum Analysis
- Microwave Spectrum Analysis
- Sonic and Ultrasonic Frequency Response Tracing

...and many other analysis and measurement problems...

consult... PANORAMIC

the pioneer — for instruments designed to your needs.

Shown here are just a few of the many instruments Panoramic has designed to meet your needs for rapid yet accurate analysis and measurement. Send for Panoramic's Catalog and find out how Panoramic can give you the right answer to your research, development and production problems. Our specialists are available for consultation without obligation.

LP-1—AP-1 Panoramic Sonic Analyzer for Audio Frequency Waveform Analysis—20 cps—20 kc.

SB-7a—Panoramic Ultrasonic Analyzer for Ultrasonic Waveform Analysis—1 kc—300 kc.

SB-8b, SA-8b, SC-8b—Panalyzer, Panadapter and Panoramic Indicator for RF, VHF and UHF Spectrum Analysis.

SPA-1—Panoramic Spectrum Analyzer for Microwave Spectrum Analysis—50 mc—4000 mc.

SG-1—Panoramic Sweep Generator for Sonic and Ultrasonic frequency response tracing—20 cps—200,000 cps with one instrument.

Write today for complete Catalog and prices. Inquiries invited for development of special Panoramic analyzers.

PANORAMIC RADIO PRODUCTS, INC.

15 S. Second Ave., Mount Vernon, N.Y., MO 4-3970

CIRCLE 246 ON READER-SERVICE CARD FOR MORE INFORMATION
Battery Charger
In Variety of Models

The "Style EW" Battery Charger is a "floating type", built to provide continuous service, with current control from a few mils to maximum. The high reverse characteristics of its selenium cells prevents the batteries from discharging through the rectifier.

Models are now available for 115v and 230v, single-phase input, and outputs of 0-1amp, 0-3amp, and 0-6amp for batteries of 12v, 24v, 48v, and 120v. The Electronic Rectifier Co., Dept. ED, 126 Argyle St., Rochester 7, N. Y.

CIRCLE 247 ON READER-SERVICE CARD FOR MORE INFORMATION

Signal Generator
Combined With Sweep Unit

The "Sweeplator" will serve as a combined signal generator and sweep generator. It features decade switching, crystal CW or center frequencies, and wide-range calibrated output. Specifications include: range, 10ke to 1.5Mc; steps, 1ke in 3 decades; interpolation, calibrated 0-1ke; accuracy, 100cy; short term stability, ±25cy; harmonic content, 3% max; output, 3v rms; attenuator, 3v, 1v, 0.3v, 0.1v, 0.03v, 0.01v full scale; meter, calibrated 0-1v and 0-3v. Decade Instrument Co., Dept. ED, Box 159, Caldwell, N. J.

CIRCLE 248 ON READER-SERVICE CARD FOR MORE INFORMATION

Vane Axial Fan
For Aircraft Electronic Units

This compact vane axial fan is less than 7" x 4" x 5-1/4". The unit delivers 60cfm at 5" pressure water gage, and 112cfm at 1". It is designed and built especially to meet the service requirements of aircraft installations, is oil proof and explosion proof. Ilg Electric Ventilating Co., Dept. ED, 2850 N. Pulaski Rd., Chicago 41, Ill.

CIRCLE 249 ON READER-SERVICE CARD FOR MORE INFORMATION

Bendix
needs
ELECTRONIC
and
MECHANICAL
ENGINEERS
in
SOUTHERN
CALIFORNIA

Unusual engineering positions in electrical and mechanical design of radar, sonar and telemetering are available. These positions, which are directly associated with our long-range projects for industry and for defense, are available at all levels. Now nearing completion at Bendix-Pacific is the new Engineering Center. With more than 100,000 square feet of area it represents the latest and one of the most complete engineering facilities in the nation.

You are invited to consider becoming a member of this vital engineering group - with a forward looking company in Southern California.

Please fill in the coupon or write us for complete information.

W. C. Walker, Engineering Employment Manager
Pacific Division, Bendix Aviation Corp.

Please send information.
I am a graduate engineer with _______ degree.
I am not a graduate engineer but have _______ years experience.

Name

Address

City Zone State

CIRCLE 250 ON READER-SERVICE CARD

ELECTRONIC DESIGN • November 1955
NEW CURTISS-WRIGHT
DISTORTION ELIMINATING
VOLTAGE REGULATOR

- Reduces typical power line distortion to less than 0.3%
- Furnishes 1.4 KVA of distortion-free power
- Electronically regulates 115 V output to ±1%
- Recovery time less than 1/50 cycle
- Provides additional 4 KVA of ±1% electromechanically regulated power
- Electromechanical time constant only 0.6 seconds
- Electromechanical regulator, unlike usual magnetic voltage stabilizer, introduces no distortion or phase shift

Here at last is the ideal solution to the disturbing problem of harmonics and low frequency noise appearing in 115 V, 60 cps power sources. In one compact package, every laboratory can now obtain both

1) distortion-free, regulated power when needed, and simultaneously
2) a large supply of electromechanically regulated power for applications where normal line distortion is tolerable.

In addition to its general laboratory utility, this instrument is ideally suited for preventing instability and inaccuracy in a.c. computer system nulling operations. Many other applications, 230 V, model also available. Immediate delivery. $1,689 f.o.b. Carlstadt, N. J. Write for details.

Component & Instrument Department

CIRCLE 252 ON READER-SERVICE CARD FOR MORE INFORMATION

110v Power Supply
Portable, Battery-Operated Unit

The "Carter-Pak" is a complete "carry-out" power plant in a package. The carrying case contains a 12v aircraft storage battery, a frequency-controlled d-c to a-c rotary converter, and a battery charger which can be plugged into any a-c outlet to replenish the battery when required. Output is 110v a-c for operating dictating machines, recorders, amplifiers, laboratory apparatus and similar equipment. Carter Motor Co., Dept. ED, 2644-A N. Maplewood Ave., Chicago 47, Ill.

CIRCLE 253 ON READER-SERVICE CARD FOR MORE INFORMATION

Coil
Uses Ceramic Phenolic Covering

A ceramic phenolic covering holds both the coil and leads firmly in place in this unit, eliminating the need for terminals. Various colors may be provided in the covering. The OD of the ceramic form is ground to ±0.002” to insure uniform electrical characteristics. The forms are silicon impregnated. All metal parts are alloy plated. The coils meet all applicable MIL specs. National Coil Co., Dept. ED, 3001 N. Main St., Sheridan, Wyo.

CIRCLE 254 ON READER-SERVICE CARD FOR MORE INFORMATION

D-C Supply
Output Set with 2mv Accuracy

Designed especially for instrument calibration work, the Model 406 D-C Supply features high resolution and excellent stability. Coarse, fine, and vernier output controls permit setting the output to within 2mv of the value desired over the entire 530v range. Regulation against 20% line voltage change or 100ma load change is 0.01% or 50mv. Ripple is less than 1mv, and short term stability is better than 0.01%. John Fluke Mfg. Co., Inc., Dept. ED, 1111 W. Nickerson St., Seattle 99, Wash.

CIRCLE 254 ON READER-SERVICE CARD FOR MORE INFORMATION
IMMEDIATE DELIVERY

of TACHOMETER GENERATORS

Type MG 100 (MK 16 MOD 0) (Size 18)
Type MG 110 (MK 12 MOD 0) (Size 15)

CHARACTERISTICS

<table>
<thead>
<tr>
<th>Voltage excitation at 400 cps</th>
<th>115/115</th>
<th>115/115</th>
</tr>
</thead>
<tbody>
<tr>
<td>No load speed (min. RPM)</td>
<td>4800</td>
<td>4800</td>
</tr>
<tr>
<td>Stall Torque (min. in oz.)</td>
<td>2.35</td>
<td>1.45</td>
</tr>
<tr>
<td>Power input (nom. watts at stall)</td>
<td>9.5</td>
<td>6.1</td>
</tr>
<tr>
<td>R (nom. ohms at stall)</td>
<td>280</td>
<td>490</td>
</tr>
<tr>
<td>X (nom. ohms at stall)</td>
<td>575</td>
<td>890</td>
</tr>
<tr>
<td>Z (nom. ohms at stall)</td>
<td>640</td>
<td>1030</td>
</tr>
<tr>
<td>Reff. (nom. ohms at stall)</td>
<td>1400</td>
<td>2200</td>
</tr>
</tbody>
</table>

GENERAL CHARACTERISTICS

| Voltage excitation at 400 cps | 115     | 115     |
| Power input (nom. watts at stall) | 5.4   | 5.4     |
| R (nom. ohms at stall) | 1012    | 1012    |
| X (nom. ohms at stall) | 1210    | 1210    |
| Z (nom. ohms at stall) | 1575    | 1575    |
| Reff. (nom. ohms at stall) | 2440    | 2440    |
| Output Volts/1000 rpm | 3.2     | 3.2     |
| Phase Shift (nom. degrees) | 5       | 5       |

Above Units may also be supplied with High impedance control windings in motor sections.

Write today for specifications and prices!

DESIGN, DEVELOPMENT and PRECISION
MANUFACTURING OF ELECTRONIC and ELECTRO-MECHANICAL COMPONENTS and SPECIALIZED SYSTEMS

INFRA ELECTRONIC CORPORATION
ROSELAND, NEW JERSEY

CIRCLE 255 ON READER-SERVICE CARD FOR MORE INFORMATION
A NEW COST-SAVING FEATURE of Fafnir Flanged Instrument Bearings

Simplification of housing designs is made possible by the addition of flanged bearings with straight outside diameters in several sizes that match those of Fafnir unflanged or plain radial ball bearings. Now, one-size, straight bored housings may be planned. This new series of flanged bearings is available with or without shields. For additional information, write The Fafnir Bearing Company, New Britain, Connecticut.

### FLANGED BEARING NUMBERS

<table>
<thead>
<tr>
<th>FLANGED BEARING NUMBERS</th>
<th>OUTSIDE DIAMETERS</th>
<th>BORE</th>
<th>EXTRA SMALL SERIES RADIAL BEARING NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>FS3K3</td>
<td>.3750</td>
<td>.1250</td>
<td>33K3</td>
</tr>
<tr>
<td>FS3K5</td>
<td>.5000</td>
<td>.1675</td>
<td>33K5</td>
</tr>
<tr>
<td>FS1K7</td>
<td>.6250</td>
<td>.2500</td>
<td>51K7</td>
</tr>
<tr>
<td>FS3K</td>
<td>.8750</td>
<td>.3750</td>
<td>53K</td>
</tr>
</tbody>
</table>

PATHWAYS TO PRECISION

The atomizer wash given to Fafnir Instrument Ball Bearings illustrated at the left is typical of the extremes to which Fafnir will go to assure the maximum of consistent high quality. The operation takes place in air-conditioned areas where the air is slightly pressurized and thoroughly cleaned.

Write for latest catalog.

**FAFNIR BALL BEARINGS**

MOSt COMPLETE LINE IN AMERICA

![D-C Power Supplies](image)

**D-C Power Supplies**

In Wide Variety of Ratings

Illustrated is a typical "Sel-Rex Reactronic," a regulated d-c power supply unit for continuous output of 5-amp at 150v. Static regulation is ±1% from no load to full load. These units are available from 4 to 300v capacities, current values from 1 to 50,000amp. Bart-Messing Corp., Dept. ED, 229 Main St., Bellaire 9, N. J.

CIRCLE 257 ON READER-SERVICE CARD FOR MORE INFORMATION

**Non-Abrasive Grommets**

For Aircraft and Electronic Uses

The S1154 series of non-abrasive one-piece grommets are fabricated of "Kelon-T" (Teflon). Designed for use in aircraft and electronic applications to guide cables and conduits through bulkheads, they resist chemical action and heat. The natural slipperiness of "Kelon-T" and smooth rounded edges minimize abrasion. They can be installed easily in blind locations. Shamban Engineering Co., Dept. ED, 11617 W. Jefferson Blvd., Culver City, Calif.

CIRCLE 258 ON READER-SERVICE CARD FOR MORE INFORMATION

**Thermistor Detectors**

Can Sense Infrared in 2Millisecc

"Optitherm" Infrared Detectors can sense infrared radiation in as little as 2millisecond, and are also rugged, stable, and long-lived devices. The sensitive elements are 0.01mm rectangular flakes of thermistor material. The detectors are available with standard silver chloride or KRS-5 windows, or with special windows on order. Housings are hermetically sealed and do not require a vacuum. Barnes Engineering Co., Dept. ED, 30 Commerce Rd., Stamford, Conn.

CIRCLE 259 ON READER-SERVICE CARD FOR MORE INFORMATION

A Motor for LOW SPEED OPERATIONS

If you are now manufacturing a product or developing a product where you need motion at slow speed, here is the motor for you. Hundreds of thousands now in use on cooking appliances, vending, coin operated, amusement, and advertising displays.

These AC gear motors are precision built and are being manufactured in volume for immediate delivery. For further information, send the requirements of your application to us. Special motors are built to meet your new product needs. Write today for data sheet.
Variable Speed Reducer
1/3hp Unit Weighs only 5-1/4 lb

The Model 143 “Zero-Max” infinitely variable speed reducer has a constant torque rating of 30 in-lb throughout its speed range of true zero to 1/4 the input speed (0-450- rpm with an 1800rpm input speed). At about 400- rpm it is rated at 1/3hp. Speed can be changed while running. Heat is not developed at zero speed. It weighs 5-1/4 lb. Revo, Inc., Dept. ED, 2 E. Franklin Ave., Minneapolis, Minn.

CIRCLE 264 ON READER-SERVICE CARD FOR MORE INFORMATION

Tube Test Kit
Takes All Radio and TV Tubes

Tube Tester Kit 327A will test all tubes in use in all current-model radio, FM, and TV sets, including color TV. Free point selector system circuitry protects against obsolescence, and double fuse protection for both the meter and transformer gives protection against damage. The tester provides for reactivating picture tubes. General Electronic Equipment Co., Dept. ED, Mantua and Glenvale Sts., Easton, Pa.

CIRCLE 265 ON READER-SERVICE CARD FOR MORE INFORMATION

Adapter Nut
With Floating Lock

This adjustable “Glenlock” adapter nut with a “floating lock” has been used on production by one of the “big three” auto companies for over a year and is now available to industry. The “floating lock” is hinged into the nut itself by peening, so it cannot come off. Yet it is a separate piece that moves freely in locking and unlocking. They lock over milled drift slats or flats. The J. C. Glenzer Co., Dept. ED, Ferndale, Mich.

CIRCLE 266 ON READER-SERVICE CARD FOR MORE INFORMATION
As a lamination user, you will want to know that guaranteed maximum va. and core loss is available for standard EI transformer laminations and that you can correlate the figures for your own applications.

This valuable information is offered exclusively by Thomas & Skinner. For several years, Thomas & Skinner has accumulated data on standard EI laminations. Based upon an analysis of this information, T&S has established maximum va. and maximum core loss values of each EI lamination at 1,000 and 10,000 gauss, 60 CPS.

A MATERIAL CERTIFICATION is furnished with each shipment of T&S laminations, and gives test figures for both core loss and exciting current on each heat annealed.

This CERTIFICATION attests that each shipment meets the specifications set by the customer.

To you — as a lamination user — these test figures mean elimination of need for retesting, adding up to important savings in your production.

WRITE TODAY for Technical Bulletin DMF-1 giving test details and tables showing core loss and maximum va. Also request new 40-page Bulletin No. L-355 (illustrated below), on special and standard laminations.
Characteristic-Curve Tracer
For Vacuum Tube Analyses

The Type 570 Characteristic-Curve Tracer displays families of characteristic curves calibrated to permit current and voltage readings directly from the screen. Features include: curves per family adjustable from 4 to 12; ability to plot six different characteristic curves ($E_p-I_p$, $E_g-I_p$, $E_p-I_g$, $E_g-I_g$, $E_p-I_e$, and $E_g-I_e$), and a variety of ranges. Tektronix, Inc., Dept. ED, P. O. Box 831, Portland 7, Ore.
CIRCLE 269 ON READER-SERVICE CARD FOR MORE INFORMATION

Thyratron Tube Analyzer
Provides Actual Operating Circuit

With this unit, a thyratron actually functions in an operating circuit with meters indicating operating points, permitting quick comparison with tube manufacturer's specifications and curves, and automatic indication of critical grid volts. An average are drop voltmeter provides direct indication. Alcan Manufacturing Co., Dept. ED, 7842 39th Ave., Kenosha, Wis.
CIRCLE 270 ON READER-SERVICE CARD FOR MORE INFORMATION

Set Screw
Slabbed Type for Flush Mounting

"Flush-Lok" slabbed-head set screws are for applications in which the slab portion cannot extend beyond the tapped hole. In addition, there is a positive locking action that is effectively retained in all positions. Also, being flush with the surface, the screw becomes practically tamper-proof as well as resistant to accidental removal. A special wrench is provided to use when removal is desirable. Set Screw & Mfg. Co., Dept. ED, Main St., Bartlett, Ill.
CIRCLE 271 ON READER-SERVICE CARD FOR MORE INFORMATION

IF YOU ARE OVER 45 and your wife keeps insisting that you should have two chest x-rays every year... don't blame her. Thank her! Semi-annual chest x-rays are the best "insurance" you can have against death from lung cancer.

The cold fact is that lung cancer has increased so alarmingly that today you are six times more likely to develop lung cancer than a man of your age 20 years ago. Our doctors know that their chances of saving your life could be as much as ten times greater if they could only detect lung cancer before it "talks"... before you notice any symptom in yourself. That's why we urge you to make semi-annual chest x-rays a habit—for life.

To see our new life-saving film "The Warning Shadow" call the American Cancer Society office nearest you or simply write to "Cancer" in care of your local Post Office.

American Cancer Society
Details on a Better Pencil
(MARS TECHNICO with Mars Lumograph lead)

A U-Clamp offered by this firm is molded of type FM 10001 Nylon and will withstand constant operation at 250°F. Known as the Type 201, it eliminates tying and facilitates quick changes in the routing of wires.

The clamp is a two-piece assembly consisting of a U shape and keeper plate. The U shape is serrated and designed for permanent attachment to a chassis. The keeper is pushed over the ends of the U and comes to rest in the proper position for retaining the wires firmly in place. To change, add, or remove wires, the ends of the U are simply pressed toward each other and the keeper is removed. Dakota Plastics Co., Dept. ED, 810 N. Mayo Ave., Compton, Calif.

Tolerance Indicator
For Testing of R-L-C Components

The FT-KZS Tolerance Indicator permits rapid testing of resistors, capacitors, and inductors by comparison with an external standard. Direct readings in per cent are given on a 4" meter with four tolerance ranges providing sensitivities as high as 2.5% full scale. The wide range of measurements include 10 ohm to 1 megohm, 10mfd to 1fmd, and 100µh to 2mh with an accuracy of ±5% of full scale. With a separate accessory meter, sensitivity of 0.01% division is available, equivalent to 0.5% full scale. Size is 12-1/2" x 9" x 9", and weight is 15 lb. The unit is self-contained and easily portable. Instrument Div., Federal Telephone and Radio Co., Dept. ED, 100 Kingsland Road, Clifton, N. J.

If you need a special component, send a brief statement of your specifications addressed to Bulletin Board, Electronic Design, 19 E. 62nd St., New York 21, N. Y. Include your complete address.

ACTION
when ADVANCE supplies your relays... you get ACTION

Action on Standard Items. Choose from a wide variety of in-stock relays, available for immediate shipment from Burbank or Chicago. Light-weight, small and precision-built, ADVANCE relays stand up under rugged service. They’re specified by major manufacturers the country over.

Action on “Specials.” When you need a specially designed relay, ADVANCE will work closely with your engineers to determine accurately what’s needed...develop it in minimum time. You’ll find us ready to cooperate with you on any relay problem.

Action on Producing Relays. There’s manpower here to build your relays right...on time...and at the lowest prices consistent with top quality. It’s our aim to help keep your production rolling...your products operating dependable. Whatever your relay problems—call ADVANCE for action.

ADVANCE ELECTRIC AND RELAY CO.
AN ELGIN NATIONAL WATCH COMPANY AFFILIATE
2435-M NORTH NAOMI STREET, BURBANK, CALIFORNIA

Sales Representatives in Principal Cities of U.S. and Canada

CIRCLE 274 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 273 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 272 ON READER-SERVICE CARD

ELECTRONIC DESIGN • November 1955
Inductances
With Indented Turns for Tapping

“Air Dux” air-wound inductances offer two design features that give them high adaptability in meeting the engineering demands of r-f transmission equipment. They may be made with a change in the pitch of the winding for higher Q's, and they have indented alternate turns that can be utilized for greater ease of tapping.

ILLUMITRONIC ENGINEERING
680 E. Taylor, Sunnyvale, Calif.

Ganged Potentiometer
Up to 17 Taps Per Section

The Series Y “Helipot” precision potentiometer is a single, continuous-rotation component designed for servo or bushing mounting. As many as 14 sections may be ganged on a common shaft during manufacture, with as many as 17 taps added to any section. Each tap is spot-welded to a single turn of resistance wire. Helipot Corp., Dept. ED, 916 Meridian Ave., South Pasadena, Calif.

NEW FULL-TRACK REDHEADS FOR PROFESSIONAL RECORDING

Now full-track magnetic recording heads join the famous Brush Redhead series. Designed for the best in professional recording, these heads provide improved signal to noise ratio and greater dynamic range. Uniform track width and a 

Printed Circuits

Can simplify your design... speed output... cut costs

Eliminate wiring! With Du Pont Conductive Coatings, you can print circuits for capacitors and couplings: for static shielding to replace foils and cans; for resistors and solder seals. Streamline your designs in television sets and radios, electronic equipment, meters and switchboards.

Coatings are easily applied by spray, brush, dip or stencil on metals or non-conductors. Fit right into high-speed assembly-line operation. Save you money. For up-to-date, descriptive bulletin write to: E. I. du Pont de Nemours & Co. (Inc.), Electrochemicals Department, Wilmington 98, Delaware.

Du Pont Conductive Coatings
—Best for printed circuits!
Can you make your transformers smaller, lighter... with Class C encapsulation?

Where a higher hot spot is permissible, you can reduce the ounces and the inches of your transformers by 1/4 to 1/2.

How? With silicone rubber encapsulation. This allows operation in the 160°C. to 200°C. range at a reduced size.

Silicone rubber encapsulation is one of the many services available to the communications industry at Caledonia. (We provide Class C transformers open and in cases, too.) All encapsulation is done in our plant.

For help with this problem, and others involving transformers and related electronic assemblies, contact Caledonia.

When you have a transformer problem, call on

CALEDONIA
ELECTRONICS AND TRANSFORMER CORPORATION
Dept. ED-11, Caledonia, N. Y.

Magnetic Amplifiers
A Wide Range of Stock Units

Stock units are available over wide ranges of impedance, power gain, response time, and supply frequency. Toroidally wound reactors are used throughout, and the units are available in hermetically sealed cases or plastic-encapsulated forms.

The Type 402, illustrated, is a two-stage amplifier. Power gain is 2,000,000; input impedance 200 ohms; load impedance 3000 ohms; supply frequency 400cy at 115v, and response time 1 second. All necessary rectifiers are self-contained. Ilycor Co., Inc., Dept. ED, 11423 Vanowen St., N. Hollywood, Calif.

Glow Transfer Register
Permits Preset Counts to 1 Billion

The GT-6 Glow Transfer register is used in conjunction with this firm's Model 200 Sealer. The register is exceptional in that a preset count of any number from 10 to a billion may be selected. Radiation Instrument Development Laboratory, Dept. ED, 2337 W. 67th St., Chicago 36, Ill.

Voltage Regulators
Employ Mag-Amps

A line of magnetic amplifier voltage regulators is built by this firm to customer specifications. The typical unit illustrated takes a 120v single-phase 400cy input and delivers a d-c output of 15-150v at 0.05-0.50 amp (to fields of exciter); va rating is 50; voltage adjustment is ±10%, and regulation accuracy is ±1%. Dimensions are 13'' x 11'' x 10''; weight is 35 lb (approx). Perkin Engineering Corp., Dept. ED, 345 Kansas St., El Segundo, Calif.

Tubular Rivet
Multi-Head Riveters can automatically feed and set six or more rivets simultaneously, depending upon the dimensional limits of the assembly. They infinitely simplify and speed up complex assembly fastening. Basic machines positioned to meet your present needs... economically re-positioned when requirements change. Feed and set rivets from 1/8'' to 1/4'' diameter—all alike or all different. Machine shown sets four rivets at a time, assemblies 475 units per hour, reduces fastening costs about 50%.

Tubular's Multi-Head Riveters can automatically feed and set six or more rivets simultaneously, depending upon the dimensional limits of the assembly. They infinitely simplify and speed up complex assembly fastening. Basic machines positioned to meet your present needs... economically re-positioned when requirements change. Feed and set rivets from 1/8'' to 1/4'' diameter—all alike or all different. Machine shown sets four rivets at a time, assemblies 475 units per hour, reduces fastening costs about 50%.

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Free samples - write WECKESSER CO.
5253 N. Arndale Ave. • Chicago 30, Ill.

CIRCLE 283 ON READER-SERVICE CARD FOR MORE INFORMATION
ELECTRONIC DESIGN • November 1955
**Delay Line**

*With 5,000μsec Overall Delay*

Model DL 0510-400/125 Delay Line is a precision, low - attenuation unit, developed for correlation measurements and waveform analysis covering sub-audio and audio frequencies. Overall delay is 5000μsec. Characteristic impedance is 510 ohms.

Taps are available on this unit every 40μsec. Calibration accuracy at each of 125 taps is ±0.1μsec, and insertion loss is 1.7dB. Cut-off frequency is 9ke, and phase linearity is ±1% up to 5ke. The unit size is 19" x 6" x 6" for relay rack mounting. Epson, Inc., Dept. ED, 588 Commonwealth Ave., Boston, Mass.

CIRCLE 195 ON READER-SERVICE CARD FOR MORE INFORMATION

**Tape Resistor Kit**

*Provides MIL-R-11A Ratings*

Designed for laboratory use in experimental or development work involving the use of tape resistors, the Tyco RNP-1C Kit includes 10 each of the 49 standard MIL-R-11A values from 100 ohms to 1 megohms, inclusive, in ±5% tolerance. The entire kit is packaged in a compartmented case of heavy-gage polystyrene plastic. Hansen Electronics, Dept. ED, 7117 Santa Monica Blvd., Los Angeles 46, Calif.

CIRCLE 196 ON READER-SERVICE CARD FOR MORE INFORMATION

**Cap and Set Screws**

*Miniature Hex-Socket Types*

A complete line of miniature hex-socket cap and set screws, in diameters from No. 0 through No. 3, is now produced by this firm. Lengths run from 1/8" to 1/2"; cap and set screws are manufactured in both coarse and fine series, unified threads, except No. 0 and No. 1 diameters, which are standard in fine series only. Allen Mfg. Co., Dept. ED, Hartford, Conn.

CIRCLE 197 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic Design • November 1955
Miniature Oscillograph
Has Precision of Larger Units

This cathode-ray oscillograph, Type 331, is particularly suited for field or laboratory testing and servicing of many types of electronic computers, as well as a variety of other equipment. The instrument weighs only 19 lb. Allen B. DuMont Laboratories, Inc., Dept. ED, 750 Bloomfield Ave., Clifton, N. J.

CIRCLE 294 ON READER-SERVICE CARD FOR MORE INFORMATION

Sequence Timer
Has 10 Stages

This timer, for use in the controlling of a sequence of events, contains 10 stages of thyatron-controlled time-delay circuits. The length of delay of each stage can be varied from 10 millisees to 2 sec in 10 steps. Each stage may be controlled either automatically or manually by the use of switches on the front panel. Any of the 10 stages can be switched in or out of the sequence at will. Chicago Electronic Laboratories, Dept. ED, 1214 W. Madison St., Chicago 7, Ill.

CIRCLE 295 ON READER-SERVICE CARD FOR MORE INFORMATION

Thermometer/Thermostat Sets
Preset Types

A line of thermometer/thermostat sets is offered specifically for precision temperature control systems. The thermostats are 90° angle form, stem immersion type. Three standard models are offered, pre-set for operating temperatures of 125°, 190°, and 265°, respectively. Precision Thermometer and Instrument Co., Dept. ED, 1434 Brandywine St., Philadelphia 30, Pa.

CIRCLE 296 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronics Design • November 1955
A complete line of 5mm equipment, operating over the full waveguide frequency range of the RG-97/U waveguide (50.00-75.00KMc), has been made available by this firm. A slotted section, flap attenuator, tunable detector mount, E/H tuner, frequency meter, termination, sliding short, horn, harmonic generator, bends, tees, transmission line stand, klystron tube mount, and power supply are available. Equipment is also available for RG-97/U waveguide. Electronics & X-ray Div., F-R Machine Works, Inc., Dept. ED, 26-12 Borough Pl., Woodside 77, N. Y.

5mm Equipment
For Frequency Range of RG-98/U

10-Speed Timer
Operates at 1 rpm to 1 rev/month

This timer and program control instrument is offered at very low cost. It provides 10 instantly selected speeds which move a cam or program disk in one revolution per every 1, 5, or 15 minutes; 1, 4, or 12 hours; 1 or 2 1/3 days; or 1 or 4 weeks. A pick-up gear is merely slid along its shaft to the speed desired. Gorrell & Gorrell, Dept. ED, Haworth, New Jersey.

Voltmeters
Accurate to 1/2 %

This line of d-c Expanded Scale Voltmeters for panel mounting is accurate to 1/2% of input voltage. The meters offer a linear scale which includes only the useful portion of the scale; the rest has been entirely eliminated to give highest readability. Arga Div., Beckman Instruments, Inc., Dept. ED, 220 Pasadena Ave., South Pasadena, Calif.
ELECTRONIC PRODUCTION SINCE SIMMONS

This SMALL, COMPACT Productimeter has hundreds of applications in all phases of industrial production. Make exact production runs to any predetermined count you set. Extremely rugged, fast and accurate the "SP" Productimeter will eliminate wasteful over- or under-runs. It will turn on a light, ring a bell or stop the machine. Available in ROTARY or STROKE models.

DURANT MANUFACTURING CO.
1993 N. Buffum St.
Milwaukee 1, Wisconsin

PRODUCTIMETERS
Count Everything

CIRCLE 304 ON READER-SERVICE CARD FOR MORE INFORMATION

This fastener works through thick and thin!
Spring-Lock works whether panel thicknesses run over or under specifications. Spring wire deflects automatically to handle greater or lesser thicknesses. Made in all-metal and plastic with steel insert, it can be adapted as a shelf-support, washer knob, bracket or any similar panel-mounted device.

Write for 40-page catalog on complete line, containing application examples, specifications, installation instructions and engineering data. Ask for samples, too.

Oscilloscopes
Available in Console Cabinets

Electrome Large Screen Oscilloscopes in all 1700 Series Models can be installed in this modern console type cabinet for greater convenience of the operator. The console oscilloscope, utilizing a 17" rectangular tube, is especially useful for test set-ups where space can be placed in front of the operator during test. The oscilloscopes are designed for detailed observation of data or complex signals. The console makes them easy to use for data plotting, production test, wave form analysis, and display applications. Electrome, Inc., Dept. ED, 3200 N. San Fernando Blvd., Burbank, Calif.

CIRCLE 306 ON READER-SERVICE CARD FOR MORE INFORMATION

A-C Power Source
With Frequency Accurate to 0.001%  

The "Invertron" is designed to provide a-c power outputs of exceptional stability and accuracy. Units are available in a series of models that provide a wide range of output frequencies and power ratings. The unit shown has a continuous power output of 160va single phase, with output frequency continuously variable from 360cy to 450cy. Behlman Engineering Co., Dept. ED, 114 S. Hollywood Way, Burbank, Calif.

CIRCLE 307 ON READER-SERVICE CARD FOR MORE INFORMATION

D-C Relay
Resists Tough Shock, Vibration

The No. 64-243 Relay has vibration immunity up to 10g between 10-5000cy; ability to withstand extreme shock of 30g; and it operates in the ambient range of -65° to +125°C.

Contact rating is 25amp resistive at 29v d-c. These characteristics far exceed MIL-R-6106. U. S. Relay Co., Dept. ED, 1744 Albion St., Los Angeles 31, Calif.

CIRCLE 308 ON READER-SERVICE CARD FOR MORE INFORMATION
Research and development in the technology of guided missiles is not confined to any one field of physics. Broad interests and exceptional abilities are required by the participants. Typical areas at Lockheed Missile Systems Division include:

- Applied mathematics such as the numerical solution of physical problems on complex computers
- Analytical systems analysis of guidance and control problems
- Ballistics and the integration of ballistic type missiles with vertical guidance
- RF propagation, microwave and antenna research and development
- Integration of ground and flight test data to evaluate dynamic performance
- Stress and structures
- Instrumentation and telemetering
- Advanced electronics and radar systems

Continuing developments are creating new positions for those capable of significant contributions to the technology of guided missiles.
Sampling Switch
For Telemetering, Recording

The Model No. 1205 is a high-speed sampling switch for telemetering, data recording, and related applications. It has two synchronized poles, with 30 contacts per pole. Fifteen alternate contacts and collector rings per pole are tied to individual plugs. The unit has a self-contained 5cy motor. General Devices, Inc., Dept. ED, P. O. Box 253, Princeton, N. J.

CIRCLE 310 ON READER-SERVICE CARD FOR MORE INFORMATION

Filters
High Insertion Loss Types

A complete series of extremely small, high-insertion-loss filters is offered for aviation and mobile electrical and electronic equipment.

These bulkhead-mounting interference filters are available in production quantities in ratings from 0.1amp to 20amp, for both 125v d-c and 125v 400cy service. Sprague Electric Co., Dept. ED, 347 Marshall St., North Adams, Mass.

CIRCLE 311 ON READER-SERVICE CARD FOR MORE INFORMATION

Brake-Motor
For 10-Minute Intermittent Duty

This unit is desirable wherever short span power (5 - minutes - on - and - 5 - minutes - off) is needed. Dimensions are only 8-5/8" OD x 7-5/8" over - all length.

Starting torques of this brake-motor are up to 500% of running torque. This provides sufficient power to overcome starting inertias of heavy loads or those stuck or "frozen". Rouland Electric Co., Dept. ED, Alhambra, Calif.

CIRCLE 312 ON READER-SERVICE CARD FOR MORE INFORMATION

NEED PHOTOTUBES?

FAMOUS CETRON QUALITY

Lead Sulfide
(Photoconductive)
CE-701, CE-702, CE-703, CE-704, CE-705, CE-706, CE-709, CE-706,

From 10 to 25%
LESS!

Large production of civilian and government contracts plus increased plant operation results in volume inventory of popular phototube types—now offered at big savings.

Available also are thyatrons, rectifiers made to government specifications: 3B22, 3B28, C6J, C393A, 3C23, 4B26, 4B28, etc.

CONTINENTAL ELECTRIC CO.
Geneva, Illinois

Please send full particulars:
Name __________________________ Title __________________________
Address __________________________
Company __________________________
City __________ Zone__ State __________

CIRCLE 313 ON READER-SERVICE CARD

ELECTRONIC DESIGN • November 1955
American Electric Model 201D
HYSTERESIS SYNCHRONOUS MOTOR FOR REFERENCE TIMING APPLICATIONS

This totally enclosed miniature hyster-
esis synchronous motor develops 5gm-
cm. minimum torque, operates at 12,
000 r.p.m. synchronous, continuous
duty on 115 V., single phase, 400 cycle
ac. Ambient temperature range is −55°C to +45°C. Diameter: 1,450
Length: 1,562. Weighs only 5.5 oz.
Built to MIL-M-7969 specifications.

Many Other Models Fully Developed
American Electric Miniatures are avail-
able for operation on 60, 400, 1600, or
2000 c.p.s. or on variable frequencies
from 320 to 1200 c.p.s.

TWO TYPES
INDUCTION—Output torque range from 1/2
in. oz. to 120 in. oz.
SYNCHRONOUS (Hysteresis or Reluctance
Models) Output torque range from .01 in.
oz. to 16 in. oz.
Ask for quotations on special requirements!

MODEL 1826A AXIAL FAN MOTOR—Totally enclosed, panel mount, screwed intakes,
high temp. operation 20-276
72°C to 250°F, 400 cycle,
115 V., single phase,
400 cycle, or variable fre-
quency models.

MODEL 430 AIRCRAFT DRIVE MOTOR—1/12 h.p., 11,000
400 cycle, Teflon insulation,
3.5-185 V., single phase,
400 cycle, or variable fre-
quency models.

MODEL 333 ELEVEN ACTU-
ATOR—Develops 1/8 h.p., at
11,200 rpm. 200 V. line-to-
line, 3 phase, 4 wire, 400
cycle, Teflon insulated for
−65°F to +160°F. opera-
tion. Meets MIL-M-7969
specifications.

FIELD ENGINEERING OFFICES in all
major industrial areas in the United
States and Canada.

American Electric Motors, Inc.
Miniature Components Division of

CIRCLE 314 ON READER-SERVICE CARD

Electronic Design • November 1955

Electric Counters
With Life of 300 Million Counts

Named "Super-Wizards", these improved elec-
tric counters have an aver-
age life expectancy of 300
million counts. Rated at
1000 cpm, they operate at
speeds to 1600 cpm with
suitable actuation.

Current draw of less
than 5w permits dependa-
ble operation in the plate
circuit of electronic tubes
having an output of 5w or
more. Production Instrument Co., Dept. ED, 706-34
W. Jackson Blvd., Chicago 6, Ill.

CIRCLE 315 ON READER-SERVICE CARD FOR MORE INFORMATION

Impedance-Matching Units
Dispell TV Ghosts

The Type MB
units are imped-
ance-matching de-
vices for TV equip-
ment. They are
balun units which
clear up TV pic-
tures by reducing
ghosts and reflec-
tions originating in lead lines or through mismatch.
They can contribute to picture clarity over the whole
range of vhf-uhf frequencies. Lynmar Engineers, Inc.,
Dept. ED, 1432 N. Carlisle St., Philadelphia 21, Pa.

CIRCLE 316 ON READER-SERVICE CARD FOR MORE INFORMATION

Inductance Bridge
Measures from 0 to 180h

The Type 1002-C
is a wide-range in-
cremental - induct-
ance bridge that will measure from
0 to 5h, and 5 to 180h at any fre-
cquency from 60 to
1000cy. It is used
to measure small
chokes, toroids,
relay coils, audio filter coils, and similar applications.
Waters Manufacturing, Inc., Dept. ED, 4 Gordon St.,
Waltham 54, Mass.

CIRCLE 317 ON READER-SERVICE CARD FOR MORE INFORMATION
Solar specials can solve your design problems

We'll build electro-ceramic components and assemblies for any requirement

When chassis space is too small, or ambients too high for standard components—call Solar. Ditto when you need whole circuits condensed into limited-size areas...or many components integrated into a single unit. Solar takes your problem and winds up with the needed special components or sub-assemblies.

Equipped for the job

The Solar research laboratory is amply staffed with personnel experienced in designing specials. Engineering facilities are complete—we even do our own ceramic compounding, which gives us the flexibility to design exactly what you need—or adapt to it. Extensive production facilities, recently expanded, enable us to manufacture your specials in the shortest time possible. No matter how complex your problem, send it in. We'll work with you—in confidence.

SOLAR MANUFACTURING CORP.
New York, N. Y.

SALES OFFICES: 46th & Seville, Los Angeles 58, Calif.
4000 W. North Ave., Chicago 39, Ill.

CERAMIC CAPACITORS • PRINTED NETWORKS • PIEZO CERAMICS

CIRCLE 318 ON READER-SERVICE CARD FOR MORE INFORMATION
new screen process ink for PRINTED CIRCUITS

NAZ-DAR 211 PC BLACK

exciting new ink for printed circuits NAZ-DAR PC BLACK prints hairline circuits perfectly, resists all common etches, washes off instantly in solvent bath.

CIRCLE 320 ON READER-SERVICE CARD FOR MORE INFORMATION

Test Meters Capacitance and Inductance Type

The FT-KARU Capacitance Meter and the FT-LARU Inductance Meter offer such features as portability, complete coverage of commonly encountered component values; high accuracy; rugged construction; and error-reducing controls. The controls employ gear-linked selector switches and sliderule dials providing rapid band switching and parallax-free direct reading. Selection of a given range on either instrument automatically brings the corresponding scale into the viewing window.

The capacitance meter covers a range of 0.5mmfd to 10mfd in seven steps, holding to ±1% +0.5mmfd within the entire range. The inductance meter (illustrated) covers 0.1µh to 1h with accuracy of ±1% +0.01µh. Both meters measure 12" x 8-3/4" x 8-3/4", and each weighs 16 lb. Instrument Div., Federal Telephone and Radio Co., Dept. ED, 100 Kingsland Rd., Clifton, N.J.

CIRCLE 320 ON READER-SERVICE CARD FOR MORE INFORMATION

PUT DAGE TV TO WORK FOR YOU

As an efficient, modern "tool", Dage closed-circuit TV is saving time and money today for almost every type of business, industry and institution... keeping materials flowing... transmitting records accurately and swiftly... training personnel... safeguarding property... and doing literally hundreds of other vital jobs.

Its applications are endless - Let our engineers suggest an answer for your problems.

CIRCLE 321 ON READER-SERVICE CARD FOR MORE INFORMATION

FLEXLOC

SELF-LOCKING NUTS

DO YOU KNOW? Standard FLEXLOCS improve the finish of rough bolts. They smooth off rough threads. And the locking threads on all-metal FLEXLOCS are not chewed up when used on rough bolts. FLEXLOCS are stocked by authorized industrial distributors in a full range of sizes from #4 to 2". Write for Bulletin 866. STANDARD PRESS CO., Jenkintown, Pa.

CIRCLE 322 ON READER-SERVICE CARD FOR MORE INFORMATION
New kind of catalog

Complete facts on cathodes, anodes, grid cups — their characteristics, uses, variety


Superior Tube
The big name in small tubing

All analyses .010" to .016" O.D. Certain analyses in light walls up to 2.5" O.D.

CIRCLE 325 ON READER-SERVICE CARD FOR MORE INFORMATION

Maximum Temperature Control
In A Minimum Of Space

These miniaturized temperature controls utilize the famous Fenwal THERMOWATCH® principle. The outer shell is the activating element. That means short heat transfer path, built-in temperature anticipation, control stability and inherent thermostat sensitivity of less than 1°F. That's why they're ideal for such applications as aircraft, guided missiles, antennas, electronic equipment, radar, motors, computers, wave guides, crystal ovens, etc.

MIDGET. Shell is ¾" O.D. and is highly sensitive to changes over entire area. Single wire and two wire types; wide range from -50°F to 500°F; units which either make or break on temperature rise for control of gases, solids, liquids.

MINIATURE. Control within 2°F to 6°F is typical, even under 5G acceleration. Fully adjustable ranges of -20°F to 200°F or -20°F to 275°F. Hermetically sealed units -20°F to 200°F.

Get new, helpful facts on small-space temperature control and detection. Write for free bulletin MC-124, Aviation Products Division, Fenwal Incorporated, 911 Pleasant Street, Ashland, Massachusetts.

Fenwal Controls Temperature...Precisely

CIRCLE 327 ON READER-SERVICE CARD FOR MORE INFORMATION

You can get rugged, stable
Corning Film-Type Resistors
in all these styles

HIGH-POWER—STYLE I Combine high-power with excellent high-frequency characteristics. Resistance film is continuous, spiraled or striped according to resistance range or application. Silver metallized bands fired-on ends for termination. Silicone coated; water-cooled types uncoated.

HIGH-POWER—STYLE II 25 to 1,000,000 ohms; ratings from 3- to 115-watts; non-inductive. Standard tolerance ±2% to 10 to 1,000,000 ohms. Exceptionally good noise and frequency characteristics. Superior moisture resistance and overload capacity.

HIGH-TEMPERATURE—STYLE S Stable performance up to 200°C without encapsulation or hermetic sealing. For HF, test equipment, radio and TV, hi-gain amplifiers where low-noise, stable performance is needed.

LOW-POWER • In 3, 4, 5, and 7-watt sizes. Low-power—low-cost. High resistance values available, non-inductive. Stocked by Erie Resistor distributors.

WATER-COOLED—STYLE WCS For high-frequency, high-power TV, FM, low-reactance use. Allows mounting on 37° conical base with both water intake and outlet at RF ground potential. Interchangeable resistance elements.

HIGH-FREQUENCY—STYLE H Combine high-power with excellent high-frequency characteristics. Resistance film is continuous, spiraled or striped according to resistance range or application. Silver metallized bands fired-on ends for termination. Silicone coated; water-cooled types uncoated.

Stability • You can cycle the resistive element of Corning Resistors from near absolute zero to red heat without damage to electrical properties.

Moisture-Proof • Wet won't affect them. They pass MIL-R-10509A and MIL-R-11804A moisture resistance tests.

Durability • Rough handling doesn't affect them. The film material is fired on at red heat, makes an integral bond with Pyrex brand glass base. No special handling needed.

Quiet • No need to use over-size resistors to avoid noise caused by soldering. Fired-in silver bands give low-load resistance, low-noise terminations.

Compact • Couple them close—without damage or noise.

Important • New products and new prices—news in general—happens fast here. Let us keep you posted with our New Products Catalog and supplements. Send the coupon for your free copy.

CIRCLE 328 ON READER-SERVICE CARD FOR MORE INFORMATION
NEW TECHNICAL DATA on
Stupakoff CERAMIC MATERIALS

The very latest technical information on a wide range of ceramic materials is given in the new Stupakoff Technical Data Chart. Electrical and physical characteristics and the chemical composition of various grades of the following ceramic materials are included:

ALUMINA
ALUMINUM SILICATE
STEATITE

PORCELAIN
STUPALITH
CORDIERITE
MAGNESIA

ZIRCON
ZIRCITE
FORSTERITE

Valuable design and application suggestions included in the Stupakoff Data Chart help you engineer your ceramic parts for lowest cost and greatest satisfaction.

Send today for your free copy of the new Stupakoff Data Chart. Arranged for ready reference.

Stupakoff
Division of The CARBORUNDUM Company
LATROBE, PENNSYLVANIA

CIRCLE 329 ON READER-SERVICE CARD FOR MORE INFORMATION
In 1956

ELECTRONIC DESIGN will reach your desk 24 times

Oscillograph
In 36 and 60-Channel Models

The Series 700C Recording Oscillograph is engineered to centralize all automatic operating controls on a front panel and designed to simplify internal adjustments. Record magazines can be loaded in daylight and handle film or paper up to 12” wide. Record speeds range from 1/32 to 144 ips.

Heiland, Div. of Minneapolis-Honeywell Regulator Co., Dept. ED, 130 E. 5th Ave., Denver, Colo.

CIRCLE 330 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistor Transformer
Measures 3/8” x 3/8” x 3/8”

Now measuring only 3/8” x 3/8” x 3/8”, the redesigned No. 8901 Transistor Interstage Transformer has numerous industrial uses in audio amplifiers, hearing aids, control circuits, and other transistorized circuitry. Output and input models of this transformer are also available on special request. All three types are readily available in a fractionally larger size.

E-A Div., Telex, Inc., Dept. ED, Telex Park, St. Paul 1, Minn.

CIRCLE 331 ON READER-SERVICE CARD FOR MORE INFORMATION

Vibration Mount
For Airborne Electronics

The “Finnflex” all-metal vibration mount for airborne electronic equipment meets all requirements of MIL-C-172-B. The basic construction consists of two load-carrying convex Bellville-type springs in conjunction with a circular coil spring for dampening and wire mesh pads for snubbing.


CIRCLE 332 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1955
Signal Generator
A Low Drift Unit

The Model 162 AM Signal Generator includes all components except the power supply, are in the r-f cavity to minimize leakage. Bands are changed by a rotating turret arrangement. Internal modulation is 400 and 1000cy from 0 to 50%. New London Instrument Co., Inc., Dept. ED, 82 Union St., New London, Conn.
CIRCLE 325 ON READER-SERVICE CARD FOR MORE INFORMATION

Terminal Blocks
1/2” Center-to-Center

Type “MA” and “MAT” Terminal Blocks meet the requirements of many UL standards. They have only 1/2” center-to-center spacing of terminals while providing a full 3/8” creepage distance between terminals and to ground. The blocks consist of separate molded bakelite terminal sections held securely in place within a plated steel channel. Curtis Development & Mfg. Co., Dept. ED, 3250 33rd St., Milwaukee 16, Wis.
CIRCLE 336 ON READER-SERVICE CARD FOR MORE INFORMATION

Oscilloscope Camera
With Fast-Print Feature

The “Recordoscope 1414” is a compact, moderately priced, oscilloscope camera capable of providing accurate, single-frame photographic records of CRT phenomena 60sec after exposure of the scope image. Based on an adaptation of the small “Polaroid” fast-print magazine, it mounts easily on any standard 3” or 5” scope. Aremac Associates, Dept. ED, 50 S. San Gabriel Blvd., Pasadena, Calif.
CIRCLE 337 ON READER-SERVICE CARD FOR MORE INFORMATION
Gaussian Noise Generator
In Low Frequency Range

The Low Frequency Gaussian Noise Generator provides a random voltage whose amplitude probability distribution is gaussian to within 1%. The output frequency spectrum is flat to within 1db from dc to 2cy in the standard model, but the frequency spectrum can be modified upon special request. The output voltage is 5v rms, regulated to within 0.1db, and available from a low source impedance. A continuously adjustable calibrated attenuator permits the output to be decreased from this value. A front panel meter continuously monitors the rms value of the output voltage.

The instrument can be removed from the cabinet and mounted in a standard rack. It is intended for use with analog computers, simulators, servo testing, and many other applications. Automatic Instrument Div., Automation Laboratories, Inc., Dept. ED, 517 W. 207 St., New York 34, N. Y.

CIRCLE 341 ON READER-SERVICE CARD FOR MORE INFORMATION

Wood Specialty MANUFACTURING CO.
DIVISION OF GENERAL CEMENT MFG. CO.
920 Taylor Avenue
Rockford, Illinois

CIRCLE 343 ON READER-SERVICE CARD FOR MORE INFORMATION

New Miniature POWER OUTLETS
For Small Electrical and Electronic Units
- SMALLEST MADE
- TAKE STANDARD PLUG
- MOUNT FROM TOP OR BOTTOM OF FLAT BRACKET
- CHOICE PRE-WIRED STYLE, OR WITH SOLDERING TERMINALS
- PHENOLIC BLOCK HAS BARRIER TO PREVENT SHORTS
- AC and DC

Get your line into production without delay with immediate deliveries from the world's largest stock of silver plated terminal lugs. Over 21 million pieces! Prompt service also on standard and special terminal boards and etched circuits, including "Wrap-Around," "Plated-Thru" and "Flush" circuits. Write for latest catalog covering our complete line of electronic hardware. Please address Dept. 7.

CIRCLE 344 ON READER-SERVICE CARD FOR MORE INFORMATION

KULKA ELECTRIC MFG. CO., Inc.
Manufacturers of Electrical Wiring Devices
MOUNT VERNON, N. Y.
R-F Bridge
Covers 400kc to 60Mc Range

The Type 1606-A Radio - Frequency Bridge retains all the desirable features of this firm's older Type 916-A, and adds several new ones. A new broadband bridge transformer efficiently covers a range from below 400kc to 60Mc. New milled-plate variable air capacitors, which have very low losses, are used as reactance standards. General Radio Co., Dept. ED, 275 Massachusetts Ave., Cambridge 39, Mass.

CIRCLE 345 ON READER-SERVICE CARD FOR MORE INFORMATION

Sweep Generator
V-H-F Permeability Type

The Model SCA has 14 channels, including 12 TV and two intermediate frequency channels of 21Mc and 41Mc. It has a permeability sweep transformer, with an individual switch-selected core for each channel. It is frequency shift compensated for each channel. Crystal-controlled video and audio markers are automatically provided on each channel with a channel selector. Output is 1v on all channels. Invar Instrument Co., Dept. ED, 1400 N. Mission Rd., Los Angeles 33, Calif.

CIRCLE 346 ON READER-SERVICE CARD FOR MORE INFORMATION

Digital Voltmeter
Automatically Measures, Displays

The Model 451 Digital Voltmeter provides automatic measurement and digital display of d-c voltages at low cost. The measured voltages are displayed in a horizontal line of four luminous numerals 1" high, plus the decimal point and polarity sign. Voltage measurements are made in ranges: 0 to ±9.999v d-c; ±0.00 to ±99.99v d-c; and ±000.9 to ±999.9v d-c. Non-Linear Systems, Inc., Dept. ED, Del Mar Airport, Del Mar, Calif.

CIRCLE 347 ON READER-SERVICE CARD FOR MORE INFORMATION

Valuable Engineering Information on BERYLCO BERYLLIUM COPPER

Informativ technical bulletin, issued every month by the Beryl- lom Corporation, world's largest producer of beryllium copper, supply you with information an
- Practical applications of versatile Beryllium Copper
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CIRCLE 348 ON READER-SERVICE CARD FOR MORE INFORMATION

A MIGHTY MITE FOR FREQUENCY MEASUREMENT...

MINIATURE, SEALED TYPE FRAHM® RESONANT REED FREQUENCY METER

Hermetically sealed construction makes the Frahm Miniature Frequency Meter practically indestructible and foolproof in conditions of heavy moisture or fine dust. Design engineers who try Frahm Sealed Type Frequency Meters specify them repeatedly for land, sea and airborne equipment because they withstand dirt, fungus attack, humidity and other destructive atmospheric conditions. The "miniature" is available in 2 1/4" and 3 1/2" sizes. WRITE FOR BULLETIN 32PZ-ED.

ALSO AVAILABLE
IN STANDARD OR SPECIAL MODELS
FOR PANELBOARD OR PORTABLE USE

Frahm Resonant Reed Frequency Meters are available in a variety of standard shapes and sizes to indicate alternating current frequency from 15 up to 1500 cycles per second. They are applicable to pulsating or interrupted D-C as well as A-C supply circuits. If you have special design requirements for range, methods of activating, scale graduations, etc., we invite your correspondence. We are confident we can meet your specifications.

WRITE FOR BULLETIN 32-ED.

JAMES G. BIDDLE CO.

- ELECTRICAL TESTING INSTRUMENTS
- SPEED MEASURING INSTRUMENTS
- LABORATORY & SCIENTIFIC EQUIPMENT

1316 ARCH STREET
PHILADELPHIA 7, PA.

CIRCLE 350 ON READER-SERVICE CARD FOR MORE INFORMATION
Heavy-Duty Vibrator
For Communications Service

The 1700 Series Heavy-Duty Vibrator, designed especially for communications service, incorporates a design which eliminates the usual contact buttons. The spring leaves themselves, made of special contact alloy, act as contacting members, affording greatly increased contact area.

The construction increases vibration life from 50 to 100%, eliminates sticking of contacts, and provides steadier output throughout the service life, due to the lower rate of erosion at the contacts. Reduction of the mass of the contacts assures flare-proof starting without need for greater driving power. Both split-reed and duplex types (without split-reed) are available for two-way communications equipment and other heavy-duty electrical and electronic applications. P. R. Mallory & Co., Inc., Dept. ED, 3029 E. Washington St., Indianapolis 6, Ind.

CIRCLE 353 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Potentiometers
at Popular Prices

The New G-R 970 Series Wire-Wound Potentiometers Feature

- Accurate Resistance Values
- High Resolution
- Good Linearity
- Low Capacitance to Ground
- Uniform Contact Pressure
- Low Electrical Noise
- No Pressure Connections
- Total Enclosure
- Stable & Repeatable Settings
- Long Life
- Seventeen Stock Values: 2 to 500,000 Ohms
- Eight Sizes: 2 to 20 Watts
- Low Cost: $3.15 to $10.00

Before purchasing any precision potentiometer, investigate these new G-R Units. Write for the POTENTIOMETER BULLETIN

GENERAL RADIO Company
275 Massachusetts Avenue, Cambridge 39, Massachusetts, U.S.A.
90 West St., NEW YORK & Roslyn 18th St., Silver Spring, Md. WASHINGTON, D.C.
Yale Road & Governor Avenue, Arlington, Va., PHILADELPHIA
920 South Michigan Ave., CHICAGO 5 - 100 North Sawin St., LOS ANGELES 13
CIRCLE 355 ON READER-SERVICE CARD FOR MORE INFORMATION

Every plant needs an
Engravo Graph

15,000
IN USE!

Immediate engraving with unskilled labor.
- Name plates • Dials • Panels
- Tools • Parts

new hermes ENGRAVING MACHINE CORPORATION
13-19 UNIVERSITY PLACE • NEW YORK 3, N.Y.

CIRCLE 356 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 352 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 354 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 357 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 358 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 359 ON READER-SERVICE CARD FOR MORE INFORMATION
For Sensitive and Accurate Control

RANGES:

0/20 uA to 0/50 A
0/5 MV to 0/500 V

The trip point is adjustable to any point on the scale. These meter-relays are sensitive to changes of as little as 1%. One contact is carried on moving pointer. The other is on a semi-fixed pointer. When two pointers meet contacts close and lock. Holding coil is wound directly over moving coil. Reset can be manual or automatic. Spring action in contacts kicks them apart forcefully. Three sizes of clear plastic case models, 2 1/2, 3 1/4 and 4 1/4 inches (all rectangular). Two ruggdized and sealed models, 2 1/2 and 3 1/4 inches (round metal cases).

Contact arrangements: High Limit Single, Low Limit Single or Double (both high and low). Contact rating is 5 to 25 milliamperes D.C.

Suggested circuits for meter-relays and complete specifications including prices are covered in new 16-page Bulletin G-6, which you can get by writing Assembly Products, Inc., Chesterland 17, Ohio.

ATOMIC EXPOSITION, BOOTH 423, DEC. 10-16, CLEVELAND, OHIO

CIRCLE 357 ON READER-SERVICE CARD FOR MORE INFORMATION

Cirulating System
Provides Constant Temperatures

The “Temp-Trol”, a portable constant-temperature circulating system used for accurate temperature control of refractometers, spectrophotometers, and a wide variety of other instruments, has been redesigned. A new “Micro-Set” Thermo-Regulator is coupled with an electronic relay to provide faster, more accurate response to temperature change; temperature control is accurate to ±0.05°F. Other features include a wide temperature range (from ambient to 210°F), and a built-in cooling coil for operation below room temperature. A submerged pump provides rapid circulation (up to 5gpm at zero head). The system does not require a continuous water supply, since the 2-1/2 gal capacity is ample for continuous circulation. Precision Scientific Co., Dept. ED, 3737 W. Cortland St., Chicago 47, Ill.

CIRCLE 359 ON READER-SERVICE CARD FOR MORE INFORMATION

If you need a special component, send a brief statement of your specifications addressed to Bulletin Board, Electronic Design, 19 East 62nd St., New York 21, N. Y. Include your complete address.
the ONLY instrument in the field that offers ALL these features at

NO EXTRA COST!

- FREQUENCY Measurement
- 1 and 10 SECOND Time Base
- PERIOD Measurement
- 1 and 10 CYCLEGate Time
- PRECISION ACCURACY
- Over 1-100,000 cps range
- EASILY PORTABLE 
- Only 25 Pounds
- SMALL SIZE 
- 14½" W x 7½" H x 13½" D

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5457 Clean Avenue, Dept. 76-N
North Hollywood, California

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CORD SETS
Ready for Your APPLICATION

Cords manufactures a complete line of U.L. approved cord sets for any application. Through their extensive standardization, Cords Ltd. can reduce both your engineering and inventory costs... and at the same time furnish quality cord sets at a competitive price. Sales offices in principal cities.

Write Cords today for free catalog outlining complete specifications of standard cord sets... or for Bulletin C442 on new 3 conductor U.L. approved cord sets.

CORDS LIMITED
DIVISION ESSEX WIRE CORPORATION
121 DOUGLAS STREET, DEKALB, ILLINOIS

Tantalum Capacitors
For Transistor Circuits

Porous sintered anodes, compacted from a special grade of tantalum metal powder of carefully controlled particle size, provide a large surface area for contact with the electrolyte to permit large capacity in small space. The anodic oxide film is formed electrolytically, after which the anode is inserted, with proper insulating seals, into a fine silver case which also serves as the cathode.

Tantalum capacitors of this type are made in 58 sizes and ratings, ranging from 1.75v d.c (w) to 325mfd at 6v. The normal temperature range is from 

-55°C to +85°C. Hermetically sealed capacitors, also available from this company, may be operated in temperatures up to 125°C.

D-c leakage is remarkably low, ranging from 1.0μamp at 6v d-c to a maximum of 5μamp at 125v.


CIRCLE 365 ON READER-SERVICE CARD FOR MORE INFORMATION

CURTIS DEVELOPMENT & MFG. CO.
3236 North 33rd Street
Milwaukee 16, Wisconsin

CIRCLE 367 ON READER-SERVICE CARD FOR MORE INFORMATION

3 heavy-duty resistors meet high-current needs

Bareohm unit is used for continuous-duty battery charging, space heating, load bank, projection arc, similar equipment.

Loophorn, another continuous-duty unit, is designed for applications where mechanical shock or vibration prevail, such as crane hoists, welding and other portable equipment.

Edgeohm, an intermittent-duty unit, is used in motor starting, plugging, field discharging and similar applications.

Write for Bulletin 35 for complete details. Ward Leonard Electric Co., 77 South St., Mount Vernon, N.Y.

CIRCLE 368 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1955
Temperature Relay
Extremely Sensitive

The glow of a cigarette at a distance of ten feet will actuate the “Infra-Ray” Relay. This device can be used to actuate, at a safe distance, any device associated with high temperature operations (turn on cooling sprays, actuate hot strip coolers, stop pouring of molten metal at the correct level, activate recorders of high temperature instruments, etc.). It is a self-contained unit providing contact ratings 250va rms at any time, up to 5amp immediately prior to opening and up to 500v immediately prior to closing. Cabinet is 9” x 12” x 6” deep. Power required is 115v ±10%, 60cy, 0.1amp, one side grounded. Industrial Gauges Corp., Dept. ED, Englewood, N. J.

CIRCLE 369 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic Timer
For Industrial Controls

The T-1 Timer is a simple electronic unit with ±2% repeat accuracy. It permits multiple modes of operation including interval, delayed action, repeat cycle, and single cycle timing, and it can be supplied with standard time ranges of 0.3-25sec, or 0.5-50sec. The 270° calibrated dial assembly can be removed for remote operation. Ferrata, Inc., Dept. ED, 8106 W. Nine Mile Rd., Oak Park, Mich.

CIRCLE 370 ON READER-SERVICE CARD FOR MORE INFORMATION

Turns-Counting Dial
In Four Precision Models

The 900 Series “Duodial” turns-counting dial, which replaces this firm’s W series, consists of two coaxial dials: the inner counts hundreds of each turn, and the outer counts the number of completed turns. The dial is integrally mounted with the inner dial and connects directly to the shaft of the device using it, assuring accurate readings, free from backlash. Helipot Corp., Dept. ED, 916 Meridian Ave., South Pasadena, Calif.

CIRCLE 371 ON READER-SERVICE CARD FOR MORE INFORMATION

For any application, you can choose an Automatic Electric relay—a top-quality relay in every way—with the additional advantages of plug mounting:

Minimized Inventory—When youstandardize on plug-in relays, you can often interchange the same basic relay in many models of your equipment. Thus, you make substantial savings by reducing your inventory costs, speeding assembly.

Fast, simplified Inspection and maintenance—Plug-in relays permit periodic bench inspections with almost no "down time" involved. Entire banks of relays can be removed for testing, and then replaced, in seconds.

Simplified replacement—Plug-mounted relays can be replaced quickly and easily at otherwise inaccessible points in your equipment. Even an unskilled service man can replace relays in a matter of seconds without tampering with circuit wiring.

You can select Automatic Electric plug-in relays from five basic types and thousands of individual assemblies.


CIRCLE 372 ON READER-SERVICE CARD FOR MORE INFORMATION
Improve design simplify purchasing speed production with

C-D-F SPIRAL TUBING

Looking for low-cost tubing to reduce unit costs and improve product performance? Consider the use of C-D-F Spiral Tubing, a high strength plastic made from paper or fibre that is spirally wound and cured at high temperatures. In many cases it can replace rolled or molded laminated plastics...at a good cost saving. Small sizes, thin walls are not a problem. For many applications, dimensional stability and moisture resistance is excellent. Coil forms, insulating tubes, paint roller tubes, shipping containers, bushings are just a few applications.

Write today for 5-page Technical Folder ST-53, giving properties, sizes, tolerances on impregnated and unimpregnated round, square and rectangular C-D-F Spiral Tubing. Well illustrated. Call your C-D-F Sales Engineer (offices in principal cities) — he's a good man to know!

Continental Diamond Fibre
CONTINENTAL DIAMOND FIBRE DIVISION OF THE BUDD COMPANY, INC.
CIRCLE 373 ON READER-SERVICE CARD FOR MORE INFORMATION

Preamplifier
Produces D-C Voltages from A-C

To overcome the limitations of excessive power drain and sluggish response of a meter movement in recording the rms value of a-c voltages and currents, this circuit produces a d-c voltage proportional to the rms value. Known as the Model 150-2500 RMS Volt/Ammeter Preamplifier, it plugs into an appropriate driver amplifier—power supply unit in any Sanborn "150 Series" system.

Typical specifications, when used with associated Sanborn equipment, are voltage ranges: 25v, 125v, 250v; current ranges: 50ma, 100ma, 250ma, 500ma, 1amp; full-scale deflection: 5cm; overall tolerance: ±3% of full scale, for frequencies between 50cy and 2ke. The preamplifier is usable to 4ke, and its rise time is 0.15sec. Sanborn Co., Industrial Div., Dept. ED, 195 Massachusetts Ave., Cambridge, Mass.

CIRCLE 375 ON READER-SERVICE CARD FOR MORE INFORMATION

New Differential DC VOLTMETER

Read Out

432.02 VOLTS

Fast! Direct! Now! Twice as Accurate!

Mod. 800 $315

- ACCURACY OF THE NEW MOD. 800 NOW INCREASED TO 0.05%. Highly stable reference supply calibrated against standard cell. 5-dial decade attenuator uses matched, precision wire-wound resistors.

- 500-VOLT RANGE...estimates value of unknown voltage to within 2% by direct meter reading.

- 10 CALIBRATED NULL SCALERS...10-0-10 and 1-0-1 volt ranges give direct reading of deviations from null. High resolution—500 volts are spread over 80 ft. of effective scale length.

- INFINITE INPUT RESISTANCE at null.

- PRINTED CIRCUIT...light, strong, aluminum construction; easy to read illuminated dials.

Electronic Tools for Industry

John Fluke Manufacturing Co.
101 W. Nickerson St., Seattle 98, Wash.

CIRCLE 376 ON READER-SERVICE CARD FOR MORE INFORMATION

WIRE-MIKE takes guesswork out of wiring

- pocket size, 4½” closed, 2 oz. weight
- heavy-gauge stainless steel
- inside and outside caliper, calibrated in 10ths
- precision-etched direct reading scales
- pipe size to i. d. conversion table
- genuine leather sheath

Frankly, we never intended to get into the WIRE-MIKE business. Our engineers designed WIRE-MIKE as a labor of love—because they felt such a tool was long overdue. We made several hundred for our friends, and thought we had heard the last of it. Not so. Before you could say "WIRE-MIKE," we were snowed under with demands for this handy gadget. Since our distributors knew we couldn't keep giving them away, they asked us to put WIRE-MIKE into production at a nominal price. A few improvements made WIRE-MIKE better than ever—now everyone can have this famous precision lifetime tool for instantly measuring conductor size (stranded, solid or ACSR), conduit size (rigid or thinwall), and pipe size. Only $1.95 at your Burndy distributor.

BURNS ENGINEERING COMPANY, Inc., Norwalk, Conn.

CIRCLE 378 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1955
Here is our ion CIRCLE product, combining with T-725 assembly production, saving components using Bantams

Power sources up to 500v d-c and 500ma for all types of signal or control systems are built by this firm in various mechanical arrangements to fit original equipment manufacturers' requirements. These units are also applicable to the excitation of magnetic chuckers, small motors, alternators, or dynamometers.

The typical unit shown is used in municipal fire alarm systems. It is a selenium rectifier and serves as a continuous source of d-c power for fire alarm boxes throughout a community. Durable components, good voltage regulation during overloads, and protection against short circuit damage are incorporated. It has low internal impedance, choke-capacitor hum filtering, and needs no warm-up. Slaughter Co., Dept. ED, 170 Niekin Ave., Piqua 8, Ohio.

CIRCLE 381 ON READER-SERVICE CARD FOR MORE INFORMATION

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**FIRST TRANSISTOR RADIO MADE POSSIBLE ... BY INSUROK® COPPER-CLAD PRINTED CIRCUITS!**

This 12-ounce radio was made possible mainly through the use of printed circuits and transistors! Regency laid out the circuit. Cranmer, Inc. printed it on Richardson T-725 copper-clad INSUROK, then etched it. Result: Light, compact circuit... no tedious wiring... faster assembly.

---

**D-C Power Supplies**

For Use In Other Equipment

Power sources up to 500v d-c and 500ma for all types of signal or control systems are built by this firm in various mechanical arrangements to fit original equipment manufacturers' requirements. These units are also applicable to the excitation of magnetic chuckers, small motors, alternators, or dynamometers.

The typical unit shown is used in municipal fire alarm systems. It is a selenium rectifier and serves as a continuous source of d-c power for fire alarm boxes throughout a community. Durable components, good voltage regulation during overloads, and protection against short circuit damage are incorporated. It has low internal impedance, choke-capacitor hum filtering, and needs no warm-up. Slaughter Co., Dept. ED, 170 Niekin Ave., Piqua 8, Ohio.

CIRCLE 381 ON READER-SERVICE CARD FOR MORE INFORMATION

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**TINY CONVENIENCE OUTLETS**

Tiny Convenience Outlets give your portable appliances, radios, power tools, electronic test gear greater utility and ease of use. Easy to install — takes absolute minimum of space.

**SYNCHRONIZED OUTLETS**

Simplest, most attractive answer to your multi-outlet specialized power requirements.

**SMALL OUTLET COVERS**

For those who prefer to hide their outlets, or simply want to give their walls a more pleasing appearance.

**BLINDING PURPOSES**

Screw out to expose outlets, and then simply replace when not in use.

**SIGNIFICANCE OF OUTLETS**

A feature of new High-Torque Unbrako socket set screws

Compare Unbrako-recommended tightening torques with those of ordinary socket set screws and you readily see why you can set an Unbrako and then forget it. The reasons are simple. Unbrakos have deeper sockets, which give you better purchase with the wrench; rounded socket corners, which eliminate the sharp corners where cracks start; securely threaded, which make them stronger; and knurled cup points, which keep them tight. Bulletin 2067 tells the complete story—briefly and pictorially. Ask your Unbrako Industrial distributor for a copy. Or write us today. STANDARD PRESS Steel Co., Jenkintown 12, Pa.
HOW MUCH
Should Precision Resistors
cost?

Many manufacturers of electrical-electronic apparatus have found that the use
of Continental Film Resistors results in equal or improved specifications... and
at lower costs.

Our high degree of specialization in the
film field provides unusual service and cost advantages even in orders of 500
units or under.

1/4W, 1/2W, 1W, 2W: 10 ohms through 20 megohms.
1%, 2%, 5%. Most MIL-R-10509A specifications.

We invite you to investigate the Con-
tinental Film System now... just staple
this ad to your letterhead.

Send me your
new catalog.  Have a field
engineer contact me.

CONTINENTAL CARBON, INC.
13902 Lorain Ave. • Cleveland 11, Ohio

CIRCLE 385 ON READER-SERVICE CARD FOR MORE INFORMATION

knots
tie easier, faster
and do not slip!

fungus-proof

NYLON

FLAT BRAIDED TAPE,
ROUND LACING CORD

Hemlinway & Bartlett Nylon Lacing Cords
and Tapes fit every lacing need. Their
greater strength means minimum break-
age—minimum rejects. Their special
construction prevents knot slippage... makes knots tie tighter, faster and easier!

TAPES  Most Gov Spec. FED-1613. In 3
finishes: wax free, wax and resin-
coated finish

CORDS  Comply with all construction and
finish requirements of Gov Spec.
Jan.1-713 and Jan.1-152

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San Francisco, Los Angeles, Detroit, Charlotte, N C, Cleveland, N Y,
Lynchburg Va, Foreign Agents Turner Harvey Co. Inc. 40 Worth St, N Y

CIRCLE 386 ON READER-SERVICE CARD FOR MORE INFORMATION

Meter Calibrator
Checks Variety of Instruments

This electric meter
calibrator is
suitable for check-
ing all the usual
electric meters,
cluding voltmeters,
ammeters, wattme-
ters, varmeters,
and power factor
meters, and synchro-
nization indicators. It consists of a
power supply panel which has the various required
test outputs and an instrument console including
twelve precision meters used as standards for com-
parison with the meters under test. The power supply
requires an input of 110v 60cy at a maximum cur-
cent of approximately 5amp.

The console is also provided with a wheatstone
bridge for checking multiplier resistors and with res-
sistors from 10 ohms to 100 megohms for calibrating
ammeters. Overall dimensions of the calibrator are
48" x 28" x 26", with a weight of approximately
ED, 6108 Rhode Island Ave., Riverdale, Md.

CIRCLE 387 ON READER-SERVICE CARD FOR MORE INFORMATION

Kester Solderforms®

The right amount
of solder every time when you
use Kester Solderforms in your assembly operation.
Produce better looking and more efficient products
as well as greatly increase speed
of manufacturing.

WHERE TO USE KESTER SOLDERFORMS

- Capacitors • Switches • Resistors • Transformers
- Relays • TV and Radio Tuners • Gauges • Small
- Metal Assemblies and Controls...many,...many others.

WRITE TODAY for free samples and complete information

CIRCLE 389 ON READER-SERVICE CARD FOR MORE INFORMATION

Federal Short Run
Stampings

Cost Less

20 SIZES
1/4" to 3"

ALL SIZES, SHAPES and MATERIAL
- FASTER • SIMPLER
- SAFER • MORE SECURE
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For wires, cables, conduits, tubing, light hose.
Name the use and Commercial has a clamp...
or will design one. Pioneering "know-how" and
advanced production methods of CPC offer
unmatched quality...and at a saving, too!
Send for sample clamps and prices.

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COMMERCIAL PLASTICS CO.

CIRCLE 388 ON READER-SERVICE CARD FOR MORE INFORMATION

Federal Tool and Manufacturing Co.

3650 Alabama Ave. • Minneapolis 16, Minn.
QUALITY STAMPINGS IN SMALL QUANTITIES

CIRCLE 390 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1955
DAP Resin-Base Laminates
For Moisture Conditions

Three new grades of thermosetting laminated plastics utilizing a DAP (diallyl-phtthalate) resin base answer the need for a number of design problems involving moisture—especially electronic components used in damp, humid climates. The new grades are coded according to filler material. DAP-impregnated canvas (Grade C-104), Orlon (Grade O-104), and woven glass cloth (G-104) all show a number of outstanding electrical properties in laboratory tests. Synthane Corp., Dept. ED, Oaks, Pa.

CIRCLE 391 ON READER-SERVICE CARD

Regulated Power Supply
Compact Unit

The Model 702A Power Supply is a regulated power source of conventional circuitry featuring a compact and unique method of mechanical construction which makes efficient utilization of space with no sacrifice in accessibility of components. It provides output voltages from 0 to 600v continuously variable, with currents up to 200ma. Regulation is maintained at 1/4% or better with ripple less than 10mv peak to peak. Shasta Div., Beekman Instruments, Inc., Dept. ED, Box 296, Station A, Richmond, Calif.

CIRCLE 392 ON READER-SERVICE CARD

Magnetic Heads
For Recording/Reproducing

Adequate inter-track shielding and precise gap alignment are features of these multi-track magnetic recording and reproducing heads. Each head stack is cast in plastic and mounted in a metal housing. This guarantees immunity to such adverse conditions as shock, vibration, and wide ranges of temperature and humidity. Complete interchangeability of the various models permits use of a single tape transport for varied operation. From 7 to 21 tracks per inch are available with gaps to 0.00015". The Davies Laboratories, Inc., Dept. ED, 4705 Queensbury Rd., Riverdale, Md.

CIRCLE 393 ON READER-SERVICE CARD

CIRCLE 394 ON READER-SERVICE CARD

NEW ENGINEERING CATALOG NUMBER 14
We are always at your service to make recommendations and develop the solution to any circuit protection problem.

A Littelfuse field representative will be glad to come to you.
A NEW ALLISON FILTER... RANGING FROM 10KC TO 640KC

the model 2C CONTINUOUSLY VARIABLE
PASSIVE NETWORK AUDIO
FREQUENCY FILTER

Another significant engineering achievement...
the model 2C Allison Filter has been designed for telemetering and general electronics applications in frequencies ranging from 10kc to 640kc. It offers unprecedented technical advantages through precise performance, range and versatility of application and easy maintenance-free operation.

FEATURES
- Low Pass, High Pass and Band Pass with Continuously Variable low cut-off and high cut-off (independently controlled) from 10kc to 640 kc.
- Passive Network... No Power Supply, No Vacuum Tubes.
- Low Loss... Approximately 1 db. in Pass Band.
- High Attenuation Outside Pass Band...30 db/octave.
- Maximum Input 2 Watts.
- Designed for 600 Ohm Circuits.

allison laboratories
14189 SKYLIN Drive • PUENTE, CALIFORNIA

CIRCLE 395 ON READER-SERVICE CARD FOR MORE INFORMATION

NOW... MALCO AUTOMATIC PIN AND CONTACT INSERTING MACHINE FOR PRINTED CIRCUIT APPLICATIONS

...the Most Important Cost-Saving Advancement Yet Offered

Malco's Automatic Pin and Contact Inserting Machine can materially reduce your assembly costs — and at the same time step up production to practically any desired level.

Operation is completely automatic. Up to 40 or more self-retaining terminals are inserted into the printed circuit board in any symmetrical or non-symmetrical pattern within a 3-second cycle. A special platen engages the self-retaining snap-in feature of the terminals, and the board is ready for immediate further assembly and dip soldering.

Malco Automatic Inserting Machines can be engineered to your particular application or production requirements.

Malco TOOL and MANUFACTURING CO.
4027 W. LAKE ST., • CHICAGO 24, ILLINOIS

CIRCLE 396 ON READER-SERVICE CARD FOR MORE INFORMATION
Tape Recorder
Portable and Battery Operated

This self-contained tape recorder is housed in a weather-tight aluminum case and it weighs only 19 lb. A VU meter is incorporated to act as a level indicator, and "A" and "B" battery meter. It also simplifies the correct setting of recording and playback levels to compensate for battery voltage changes. Amplifier Corp. of America, Dept. ED, 398 Broadway, New York 13, N. Y.

CIRCLE 397 ON READER-SERVICE CARD FOR MORE INFORMATION

Trimming Potentiometer
Meets Missile Requirements

The Model 160 "TRIMpot" meets aircraft and missile requirements for a subminiature trimming potentiometer having top high temperature and power rating characteristics. A -65° to 350°F range is provided. Power rating is 0.6w at 100°F and 0.4w at 200°F. Bourns Laboratories, Dept. ED, 6135 Magnolia Ave., Riverside, Calif.

CIRCLE 398 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Meter
Measures D-C to 11,000Mc

The Model F-2 Power Meter operates over the entire frequency range of d-c to 11,000Mc. Power is measured in three ranges: 0.1-mw, 0-10mw, and 0-100mw. Accuracy of readings may be quickly checked at any time by means of self-contained d-c calibration circuit. Polarad Electronics Corp., Dept. ED, 43-20 34th St., Long Island City 1, N. Y.

CIRCLE 399 ON READER-SERVICE CARD FOR MORE INFORMATION

DataReader
Model 546

A transport unit for high-speed searching, reading and recording of data on magnetic tape.

End-of-tape sensing

Slotted, hollow guide shafts, one adjacent to each tape reel are constantly subjected to a vacuum which is maintained as long as normal tape is passing over, and sealing the shaft openings. Perforated leaders at either end of the tape interrupt the vacuum and stop the tape reels. This feature also provides an automatic stop in the event of tape failure.

PERFORMANCE:
RAPID START—STOP—REVERSE—from stop to full speed in 6 milliseconds.
HIGH TAPE SPEED—optional single speed of 30, 40, 50, 60 or 75 in/sec.
TWO-DIRECTION SEARCH—either direction, automatically at full speed.
REMOTE OPERATION—forward, reverse, stop, rewind and selection of reading and writing.
VACUUM COLUMN TAPE CONTROL—provides strain-free tape feed over entire length of tape.
RAPID Rewind—2400 ft. of 1/2" or 3/4" tape in 3 minutes.

FOR FURTHER INFORMATION WRITE
ElectroData Corporation
Component Sales Division
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Pasadena 15, Calif.

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An Affiliate of
CONSOLIDATED ENGINEERING CORPORATION
OF PASADENA, CALIFORNIA
ElectroData Corporation maintains a national-wide sales and service organization.

CIRCLE 400 ON READER-SERVICE CARD
Megohmmeter
Is Zeroed Once for All Scales

This ohmeter and megohmmeter permits measurement of high resistance values to a fraction of 1%. It has a zero adjustment which compensates for varying battery voltages; once zeroed for one scale, the adjustment is accurate for all scales. Greibach Instruments Corp., Dept. ED, Metuchen, N. J.
CIRCLE 402 ON READER-SERVICE CARD FOR MORE INFORMATION

Strip Chart Recorder
Records on 5" Paper

This miniature strip chart recorder, of the null balance potentiometer type, records on 5" translucent paper with a pen speed of 0.5 sec full scale and an accuracy of 0.25%. It is available with input sensitivities of 10, 50, 100, or 500 mv d-c. No standard cell or batteries are used; standardization is continuous and automatic. Chart speeds are adjustable for 4, 10, or 20 ips. Westronics, Inc., Dept. ED, 3605 McCurt St., Ft. Worth, Tex.
CIRCLE 403 ON READER-SERVICE CARD FOR MORE INFORMATION

Servo Valves
For 500-3000psi Systems

A line of electrically actuated, high-response, hydraulic servo valves is offered for 500-3000psi hydraulic systems. Controlled maximum output flows are 0 to 9 gpm with a time constant of approximately 1-1/2" milisecond from input differential current to output flow. Pacific Div., Bendix Aviation Corp., Dept. ED, North Hollywood, Calif.
CIRCLE 404 ON READER-SERVICE CARD FOR MORE INFORMATION
Assembly of these rugged building blocks into an integrated system is a simple and easy process. Analyze your telemetry requirements, sketch your block diagram, and select the required units from RREP's full line of FM transmitting equipment. You’ve then got the finest airborne system available.

**RREp**

RAYMOND ROSEN
ENGINEERING PRODUCTS, INC.

32nd and Walnut Streets, Philadelphia 4, Pennsylvania
Western Regional Office: 15166 Ventura Blvd., Sherman Oaks, Los Angeles, California

CIRCLE 405 ON READER-SERVICE CARD FOR MORE INFORMATION

Erik A. Lindgren Presents...

**the New Look**

**in Shielded Enclosures**

GUARANTEED HIGHEST ATTENUATION RATINGS

146 DB - Copper

128 DB - Bronze

- new pat. pend. 2-handle, completely leakproof door - roller bearing bronze hinges
- new screen sections are firmly fastened to wooden frame - then these wooded supports are bolted together at sides, inside and out, for greatest possible strength.
- new extra-reinforced floor with cross beams every 12".
- new 1" plywood flooring, covered with 1/2" vinyl tile
- new Lindgren shielded enclosures have expanded metal "kick plates" for added durability and protection.
- new interchangeable screen panels are held in contact with each other by continuous pressure, without soldering. Easily taken apart for storage or for changing location.

Meets U.S. Gov't. performance specifications.

ERIK A. LINDGREN & ASSOCIATES
Established 1939

4515-17 N. Ravenswood Ave., Dept.N-10, Chicago 40, Ill. SUNNYSIDE 4-0710

CIRCLE 406 ON READER-SERVICE CARD FOR MORE INFORMATION
TO THE FINE ENGINEERING MIND
SEEKING THE CHALLENGING PROJECTS IN

MICROWAVE ENGINEERING

Convair, in beautiful San Diego, now earnestly needs skilled MICROWAVE ENGINEERS AND PHYSICISTS: to solve design problems of an advanced nature in microwave antennas and scanners. Must be experienced in pencil beam and shaped beam designs for guided missile and airborne radar applications. For analytical and experimental work in the design of microwave components for specialized microwave radar systems and test equipment. For experimental development of components in the fields of dielectric and metallic media including familiarity with radome and microwave lens design. Unusual opportunities for senior level engineers with advanced degrees or equivalent experience.

At CONVAIR you will find an imaginative, explorative, energetic engineering department... truly the "engineer's" engineering department to challenge your mind, your skills, your abilities in solving the complex problems of vital, new, long-range programs. You will find salaries, facilities, engineering policies, educational opportunities and personal advantages excellent.

Generous travel allowances to engineers who are accepted.

Write at once enclosing full resume to:
H. T. Brooks, Engineering Personnel, Dept. 1011

CONVAIR
A Division of General Dynamics Corporation
3302 PACIFIC HIGHWAY SAN DIEGO, CALIFORNIA

Lovely, sunny, SMOG-FREE SAN DIEGO, ever-growing area of three-fourths million people, offers you and your family a way of life judged by most as the Nation's finest for climate, natural beauty and easy (indoor-outdoor) living. Housing is plentiful and reasonable.
Dipped-Mica Capacitor
Meets MIL-C-5 Specifications

A dipped-mica capacitor with parallel leads, the “Dur-Mica” DM-20 was developed especially to meet miniature requirements and all humidity, temperature, and electrical requirements of MIL-C-5 specs. It is available in capacities up to 5100mmfd at 300v d-c (w) and up to 3900mmfd at 500v d-c (w) with operating temperatures up to 125°C. Typical capacitance drift limits after temperature excursion of 25° to 85° to 25° to -55° to 25°C from the lowest to the highest capacities show performance better than characteristic F limits. Dimensions of this phenol-fcoated mica capacitor are 7/16” x 3/16” x 3/4” long. Electro-Motive Mfg. Co., Inc., Dept. ED, Willimantic, Conn.

Neon Indicator
Replaceable Bulb Type

This neon indicator, Type 1D, features a replaceable bulb and is designed to meet requirements of military and commercial specifications. With a case diameter of only 0.375", it mounts in a 3/8” hole in panels up to 3/8” thick. Overall length is 1.80”.

Using a carefully designed lens of high-impact styrene, the unit provides maximum light from an NE-2A bulb. It has low interelectrode capacity (less than 2mmfd). The container is an anodized aluminum case with 3/8” x 32 NEF thread, with lug insulator of compression-molded thermostetting plastic. Bulb removal is made from the front of the panel. Eldema Corp., Dept. ED, 9844 Remer St., El Monte, Calif.

circle 408 on reader-service card

circle 409 on reader-service card

fully engineered packaged power supplies
---ready-to-install components

Model 3-150X
Output: 200-300 V.D.C.
0-150MA

Model 1-20X
Output: 150 V.D.C.
0-20 MA

dressed-barnes
sub-chassis mounting units

The Model “X” regulated power supplies save designing time...are easily and quickly installed...cost less than units you can build yourself. Quality Dressen-Barnes construction, and freedom from maintenance. Eight stock models available in outputs from 100-500 V.D.C., current from 20-300 MA—and each model has an adjustable output range. Ripple on all models is below 10 MV. Specials built to your order.

Dressen-Barnes CORP., 250-B N. Vinedo Ave., Pasadena 8, Calif.

circle 410 on reader-service card for more information

Write for literature on Model “X” units.

Electronic Design • November 1955
Galvanometers

Will Read 200cy Signals

The first five of a "High-Performance" series of galvanometers, these instruments permit accurate recording of dynamic signals up to 200cy without amplifiers. Several of the galvanometers are electrically interchangeable with this firm's present "7-300" units, but feature extended frequency response. Other units are distinguished by extremely high sensitivity and are expected to be used where maximum resolution or recording of very low level signals is required. Types are available for direct connection to commonly used 120-ohm, 180-ohm, and 350-ohm strain gages and resistance-type pickups. No circuit revisions are necessary. Consolidated Engineering Corp., Dept. ED, 300 N. Sierra Madre Villa, Pasadena 15, Calif.

CIRCLE 411 ON READER-SERVICE CARD

Pulse Transformer

Handles 15,000v 125amp

The D211C4B is an extra-heavy pulse transformer for high power applications. It will handle 15,000v on the primary, delivering 15,000v at 125amp from secondary.

The transformer is designed to operate with pulse widths of 20µsec and features a rise time of less than 1µsec. Duty cycle is 4millisecc, continuous. Total maximum variation of output pulse from nominal peak value is less than 5%. Weight is 45 lb, and size is 8" x 6-1/2" x 9", including four stud mounts on the base, but not four 3" feed-through insulators on the primary and secondary sides. The transformer is hermetically sealed, oil filled, and has a belows-type expansion drum. Fisher Engineering, Inc., Dept. ED, Huntington, Ind.

CIRCLE 412 ON READER-SERVICE CARD

ELECTRONIC ENGINEERS

YOU CAN SHAPE THE FUTURE OF ELECTRONICS

with Sanders Associates, Inc.

Sanders Associates, Inc. offers to Electronic Engineers the opportunity to build careers in the electronic world of tomorrow by creative engineering today. Our goal is to shape the future of the industry—not to follow in the footsteps of others. The impact of Sanders on the electronics industry in four short years has been the result of engineering performance ... with such "firsts" to our credit as PANAR, tri-scan antenna, and "tri-plate" microwave plumbing.

In guidance systems, weapons systems, countermeasures, in system concepts, basic circuitry, techniques, component development, microwave antenna, electro-mechanical transducers—in every phase of the art, both military and commercial—Sanders needs ambitious, creative engineers who will move ahead, for the success of the company can only be measured in terms of the success of our people.

We would enjoy the opportunity of discussing with you your future at Sanders Associates, Inc. Drop a note to D. H. Johnson outlining your experience and we will advise you promptly. Interviews can be arranged either in Nashua or in your area.

137 CANAL ST., NASHUA, NEW HAMPSHIRE

CIRCLE 413 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1955
NEW - UNIVERSAL CABINET

WITH OPEN SIDES AND DETACHABLE SIDE PANELS

Adaptable TO GROWTH REQUIREMENTS

PAR-METAL Types "PR" and "FR" Universal* Cabinet Racks are made with Detachable Side Panels in order to assure flexibility for your future needs.

Because these are STANDARD UNITS, you get custom-quality at economical cost. They may be used singly or in a group arrangement.

Made in these dimensions:
Heights: 48½", 67½", 76½" and 83½".
Depths: 18" and 24".
Panel Widths: 19" and 24".

Built for Dependable Service
While incorporating new features of versatile assembly, there has been no sacrifice of structural rigidity. All PAR-METAL RACKS are substantially welded and reinforced for diversified industrial use.

STANDARD ACCESSORIES: Vertical Side Supports, Sliding Shelves, Rack Mounting Chasses, Bases, Roller Trucks, etc. are available as standard equipment.

PAR-METAL PRODUCTS CORP.
Metal Housings for Electronic Apparatus
32-56 49th Street * Long Island City 3, N. Y.
Mail this coupon for our Latest Catalog today.

Par-Metal Products Corp.
32-56 49th St., L.I.C. 3, N.Y.
We are interested in "Universal Cabinet Racks." 
( ) Mail a copy of your latest catalog to:

Name ........................................ Position ............
Address ......................................................
Company ..................................................................
City ........................................ Zone........... State ............

CIRCLE 414 ON READER-SERVICE CARD FOR MORE INFORMATION
R-B-M Motor Control Panels for heating, cooling and air conditioning equipment are engineered and built as complete packages. All components, from contacts and relays through wiring harnesses and cord sets, are pre-assembled and the panel is ready for you to hook-up. As part of the Essex Wire Corporation, R-B-M joins hands with the other divisions to utilize their specialized skills and produce a completely integrated unit — custom built to your needs. R-B-M engineers are experienced in Underwriters' requirements and available for consultation at any time. Call your nearest R-B-M Sales Engineer or write for information.

R-B-M DIVISION
ESSEX WIRE CORPORATION
Logansport, Indiana

CIRCLE 415 ON READER-SERVICE CARD FOR MORE INFORMATION
Oscilloscope
Weighs Only 8-1/2 lb

This portable miniature oscilloscope, Model MO-1, weighs only 8-1/2 lb and takes up less than 1/4 sq ft on the bench. The actual dimensions are 6” x 5” x 9” high.

In spite of its size, the unit is a precision instrument. Input impedance is 2 megohms shunted by 15mmfd. It has a 10:1 attenuator; vertical sensitivity of 100mv full scale; and a sweep rate of 20cy to 30ke in five steps. It is valuable for waveform analyzing and quick trouble shooting. The waveform on the 1” cathode ray tube is even sharp and clear. The device is one of the smallest complete oscilloscopes available. It has a gray enamel control panel. The Probe-scope Co., Dept. ED, 44-05 30th Ave., Long Island City, N. Y.

CIRCLE 416 ON READER-SERVICE CARD

Line-Voltage Regulator
Holds 220v ±1/2 %

This automatic line-voltage regulator maintains a 220v source of power and holds output voltage within ±1/2%. The output voltage may be set at any voltage between 210v and 240v for variations of the input line voltage between 195v and 250v. This unit is designed to handle up to 8-1/2kva loads at output currents of 22amp. Correction rate is approximately 20v/sec. It will operate from a nominal 230v 3-phase source. Inexpensive and of compact size, it is designed for wall mounting. The unit can regulate a greater variance of load than present regulators and is unaffected by unbalanced loads. Elox Corp. of Michigan, Dept. ED, 740 N. Rochester Rd., Clawson, Mich.

CIRCLE 417 ON READER-SERVICE CARD

designed for the user

MODEL 702A REGULATED POWER SUPPLY

features:
* Regulation 1/4% or better
* Ripple less than 10 mv peak to peak
* 0 to 400 v output @ 200 ma; continuously variable
* 0 to — 150 v bias output @ 3 ma
* Insulated + and — terminals permits use of high voltage with reference to ground
* Exclusive SHASTA chassis construction

brief specifications:
Output voltages: 0 to + 400 at 200 ma
0 to — 150 @ 3 ma
6.3 ac @ 8 amp
Ripple, peak to peak: 10 mv or less
Regulation: Better than 1/4%, 0 to full load
Input: 105/130 v, 50-60 cycles
Dimensions: 8” x 12” x 10”
Price (f.o.b. factory): $205.00

Write today for Technical Bulletin 702A; p. e. a.
address Dept. SE-11.

Other Shasta Quality Instruments
Expanded Scale Frequency Meters and Voltmeters • Log Scale Voltmeters • Audio Oscillators
Square Wave Generators • Power Supplies • Wide Band Amplifiers
Bridges • WWV Receivers • Decade Inductors.

Shasta division
DECKMAN INSTRUMENTS INC.
P. O. BOX 296, STATION A • RICHMOND, CALIFORNIA
TELEPHONE LANDSCAPE 6-7720

CIRCLE 418 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1955
Microwave Generator
Gives 950-10,750Mc Carrier

The Model B is a code modulated microwave generator with five independently adjustable pulse channels, equipped with four interchangeable r-f microwave oscillator heads, and providing a precision oscilloscope. It is designed to provide code modulated carrier from 950 to 10,750Mc for beacons, missiles, and radar. Each of the five pulse channels has variable pulse width and delay, and also has an external pulse time modulation input. The repetition rate is variable. The instrument is rack mounted and equipped with casters. The interchangeable microwave r-f heads are self stored in the cabinet. Polarad Electronics Corp., Dept. ED, 43-20 34th St., Long Island City 1, N. Y.

Power Rectifiers
Germanium Diffused-Junction Types

This series of germanium diffused-junction power rectifiers is now available in production quantities for general industrial use. The rectifiers, 1N91, 1N92, and 1N93, have a reverse current at least 20% lower than RETMA specifications for the type. They are particularly recommended for blocking, magnetic amplifier, and magnetic control applications. They can replace thermionic diodes in computers.

Respective rms input voltages for the 1N91, 1N92, and 1N93 under inductive load are 70v, 140v, and 210v. D-e output currents are respectively 150ma, 100ma, and 75ma, and peak inverse a-e voltages 100v, 200v, and 300v. Components Div., Federal Telephone and Radio Co., Dept. ED, 100 Kingsland Rd., Clifton, N. J.

Here's Proof...

OPPORTUNITY IS GREATEST AT RCA, FOR EXPERIENCED SCIENTISTS AND ENGINEERS!

#1—Over 500 experienced design and development engineers and scientists chose RCA careers last year...
plus additional hundreds of recent engineering graduates, field engineers and other categories of experienced engineers.

#2—Today, RCA progress opens many new, desirable positions in:
SYSTEMS ENGINEERING • ELECTRONIC DATA PROCESSING SYSTEMS
GUIDED MISSILE ELECTRONICS • AVIATION ELECTRONICS • ELECTRON TUBE DEVELOPMENT

Check positions
in your field of interest...

Modern employee benefits...
Relocation assistance
Please send resume of education and experience to:
Mr. John R. We'd,
Employment Manager,
Dept. A-246,
Radio Corporation of America,
30 Rockefeller Plaza,
New York 20, New York

RADIO CORPORATION OF AMERICA
Copyright 1955 Radio Corporation of America

CIRCLE 421 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1955
ELECTRONS, INCORPORATED
127 Sussex Avenue
Newark 3, N. J.

This doom thyatron is widely accepted for industrial use because it is not affected by ambient temperatures.

CIRCLE 422 ON READER-SERVICE CARD FOR MORE INFORMATION
So accurate and deadly is the Hughes Falcon guided missile produced in Tucson, Arizona, for the U.S. Air Force, that it has knocked maneuvering drone bombers out of the air even without an explosive warhead. Although its electronic brain can outwit any enemy bomber, it is the smallest guided missile in production.

Because of this small size and consequent extreme miniaturized packaging, new production techniques have had to be conceived. This leads to production testing of individual parts, small integrated units, self-contained components, complete integrated systems, and simulated environmental performance.

The development of equipment for producing and testing of such a missile provides a continuous challenge to engineers experienced in electronic circuit design including the following:

VTVM
With 42 Ranges

This vacuum tube voltmeter, the "777" VTVM, is a completely self-contained, ready-to-use instrument with all accessories fitting easily into its leather carrying case. Accessories include high-frequency co-axial cable, d-c probe, a-c line cord, and an instruction manual. The unit has 42 unduplicated ranges, illuminated scales, and 3% d-c and 5% a-c guaranteed permanent accuracy. Features of this vacuum tube voltmeter include:

- a double shielded 200 microamp movement,
- color-coded scales,
- 2 zero center scales for FM discriminator alignment,
- separate range and function switches, and
- unbreakable, compact metal case.

Phastrong Co., Dept. ED, 151 Pasadena Ave., South Pasadena, Calif.

CIRCLE 424 ON READER-SERVICE CARD

3" Potentiometers
Inexpensive Types, Gangable

This series of fully enclosed gangable potentiometers is priced for electronic applications that do not require the extended refinement of more expensive high precision types. The units are 3" independent phasing potentiometers with a power rating of 8w. They feature precise 360° external phasing, adjustable or fixed taps, and linear or non-linear resistance elements. Contacts are made from precious metals. Standard linearity is ±1% of total resistance. Any practical number of units may be ganged on a single shaft by one-piece stainless steel clamp rings. All turret terminals pass through the housing for direct pressure and solder connection. DeJur-Amsco Corp., Dept. ED, 45-01 Northern Blvd., Long Island City 1, N. Y.

CIRCLE 425 ON READER-SERVICE CARD

Two Companies Under One Roof Offer You a Prime Source for...

PRECIOUS LAMINATED METALS and FABRICATED PARTS

Our aim is to give you fast, efficient PERSONAL SERVICE on all orders and inquiries. Write us, we'll show you we mean business when we talk SERVICE and QUALITY.

Leach & Garner produces solid and laminated precious metals in sheet, wire and tubing. General Findings & Supply Co. fabricates precision parts from these and many other materials to your specifications.

CIRCLE 426 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1955
Cartridge Heating Unit
Compact, with Long Life

The "Firerod", a cartridge heating unit, is designed to produce five times more heat than any standard unit of similar size. In actual tests, one unit has been operated in open air for periods up to 720 continuous hours at a sheath temperature of 1800°F. By contrast, a standard unit of comparable size would last only minutes, even though it may be rated at much lower wattage. There is little difference between resistance wire and sheath temperature.

The unit has many applications. It is available in standard, moisture-proof, and special designs. It comes in sizes from 1-1/4" to 12" long and 3/8" or 1/2" diam. Intermediate lengths of this cartridge heating unit are also available on special order. Watlow Electric Mfg. Co., 1376 Ferguson Ave., St. Louis 14, Mo.

CIRCLE 427 ON READER-SERVICE CARD

Relay
Operates at 10Millisecond

Relay 100 MS incorporates a through wiping effect and has the fast operating speed of 10millisecond. Available either hermetically sealed or with dust cover, it is designed for d-e applications in contact combination from spst to dpdt.

Capacity is up to 1.5amp inductive and 3amp resistive with coil resistance to a maximum of 30,000 ohms. The bounce and chatter are eliminated by a built-in wiping action in the contact movement. Dropout, if desired, can be adjusted to about 65% of pick-up. Wattage requirement is 250mw per pole. The standard relay is equipped with octal plug in headers. Hedlin Tele-Technical Corp., Dept. ED, 87 Dorsa Ave., Livingston, N. J.

CIRCLE 428 ON READER-SERVICE CARD

encapsulated
PULSE TRANSFORMERS
wound to your requirements

SMALL IN SIZE
Weight—1/2 oz.

TYPE TE
Write for Bulletin 166 E for additional information and specifications.

SMALL IN PRICE

TECHNITROL
ENGINEERING COMPANY
2751 N. 4th St., Philadelphia 33, Pa.

CIRCLE 429 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1955
how important are these to you?

Time? No other terminals are installed as rapidly as Sealectro self-fastening, self-sealing "Press Fit" stand-offs, feed-thrus, connectors. And understandably so, because "Press-Fit" technic reflects years of specialized engineering in closest collaboration with designers and assemblers who want the best.


and No Headaches? None. "Press-Fit" terminals are shatter-proof, heat-resistant, vibration-proof. Immune to humidity, wide temperature range, fungus, etc.

FREE MANUAL! Tells all you want to know about "Press-Fit" terminals. Also lists the most extensive selection of types and sizes. Copy on request.

**PRESS-FIT**

*TEFLON* TERMINALS

by

Sealectro CORPORATION

186 UNION AVENUE • NEW ROCHELLE N Y

CIRCLE 430 ON READER-SERVICE CARD FOR MORE INFORMATION
The "Magic Mirror" Aluminized Picture Tube creates the brightest, most realistic TV picture ever seen in the American home. The "Magic Mirror" Tube effectively utilizes all the light generated by the phosphor screen.

Tung-Sol has developed a unique method of backing the phosphor screen with a mirror-like aluminum reflector. Light is prevented from radiating uselessly back into the Tube. All of the intense detail of which the receiver is capable is brought out by the full light.

Tung-Sol's exacting standards of quality control, manufacture and testing further guarantee the high uniformity and maximum performance of the "Magic-Mirror" TV Picture Tube.

Let the superior qualities of "Magic-Mirror" Picture Tubes add selling advantages to your set.

TUNG-SOL ELECTRIC INC., Newark 4, N. J.

Sales Offices: Atlanta, Chicago, Columbus, Culver City (Los Angeles), Dallas, Denver, Detroit, Montreal (Canada), Newark, Seattle.
New Literature

Precision Indicators 432

Plug-In Power Supplies 433
This data sheet describes a subminiature plug-in power supply for use with small instruments, preamplifiers, etc. Operating requirements and characteristics are provided. C. J. Applegate & Co., 1816 Grove St., Boulder, Colo.

Laboratory Heater 434
Bulletin No. 627 describes this firm's Type RH Heater, a laboratory heater with a built-in rheostat. The bulletin discusses features of the heater, including range, construction, and temperature reproducibility. Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

Pressure Gage 435
A 4-page illustrated bulletin gives specifications on pressure, vacuum, compound, and test gages. Dimensional drawings and mounting instructions are provided and specifications and standard ranges are tabulated. Instrument and Systems Div., Norden-Ketay Corp., Wiley St., Milford, Conn.

The "Airbrasive" Unit

A highly concentrated stream of tiny, sharp-edged abrasive particles—traveling at very high speeds—does the work. There's no shock, vibration, heat or pressure. These features make the Unit ideal for cutting, shaping or drilling small parts made of fragile or brittle materials and for controlled removal of deposited surface coatings.

Details in "Airbrasive" Bulletin 5411. Write Dept. 10.

THE S.ilwhite INDUSTRIAL DIVISION
DENTAL MFG. CO. 10 East 40th Street New York 16, N.Y.
Conductivity Equipment 437

Equipment for measuring and controlling solution conductivity is listed in a new catalog. The Catalog No. 22 lists a wide range of standard instruments and conductivity cells including the most recent developments in both bridges and cells. Industrial Instruments, Inc., Cedar Grove, N. J.

Plastics 438


Name Plates 439

Modern identification methods and materials are described in an 8-page brochure. All materials discussed are pressure-sensitive self-adhesive. They include roll form tapes of paper, cellophane, acetate, and cloth, sheet and roll form die-cut pickoffs, and metal name plates. Topflight Corp., York, Pa.

Laboratory Facilities 440

A description of the facilities of this firm for certified qualification testing of electrical components is given in a 4-page brochure. Laboratory facilities are available for environmental qualification and reliability testing. Rototest Laboratories, 2803 Los Flores Blvd., Lynwood, Calif.

Gyro Compass 441

A 30 lb, subminiature gyro compass is described in this 24-page brochure. Applications, features, performance characteristics, and performance test results are given. Cutaway drawings illustrate construction of the instrument. Arma Div., American Bosch Arma Corp., Garden City, L. I., N. Y.

Equipment Catalog 442

The 324-page 1956 catalog of this firm lists over 26,000 items of radio and electronic parts and equipment. Special emphasis has been placed on equipment for industrial maintenance, research, and production requirements. Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.

**CHATHAM ELECTRONICS ULTRA-STABLE REGULATED POWER SUPPLIES**

For these laboratories requiring the utmost in stability and regulation from D.C. power supplies, Chatham Electronics offers a group of ultra-stable regulated power supplies. The use of a driftless regulating circuit and mercury cell batteries as a voltage reference provides the extreme stability attained. These units can be supplied to meet your power requirements. Some typical supplies are listed below:

<table>
<thead>
<tr>
<th>D.C. VOLTAGE RANGE</th>
<th>CURRENT MILLIAMPERES</th>
<th>HUM MV</th>
<th>LINE REGULATION 110-120 VOLTS A.C.</th>
<th>LONG-TIME STABILITY*</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 to 1500</td>
<td>100</td>
<td>10</td>
<td>.002%</td>
<td>10</td>
</tr>
<tr>
<td>0 to 400</td>
<td>20</td>
<td>0.5</td>
<td>.005%</td>
<td>10</td>
</tr>
<tr>
<td>1500 to 3100</td>
<td>500</td>
<td>0.5</td>
<td>.002%</td>
<td>5</td>
</tr>
<tr>
<td>290 to 310</td>
<td>300</td>
<td>3</td>
<td>.002%</td>
<td>10</td>
</tr>
<tr>
<td>6.3 to 7.3</td>
<td>3 amps</td>
<td>3</td>
<td>.03%</td>
<td>1</td>
</tr>
</tbody>
</table>

STANDARD REGULATED POWER SUPPLIES

These units are ruggedly built and designed to give long time, trouble free operation. Either positive or negative output may be grounded. All voltages and load currents are metered. Model E-50A (at left) also has a 6.3 volt 10 ampere output available. (Non-Regulated.)

<table>
<thead>
<tr>
<th>MODEL</th>
<th>VOLTAGE RANGE</th>
<th>CURRENT MA</th>
<th>HUM LINE VOLT. REG. 150-250 V.</th>
</tr>
</thead>
<tbody>
<tr>
<td>EA-50A</td>
<td>0-500 Volts</td>
<td>0-300 MA</td>
<td>2 MV</td>
</tr>
<tr>
<td></td>
<td>E-44</td>
<td>140 to 1500</td>
<td>0-125 MA Less than 20 MV 0.5%</td>
</tr>
</tbody>
</table>

CIRCLE 443 ON READER-SERVICE CARD FOR MORE INFORMATION
A CHOPPER FOR EVERY APPLICATION AT MODERATE COST

write for engineering specifications and catalog

JAMES VIBRPOWER COMPANY
4038 N. Rockwell St. Chicago 18, Ill.
CIRCLE 444 ON READER-SERVICE CARD FOR MORE INFORMATION
Bobbin Winder

A data sheet describes a compact front loading multiple head adjustable length bobbin winder. Technical data includes dimensions, weights, types of windings, coil OD and length, maximum distance between winding centers, wire sizes, tension equipment, built-in adjustable cam, gears, slow-start and winding speed, motor equipment, etc. Geo. Stevens Mfr. Co., Inc., Pulaski Rd. at Peterson, Chicago, Ill.

Wire-Wound Resistors

This 8-page brochure describes various types of wire-wound resistors. It also includes an alloy characteristics chart listing symbols, alloys, trade names, nominal temperature coefficients, thermal electromotive force on copper, and a guide to proper selection. The bulletin covers fixed, adjustable, tapped multi-section, pigtail terminal, and ferrule terminal vitreous enamel, as well as wire-wound precision resistors. Precision, Inc., 730 Lyndale Ave., North, Minneapolis, Minn.

Production Facilities

A new 24-page booklet describes facilities and typical products made by this company. Typical products are illustrated with line drawings and photographs showing assemblies and subassemblies; aircraft industry equipment; recording and audio equipment; electronic test equipment; interphone and control equipment; electronic industry equipment; and special products and facilities. Telestro Industries Corp., 35-16 37th St., Long Island City 1, N. Y.

Silicones

A 4-page catalog describes the principal silicones sold by this company. Listed are the various silicones in liquid and solid forms, in the categories of water repellents; oils and oil emulsions; electrical insulating resins; silicone rubber gum stock and compounds; and silicones which make excellent anti-spatter, anti-foaming materials. Linde Air Products Co., Div. of Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N. Y.

Oscilloscope

The Model 411 Easy-Six, a wide-band, adaptable, precision oscilloscope, is described in a 4-page brochure. The brochure describes method of operation and the six plug-in packages which make it possible to use the oscilloscope as a delayed or undelayed model, a gated marker generator, a TV test instrument, a video switch, and a low sweep generator. Laboratory for Electronics, Inc., 75 Pitts St., Boston 14, Mass.
Receiving-Type Tubes

This 20-page booklet (Form No. RIT-104) contains technical data on 130 small industrial tubes including Special Red tubes, premium-tubes, pencil-type tubes, computer tubes, glow-discharge tubes, small thyratrons, low-microphonic amplifier tubes, and other special types. In addition, a chart lists types for government use only. Each tube type is covered by a text description, tabular data, and a base or envelope connection diagram. Representative tube types are illustrated. $0.20, Commercial Engineering, Tube Div., Radio Corp. of America, Harrison, N. J.

Saturable Reactors

An 8-page publication describes applications, models, and ratings of saturable reactors. Designated GEA-6354, the illustrated bulletin describes the theory and application of saturable reactors as control equipment for individual power loads. General applications discussed are control of electrically heated equipment, automatic temperature stabilization, reduced-voltage motor starting, continuously adjustable reactive load banks, and control of X-ray equipment. The publication also contains wiring diagrams, ratings, model numbers, dimensions, and list prices. General Electric Co., Schenectady, N. Y.

Vacuum Tube Voltmeters

An 8-page brochure describes the outstanding features of this firm's extended-range vacuum tube voltmeters. The brochure explains their range and use. The company also has issued another laboratory report, "Basic Theory of the Type 300A Vacuum Tube Voltmeter" which discusses the design considerations, giving basic circuits and development logic. Technology Instrument Corp., 531 Main St., Acton Mass.

Proportional Controllers

Bulletin No. 4-11 describes this company's line of electric proportional controllers for control of dew point, pressure, temperature, etc., in batch process, combustion atmosphere, and heat treating furnace applications. Separate sections are devoted to the electric-operated control unit, the electronic relay, and the valve operator. Foxboro Co., Foxboro, Mass.

Planetary Cabler

A planetary cabler which fabricates intricate cables from strands of conductors, coaxial circuits, and power leads into one cable length is described in a new brochure. The cabler has direct application to the guided missile, computer, and atomic energy fields. Cable Div., Douglas Roesch, Inc., 2200 S. Figueria St., Los Angeles 7, Calif.
for an entirely new range of time delays

Delay Intervals:
\[
\frac{1}{10} \text{ to } 5 \text{ seconds}
\]

Recovery Rate: extremely rapid

specify sturdy, dependable, application-tested

**G-V** Hot Wire Time Delay Relays

Designed for delay intervals which are longer than those produced by magnetic relays and shorter than can be produced by the usual types of thermal relays, these G-V Hot Wire Time Delay Relays make possible many simplified, lightened and improved designs.

**How They Operate:** G-V Series H Time Delay Relays employ a group of nickel-chromium alloy wires, 8 to 20 strands electrically in series and mechanically in parallel, as the actuating element. A mechanism holds these wires under tension and when the energizing current passes through these wires, heating them and causing elongation, the mechanism multiplies this and moves the contacts into or out of engagement.

Over two years of successful field service in electronic, aeronautical and industrial equipment prove these new G-V relays to be dependable, efficient and accurate.

**ADJUSTABLE DELAY** even though hermetically sealed
DC or AC of any frequency for energization
SMALL AND LIGHT. 3/4” diameter, 2 3/8” length. Weight: 1 oz.
WIDE AMBIENT RANGE compensated from -70 °C to 100 °C or higher
CONTINUOUS ENERGIZATION without damage
AVAILABLE in 7-pin Plug-in and Flanged designs

**G-V CONTROLS INC.**
18 Hollywood Plaza, East Orange, New Jersey

CIRCLE 461 ON READER-SERVICE CARD FOR MORE INFORMATION
Literature Index


Cleaning Machines

A new bulletin describes one of this firm’s table-type airless blast cleaning machines. This machine is intended for cleaning work which does not have too many pockets or vertical edges, such as castings, forging, heat treated parts, weldments, or stampings. Installation views, engineering drawings, and mechanical and electrical specifications are given. A complete discussion of the airless abrasive blast cleaning process is also included. Wheelabrator Corp., 1750 S. Byrkit St., Mishawaka, Ind.

Water Still

Bulletin No. 912 describes this firm’s midget water still, a laboratory still especially designed for small volume but high purity requirements. Operating economy, space economy, and convenience of operation and maintenance are discussed. Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

Resistors

Comprehensive data on Types PW-7, PW-10, and PW-4 resistors is given in two technical data sheets. Information on applications, design and construction, characteristics, ranges, power ratings, tolerance, stamping, derating is shown in charts and graphs. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

Packaging for Glassware

A 4-page, 2-color bulletin describes a new packaging program for laboratory glassware, Air-pak. This program provides bursting pressure protection amounting to about 525psi. Doerr Glass Co., Vineland, N. J.

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58 Mountain Grove St., Bridgeport, Conn.

CIRCLE 467 ON READER-SERVICE CARD FOR MORE INFORMATION
Machine Tool Control System 468

A brochure describes the application of a punched tape control system to a turret lathe for an automatic control system. Operating principles of the system are given (see also, Binotrol in Abstracts) and preparation of the punched tape, application of binary number coding to the lathe’s functions and advantages are discussed. Barnes Engineering Co., 30 Commerce Rd., Stamford, Conn.

Metallurgy Chart 469

A revised edition of this firm’s Basic Guide to Ferrous Metallurgy is available. The principal characteristics of steels are represented across the temperature range to 2900°F. The important working zones, including preheating for welding, stress relieving, normalizing, annealing, and forging are shown. At the right of the chart 24 common metallurgical terms are defined and explained. A diagram symbolizing the change in grain size with temperature is included. Tempil Corp., 132 W. 22nd St., New York 11, N. Y.

Grease 470

Bulletin No. 101, a 2-page, 2-color bulletin, describes Molykote, Type BR2, a general purpose grease with extreme bearing pressure properties. Molykote is a lithium base grease and its properties are listed. Physical specifications and test results are given. Alpha Molykote Corp., 65 Harvard Ave., Stamford, Conn.

Counting Devices 471

Automatic predetermining impulse counters are described in these data sheets. Specifications, features, and method of operation are discussed. Presin Co., 802 N. Fairfax Ave., Los Angeles 46, Calif.

Magnetic Clutches 472

Electromagnetic clutch Model C-130 is described in a 4-page bulletin. Dimensional drawings and cutaway views illustrate the clutch and graphs show torque-voltage characteristics. Dial Products Co., 7 Bergen Court, Bayonne, N. J.

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West Coast Representatives TUBERGEN ASSOCIATES 2232 W. 11th St., Los Angeles 6, Calif.

CIRCLE 473 ON READER-SERVICE CARD FOR MORE INFORMATION
PANELOC announces
a new rotary latch

This new Paneloc Rotary Latch is a simple and economical, strong and durable fastener for access panels, electrical control panels, inspection doors, machinery doors, and other hinged or removable covers. It permits a larger access opening, operates quickly with a quarter-turn. Entire assembly on access panel itself, eliminating many installation steps; no special tools required. Only four simple parts; made of steel, cadmium plated. Three standard sizes now available, more to be added. Special sizes and finishes available on order. Cost very low, performance unsurpassed. Write for a catalog and price list for your file.

PANELOC...America's most versatile line of aircraft fasteners... Rotary Latches, Styles 1, 2, and 3 Panel Fasteners, High Performance Fasteners, Snap Fasteners.

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66 Pavilion Avenue, Providence 5, Rhode Island
New York: 10 East 43rd Street, New York 17, N. Y.
Production Facilities

Practically the whole current technology of precision mechanism manufacture is pictorially reviewed in this publication. Entitled "Production Processing and Service Facilities", the 32-page publication reviews the results of developments in tools, materials, and processes for precision manufacturing. Sections present productive capabilities in plate processing, mass production of small precision parts, tool and die production, metals processing, and assembly and development. Allied Products Div., Hamilton Watch Co., Lancaster, Pa.

Electronic Sorter

This firm's electronic sorter which sorts 48,000 alphabetic, numeric, black and special code punched-cards per hour is described in a 6-page illustrated folder. Double capacity feeding magazines and card receivers permit efficient output and photo-electric sensing permits sorting of 800 cards per minute. Remington Rand Div., Sperry Rand Corp., 315 Fourth Ave., New York 10, N. Y.

Plastic Welding

A 4-page external house organ illustrates and describes various aspects of plastic welding and fabrication. Known as the "Plastics Weldor and Fabricator", it is published six times a year. The current issue covers such topics as a discussion of the new low pressure polymerized ethylenes; tips on hot gas welding of thermoplastics; and the use of polyethylene and polyvinyl chloride in the manufacture of acid tanks. American Agile Corp., P. O. Box 168, Bedford, Ohio.

Tungsten Coils and Strand

Basic factors in producing effective tungsten coils and strand are presented in this brochure. Temperature nomographs on wire diameter—resistance and wire diameter—current are given. A graph shows the effect of variations from normal weight of aluminum on expected coil life and useful information is tabulated for the high vacuum evaporation of metals. Tungsten and Chemical Div., Sylvania Electric Products, Inc., Towanda, Pa.

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LOS ANGELES 61, CALIFORNIA • Pleasant 5-1138

CIRCLE 480 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic Design • November 1955
Electronic Relay 481

Publication No. 585 describes this company's electronic relay. The relay is capable of complete follow-through action, responding to controls from a highly sensitive wire contact, no "arc" operation, and direct control of the load operating solenoid. The literature provides design and application information, circuit description, and complete dimensional and pricing data. Automatic Switch Co., 391 Lakeside Ave., Orange, N. J.

Sine and Pip Generator 483

Data Sheet No. GPM-3 describes a small rotating shaft generator suited for continuous-indicating duty in radar instrumentation and similar applications. Included in the leaflet are an illustration of the unit, a dimensioned outline drawing, a list of mechanical and electrical specifications, and performance curves relating output voltage in volts to load resistance in ohms for 20cy (1200rpm) and 35cy (2100rpm) operation. Dalmotor Co., 1326 Clay St., Santa Clara, Calif.

Resistor Guide 484

Comprehensive data on this firm's complete line of resistors and special products is listed in the revised 1955-56 Official Resistor Engineering Guide. Data given includes JAN or MIL equivalent, rated wattage, standard tolerances, temperature rise, temperature coefficient, maximum operating temperature, ohmic values available, dimensions, and approximate prices. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.
Most CHICAGO-STANCOR transformers are available in at least three different mountings and terminal types...some in as many as six! You can get the one that is best for your job...and get it fast, from stock, through your CHICAGO-STANCOR distributor.

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CIRCLE 486 ON READER-SERVICE CARD FOR MORE INFORMATION
printed circuit connectors available for 1/16", 3/32" and 1/8" board

NEW... "BELLOWS TYPE" CONTACTS
Provides longer contact life and smoother engagement. Wider printed circuit card thickness tolerances are now possible with Continental Connectors utilizing "bellows type" contacts. ON A STANDARD 1/4" COPPER CLAD LAMINATED PRINTED CIRCUIT CARD THE "BELLOWS TYPE" CONTACT ALLOWS FOR AS MUCH AS .054" TO .071" VARIATION IN BOARD THICKNESS.

SOLDER LUG CONTACTS
Single or double row contact construction (6, 10, 15, 18, 22 or 28 contacts). Up to 56 connections are possible with two rows of 28 contacts each. Polarizing stud can be placed at any contact point on the connector. Rating: 10 amps. Contacts take #16 AWG wire.

SOLDERLESS WIRE WRAP CONTACTS
No soldering required. (Name and number of tool for "wire wrap" available on request.) 44 contacts (two rows of 22) accommodate three #24 AWG wires each. Receptacle accommodates .093 board.

TAPER PIN CONTACTS
Accommodates "AMP 53" taper pins. No soldering necessary. Stainless steel brackets support printed circuit assembly. Illustrated (center) is a dip solder-type plug which can be mounted at 90° to printed circuit card - a Continental Connector special design which mates with receptacle at left.

Technical data on these connectors, and special designs requiring the use of subminiature, hermetic seal, pressurized, high voltage or power connectors, are available on request. Write today for complete catalog.

Electronic Sales Division
DeJUR-Amsco Corporation,
45-01 Northern Boulevard, Long Island City 1, N. Y.

CIRCLE 487 ON READER-SERVICE CARD FOR MORE INFORMATION
Grid Structure for Cathode-Ray Tubes


Another variation of the grid structure of the Lawrence color tube has now been patented. Like previously patented grids, it is mounted a short distance from the phosphor screen. This grid has two functions: first to focus the electron beam to a relatively small dimension at the screen to prevent the beam from spreading over more than one color area on the screen and, secondly, to direct the beam to the desired color band or strip of phosphor.

A continuous wire strung from arm to arm is illustrated. However, the pairs of arms may carry a single strand. These wires are about 2/1000" diam and are spaced apart in conformity with the width of a set of strips of three color phosphors on the tube screen. Where a continuous wire is used, the overlapping wires do not touch but are spaced apart sufficiently so...
that they do not contact at the point of crossover. There are, therefore, two sets of grid wires with the wires of one set alternating with the wires of the other set.

The grid wires are connected with a source of potential in the neighborhood of 4000v, one set of wires being connected with conductor 17 and the other set being connected with 19 (at right). The grid will focus the electron beam to a relatively small dimension so that it is slightly narrower than the color strips of the screen. By changing the potential upon one set of grid wires, the beam will be deflected. With the same potential upon the two sets of grid wires, the beam will not be deflected and will engage the center strip of the three color phosphors. If the wires of one set are made slightly positive with respect to the other, the beam is deflected to impinge upon one of the adjacent strips of phosphors. In this way, the beam is directed towards the desired color strip to produce a color picture.
Pictured here are two typical examples of why the name Phaostron is so rapidly gaining enthusiastic acceptance wherever and whenever truly fine Panel Meters are admired, required and specified. They are the latest additions to the Phaostron line of "Custom" Panel Instruments which include 2½", 3½" and 6" sizes. Built to the exacting standards of excellence that identify every Phaostron product.

**BUILT TO HIGHEST QUALITY... SOLD UNBELIEVABLY LOW**

Metal Case... won't chip, shatter or warp.
Large Clear Scales... Increments and numerals can be read at a distance of 10 feet.
Permanent Accuracy... Plastic cased meters often vary up to 35%... these metal cased meters... never.
Anti Magnetic... shielded by their metal case from stray magnetic fields.
Insulated Zero Adjustments... large, easy-to-use... safer.

Two Models:
"Custom" Chrome: Die cast bezel is finished in gleaming polished chrome and black.
"Custom": This instrument is identical, but is finished in solid color.
Both are available with self-contained 5,000 hour lamps where illuminated scales are desirable.

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OUR LABORATORY IS PREPARED TO ASSIST YOU IN THE SELECTION OF THE PROPER MULTIFORM FOR YOUR SPECIFIC PURPOSES. NO OBLIGATION FOR THIS SERVICE.

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Write to Dept. ED for complete information about Steatite, Glass Multiforms and our production facilities.

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CIRCLE 491 ON READER-SERVICE CARD FOR MORE INFORMATION

The illustrated TV receiver circuit provides a saw-tooth current of large amplitude using a relatively low-voltage-B supply. Such a saw-tooth current is needed for a wide deflection angle and resulting shorter TV picture tube.

A source of saw-tooth voltage (24) provides in its output, a signal of form 25 having a negative impulse component. This saw-tooth wave form is presented to the grid of a cathode follower tube (28) so that essentially the same form of signal (62) appears at the cathode of this tube. Signal 62 is applied to the control grid of a deflection drive tube (33), the output signal of which is peaked. This signal also has a negative voltage peak (65) that is substantially absorbed in a damper tube (46). The plate circuit of deflection drive tube 33 is the primary winding of a transformer (43) so that the signal, which is applied to the deflecting coil (44) of the tube, is a saw-tooth wave form.

Damper tube 46 also is connected with the secondary winding (45) of the transformer and the negative peaked signal (66) appearing in the circuit causes the damper tube to draw current and charge the capacitor (37) in the cathode circuit of drive tube 33. This arrangement provides a negative bias for the cathode of this tube. With a B power supply (29) of 250v and with an additional -125v provided by the grid current through the grid leak resistor (35), an effective voltage of 375v is produced between the grid and plate. A negative bias of about 100v at the cathode added to the 250v B supply results in approximately 350v between the cathode and anode of the drive tube. The grid is then biased by 25v with respect to the cathode.

With the circuit of the patent, a substantial reduction in the cost of the B power supply is achieved. Also by the design of a circuit having a damper tube the cathode of which is operated at ground potential, dispenses with a separate cathode current source and achieves a further reduction in cost.

A. R. C. CERAMIC INSULATED CONNECTORS

Minimize Leakage, Save Space

We developed this ceramic-insulated connector to obtain performance features we needed in our airborne communications and test equipment. Doubly silicone coated, it is virtually impervious to extremes of moisture, and mechanically stable under heat. Eight contact points per pin make for low contact resistance. Being of small overall dimensions, these connectors are space savers. 2, 3, 4, 6, 8, 12 and 19 contact connectors each are available in three-key keyway combinations to prevent incorrect insertion. Design them into your equipment for extra dependability. Write for details.

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ELECTRONIC DESIGN • November 1955
Marconi's new Universal Bridge is designed for peak performance and ease of operation. Dual Oscillator Frequencies of 1kc and 10kc provide sharper balance at low values of inductance and capacity.

- 21 Ranges: 1 Hz to 100 Hz, 1 mV to 100 mV, 0.1 Ω to 10M Ω
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ELECTRONIC DESIGN • November 1955
NEW FERRITE ISOLATOR...a useful device with many applications, such as oscillator isolation. This light-weight unit (less than 2 lbs.) improves system performance by reducing long-line loading. It also prevents undesired frequency shift, insures uniform power output with improved transmitted pulse spectrum.

FERRITE Resonance Absorption Transverse Field Isolator for use where high power handling capacity is required. Over a 10% band width this unit has...greater than 9 db isolation, less than 0.4 db insertion loss and VSWR less than 1.03.

STANDARD microwave equipment for laboratory or production includes attenuators, directional couplers, crystal mixers, wave meters and other components. Units are available for S, C, X, X and K. Microwave Bands in aluminum or brass.

CUSTOM-DESIGNED Microwave equipment is a Kearfott specialty. Skillful engineering, wide experience, with complete laboratory testing facilities can be brought to bear on your problem. Kearfott can supply special components such as rotary joints, R.F. sources and matched assemblies.

Write today for complete technical bulletins.
This voltage regulator was designed to supplant filament type components and thus eliminate the hazards of voltage build-up resulting in the case of failure in these early types of voltage regulating components.

Under unusual conditions, should the Victoreen voltage regulator be damaged, the result would cause a lower than normal voltage in the circuit, thus preventing damage to other components. In addition to the “fail safe” feature, the use of Victoreen voltage regulators, eliminates the use of related voltage regulating components, provides close tolerance limits, better performance and long, trouble free, service life.

Write for bulletin 3023 for full details.

VICTOREEN BUILDS VOLTAGE REGULATORS FROM 50 TO 50,000 VOLTS
This is a Birtcher KOOL KLAMP. It does two jobs. Being made of 99.2% pure heat treated silver, it reduces bulb temperature. It also serves to hold miniature and subminiature tubes secure against shock and vibration. If you have a problem of heat and/or retention write today for a catalog and complete details to The Birtcher Corporation, Industrial Division, 4371 Valley Blvd., Los Angeles 32, California.

A ball is the contact element in the rheostat described in this patent. The ball has a wiping action that keeps the contact surfaces free of foreign material.

A non-inductive ribbon such as of sinuous form, serves as the resistance element, but it does not encircle an insulating core or carrier. Two such resistance ribbons (1 and 2) are used, arranged parallel to each other and separated from each other by an insulating strip or strips (5 and 6). Insulating strips (10 and 11) engage the outer sides of the resistance elements. These parts are clamped together in a casing (8). A series of horizontal conductors (3) are connected at spaced intervals to one resistance element 11, such as at the folds. A series of vertically disposed conductors (4) are similarly connected with the other resistance element 10.

The resistance elements are bridged by a ball (18) of conductive material which is mounted in a suitable rider arm (22) of insulating material. The rider arm is received in a slot (13) so that the ball is held by the rider against the conductors of both resistance elements, and guided in its movement by the slot. By shifting the position of the rider and its conducting ball, the latter is moved to other points of contact with the conductors 3 and 4.

The rheostat may be constructed in cylindrical and pancake form which is shown in other views of the patent. One of the advantages in the rheostat is that heat generated in the resistance elements is readily conveyed to the metal case and dissipated rapidly thereby so that a cool rheostat is secured.

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ELECTRONIC DESIGN • November 1955
MINIATURE CONNECTORS

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WINCHESTER ELECTRONICS' DESIGN FEATURES:

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- Wiping Action Contacts
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- MONOBLOC Construction
- Precision Machined Contacts
- Gold Plated OVER Silver

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CIRCLE 498 ON READER-SERVICE CARD FOR MORE INFORMATION

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Now experiment with VECO Thermistors and Variators, the most versatile circuit elements ever developed. Extremely sensitive to voltage or temperature changes, these miniature semi-conductor elements are designed for use in temperature and measurement control, circuit protection, voltage regulation, switching, surge suppression and countless other functions.

VECO Kit 168 contains one varistor and two each thermistor washers, discs and beads... a $15.00 value for only $5.00 postpaid. Advanced VECO kit 168A, with two each varistor and thermistor washers, discs and beads, probe and rod plus mounting hardware... $27.50 value for $10. Suggested circuitry and technical data supplied with each kit. Order yours today!

VICTORY ENGINEERING CORPORATION

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CIRCLE 499 ON READER-SERVICE CARD FOR MORE INFORMATION
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4.Permits greater use of poor castable materials such as magnetic iron, pure copper, invar and radar plumbing materials such as aluminum 25S and 61S which are used for their better weldability.
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In EPCO’s new Vacuum Casting process may lie opportunities for further improving parts now cast, and equally important for casting parts and assemblies never before considered possible.

Investigate the savings in production costs and improvement in quality and design by getting an EPCO quotation before machining or assembling your intricate parts.

Specify EPCO for your assurance of better quality.

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CIRCLE 500 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic design engineers in the past did not have as many material selection problems as the other classifications of engineers. Chassis were always made of aluminum and cabinets of wood, and that was that. As electronic devices are increasingly used in unusual environments, frequently requiring hermetic sealing, complicated by the growing shortage of certain vital materials, the electronic engineer is faced more often with the need for making a choice between two different materials. This handbook with over 1000 pages is part of the well-known Wiley Engineering Handbooks series and resembles the others in physical appearance.


Electronic design engineers developing computers and control instrumentation for automatic factor operations are only expected to be concerned professionally with their design problems. However, it is obvi
ous that new technology of electronic control has important management and social implications. This slim volume discusses some of these implications. It is the work of seven men, all students in the manufacturing course at Harvard Graduate School of Business Administration.

Among the subjects covered are mechanization vs. the automatic factory, obstacles to the automatic factory, the status quo in automation, and social implications of the automatic factory. There are four appendices dealing with project "Tinkertoy" general terms, control terms, and machinery terms. Bibliographies are included.

Theory of Groups of Finite Order . . .

This is a reprint of the second edition of well-known text on groups first published in 1897 and long since out of print. It is published as part of a program of reprinting out-of-print classic texts in the various sciences. The first half of the book explains the notion of substitutions, the latter chapters deal with group properties, substitution groups, the isomorphism of a group within itself, graphical methods of representation, the theory of groups of linear substitutions and their variance. Sample problems are given with each of the twenty chapters. The author was formerly Professor of Mathematics at the Royal Naval College, Greenwich, England.


A good review of the current status of computer technology can be obtained by reading from this slim volume. Among the papers presented at the last Eastern Joint Computer Conference and published here are: "Characteristics of Currently Available Small Digital Computers", "Techniques for Increasing Storage Density of Magnetic-Drum Systems", "Redundancy Checking for Small Digital Computers; Panel Discussion", "Automation of Information Retrieval, Discussion", and "Applications of Automatic Coding to Small Calculators".

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Accuracy in marking is impossible unless the blank parts are equally accurate. This company has the facilities for very accurate fabrication for all types of parts and for the manufacture of complete dial and indicator assemblies. This accuracy is obtainable in USRC-furnished components.

Inquiries invited — address Dept. ED-11

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Sales Offices at: 535 Pearl Street, New York 7, N. Y. 5420 Vineyard Ave., N. Hollywood, Calif. 36 Chemin Krieg, Geneva, Switzerland
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Offer These Important Advantages:

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  - Self-contained unit designed to meet the precise needs of every Servoflex Amplifier.

- **NO D.C. POWER NEEDED**
  - Only A.C. power is required.

- **LIGHTWEIGHT**
  - Only A.C. power is required.

- **HIGH STABILITY**
  - Servoflex Amplifiers are unaffected by the usual variations in the power frequency.

- **INSTANTANEOUS RESPONSE**
  - The time lag is negligible compared to one cycle of power frequency.

- **INSTANTANEOUS RESPONSE**
  - Time lag is negligible compared to one cycle of power frequency.

- **BUILT-IN PREAMPLIFIER**
  - Integral part of Servoflex Amplifiers, the preamplifier provides peak performance.

- **EASY MAINTENANCE**
  - All tubes are standard (Mil-approved) sourced by your local source of supply.

**MODEL 1123** LOW GAIN
- Built to MIL E 5400 specifications.
- Plug-in unit, with two vacuum tube gain stages followed by unique reluctance amplifier circuit. Internal negative-feedback loop provides error rate damping in stabilizing position servosystems. 7 3/4" x 2 3/4" x 5 1/4"; 2 lbs., 15 ozs.

**MODEL 1124** HIGH GAIN
- Built to MIL E 5400 specifications.
- Plug-in unit, with four vacuum tube amplifier gain stages followed by unique reluctance amplifier circuit. Three legged transformer acts as combined power supply and output transformer. 7 3/4" x 2 3/4" x 5 1/4"; 3 lbs., 4 ozs.

**MODEL 1120**
- Designed for industrial control systems with three amplifier stages, phase inverter and push-pull output stage. It will drive any 10 watt, two phase servo motor. Operates either as a position servo or as a velocity servo. 12" x 7 3/4" x 10"; 18 lb., 3 oz.

**MODEL 1121**
- Weighs only 3 lbs., 8 oz., yet has power output of 18 watts! Operating directly from power line, total power consumption is low for small input signals. Three legged transformer acts as combined power supply and output transformer. Measures 3 1/2" x 3 1/2" x 3 1/2"; 3 lbs., 2 ozs.
Abstracts

Pertinent condensations from foreign journals, house organs, reports, and periodicals of related technologies that frequently miss the attention of electronic designers.

Unbalanced Bridge Characteristics

Unbalanced Bridge Characteristics

Emphasis on the use of the Wheatstone bridge as a null-measuring device has made us almost forget the variation of the current flowing in the bridge meter—except perhaps as an exercise in courses on network theory. We do not make full use of the bridge as an open-loop design component. It was therefore interesting, as we scanned material for our Russian translations program to find a most useful compilation of design data on Wheatstone bridges in a Russian book on meteorological instruments (by V. N. Kedrilovskiy and M. S. Sternzat, Hydrometeorological Publishing House, Leningrad, 1953). The editors of ELECTRONIC DESIGN feel this compilation will prove stimulating and valuable to circuit designers, particularly since it suggests a novel method for generating certain functions.

<table>
<thead>
<tr>
<th>Diagram</th>
<th>Current in Meter Circuit $I_y$</th>
<th>Sensitivity at Null Point $S_0$</th>
<th>Relative Sensitivity in Arbitrary Units</th>
<th>Most Suitable Value of Meter Resistance $R_y$</th>
<th>Degree of Scale Non-linearity $D = \frac{1^o - I_y}{I_y}$</th>
<th>Character of Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_1 - R_2$</td>
<td>$I_y = \frac{U_0}{R_1} \frac{1}{4(1+n) + e(3+2n)}$</td>
<td>$S_0 = \frac{U_0}{R_1} \frac{1}{4R_1(1+n)}$</td>
<td>1</td>
<td>$R_y = \frac{1+n}{2} R_1$</td>
<td>$D = \frac{3 + 2n}{4(1+n)}$</td>
<td>$-\frac{1}{2} I_y$</td>
</tr>
<tr>
<td>$R_1 - R_2$</td>
<td>$I_y = \frac{U_0}{R_1} \frac{1}{6(1+m) + e(4+m)}$</td>
<td>$S_0 = \frac{U_0}{R_1} \frac{1}{4R_1(1+m)}$</td>
<td>1</td>
<td>$(m = n)$</td>
<td>$R_y = \frac{2m}{1+m} R_1$</td>
<td>$D = \frac{4 + m}{4(1+m)}$</td>
</tr>
<tr>
<td>$R_1 - R_2$</td>
<td>$I_y = \frac{U_0}{R_1} \frac{1}{2(1+n) - e^2}$</td>
<td>$S_0 = \frac{U_0}{R_1} \frac{1}{2R_1(1+n)}$</td>
<td>2</td>
<td>$(m = n)$</td>
<td>$R_y = \frac{2m}{1+m} R_1$</td>
<td>$D = \frac{2 + m}{2(1+m)} e^2$</td>
</tr>
<tr>
<td>$R_1 - R_2$</td>
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<td>$S_0 = \frac{U_0}{R_1} \frac{1}{2R_1(1+m)}$</td>
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</tr>
<tr>
<td>$R_1 - R_2$</td>
<td>$I_y = \frac{U_0}{R_1} \frac{1}{(1+m) - e^2}$</td>
<td>$S_0 = \frac{U_0}{R_1} \frac{1}{R_1(1+m)}$</td>
<td>4</td>
<td>$(m = n)$</td>
<td>$R_y = \frac{1+n}{2} R_1$</td>
<td>$D = \frac{1-m}{1+m} e^2$</td>
</tr>
<tr>
<td>$R_1 - R_2$</td>
<td>$I_y = \frac{U_0}{R_1} \frac{1}{(1+m) - e^2}$</td>
<td>$S_0 = \frac{U_0}{R_1} \frac{1}{R_1(1+m)}$</td>
<td>4</td>
<td>$(m = n)$</td>
<td>$R_y = \frac{2m}{1+m} R_1$</td>
<td>$D = \frac{1-m}{1+m} e^2$</td>
</tr>
<tr>
<td>$R_1 - R_2$</td>
<td>$I_y = \frac{U_0}{R_1} \frac{1}{2(1+m) + e(1+4m) + 2e^2(m-1)}$</td>
<td>$S_0 = \frac{U_0}{R_1} \frac{1}{2R_1(1+m)}$</td>
<td>2</td>
<td>$(m = n)$</td>
<td>$R_y = \frac{2m}{1+m} R_1$</td>
<td>$D = \frac{1+m}{1+m} e^2$</td>
</tr>
</tbody>
</table>
RELATIONS between the diagram, meter-circuit current, scale non-linearities, along with null sensitivity values are shown in the table at the right. The various equations are not derived here, but an indication of the method of derivation is given below.

Consider first the variation of the galvanometer current. Its value is best determined by Thevenin’s theorem

\[ I_s = \frac{\text{source voltage with galvanometer disconnected}}{R_s} \]

bridge resistance with galvanometer disconnected

and source shorted

The overall expression is quite complicated; it can be simplified by expressing the individual bridge resistances in terms of the unknown resistance \( R_n \), the relative change \( \Delta R_i \), producing the unbalance in the bridge (more precisely, in terms of \( \varepsilon = \frac{\Delta R_i}{R_i} \)), and the various arms ratios (designated \( m \), \( n \), or \( p \)), as shown in the diagrams of the first column of the table. The simplified final equations are given in the second column (in conformance with European notation, the source voltage is designated \( V_s \)).

The sensitivity, given in the third column, is obtained by differentiating the equation in the second column. A measure of the relative sensitivities is contained in the fourth column.

A little known fact about unbalanced bridges is that the sensitivity depends not only on the galvanometer and battery internal resistances, but also on the relative locations of the two (i.e., interchanging the battery and the galvanometer sometimes changes the sensitivity). The value of the galvanometer resistance required for maximum sensitivity is given in the fifth column.

It is evident from the equations of column 2 and from the graphs of column 7 that the galvanometer deflection is not proportional to the current flowing in the galvanometer. The extent of this non-linearity is given in column 6. Here \( I_g^o \) is the (incorrect) value of current that would be read on a linear galvanometer scale, while \( I_s \) is the actual galvanometer current.

---

**NOW — A FULL LINE OF G-E H.F. TRANSISTORS FOR ALL RADIO APPLICATIONS**

New G-E H.F. PNP Transistors, 2N135, 2N136, 2N137, Complement the G-E 2N78 NPN

This new line of G-E High Frequency PNP Transistors offers immediate benefits to electronics manufacturers for use in RF and IF amplifier circuits. The new High Frequency designs, now in full production, were created specifically for use in radio circuits. The line provides minimum alpha cut-offs of 3 MC, 5 MC and 7 MC—coupled with a 500 ma maximum collector cut-off current. The result: all the high-gain and high-power advantages of other General Electric transistors, plus operating ranges extending from 3 to 15 MC depending on the transistor selected.

**NOW IN COMMERCIAL RADIO CIRCUITS**

In the circuit above, the 2N136 is used as a converter—its 5 MC minimum alpha cut-off assures stable oscillator performance and high conversion gain. The 2N137—with 7 MC minimum alpha cut-off—provides 33 db gain at 455 KC. The high frequency 2N135 offers a higher collector voltage rating for the second IF where it is needed. The 2N78 NPN transistor—originally designed for computer and RF circuitry—proved ideal as a power detector and audio amplifier to drive a 2N44 power output transistor with direct coupling.

**PRODUCTION QUANTITIES AVAILABLE**

General Electric's new high frequency line is in mass production now. Detailed characteristics and specifications of the G-E 2N135, 2N136, and 2N137 transistors may be obtained upon request. Your G-E Semiconductor specialist and our factory application engineers have the answers to your transistor radio circuit questions. Call them in, or write: General Electric Co., Semiconductor Products, Section X74115, Electronics Park, Syracuse, N. Y.

**Progress Is Our Most Important Product**

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**ELECTRONIC DESIGN • November 1955**
Allen-Bradley molded fixed resistors are available in four sizes:
- Type TR 1/10 watt
- Type TB 1/2 watt
- Type GE 1 watt
- Type HB 2 watt
They meet MIL-R-817, JAN-M-9111 and MIL-M-9191 specifications.
Rated at 70°C ambient, they require no derating if used on plastic board assemblies. When used according to published ratings, they will not open circuit nor have large erratic resistance changes. In circuits or on reels for automatic assembly.

**ALLEN-BRADLEY QUALITY COMPONENTS for ELECTRONIC CIRCUITS**

Type G molded variable resistors (1/2 inch diam) are ideal for subminiature assemblies. Available with plain bushings or lock-type bushings with plain or screwdriver shafts. Rated at ½ watt, total resistance from 100 ohms to 5 megohms.
Type T molded variable resistors (1 inch diam) are compact ½ watt rheostats or potentiometers for hearing aids and other compact applications. Rated at 70°C ambient. Total resistance available from 100 ohms to 5 megohms.

Ceramic dielectric capacitors
- Type GP—General purpose capacitors for by-pass and filtering at ambient temperatures up to 85°C. In RETMA, JAN, and MIL values from 1 mmfd to .22 mmfd in dc voltage ratings of 300, 1000, 2500, and 5000 volts.
- Other capacitors are Type TC temperature compensating; Type LB line by-pass; and Type DY deflection yoke capacitors for television scanning frequencies and voltages in standard nominal values from 5 mmf to 470 mmf.

Type FT feed-thru and Type SO stand-off discoidal capacitors exhibit no parallel resonance effects normally encountered with tubular capacitors in VHF and UHF frequency ranges.
Type FT feed-thru capacitors are furnished with soldering tabs or with screw thread mountings.
Type SO stand-off capacitors have soldering tabs, screw thread mountings or self-tapping threads.
Both types are available from 5 mmf to 1000 mmf.

Every step in the manufacture of these capacitors is performed in the Allen-Bradley plant.

**Abstracts**

**Binotrol**

Hole allotment
for each function

Binotrol is a compact, punched tape control system that has been applied to a turret lathe (Jones and Lamson). The lathe is completely controlled by punched tape. It is automatically cycled and provides rectilinear motion with precise control of the end points. It gives end-point positions and speeds for three motions. Hydraulic servos power the carriage, cross-slide and saddle motions. Accurate lead screws control hydraulic servo valves.

In addition to the commands to the three basic motions, the tape controls: (1) Choice of 16 spindle speeds at any time and without stopping the spindle. (2) Indexing of six-position turret to any face at any time. (3) Indexing four-position turret on cross-slide to any face at any time. (4) Operation of hydraulic-powered collet chuck and bar feed. (5) Coolant (on or off). (6) Hood (close or open). (7) Resetting of tape to repeat cycle.

The feed motor is electronically controlled.
The rest of the system uses telephone type relays. Geared to the lead screw is a Binotrol device which divides lead screw rotation into 30,000 parts for a full tool slide stroke. Thus, feedback is provided every 0.001". This signal is compared to a similar signal from the punched tape reader. Relays operate if there is a difference. The end point is anticipated to slow speed to prevent overtravel.

The plastic tape is 5" wide and a maximum of 32 holes appears across the tape. Each row commands one motion to travel a certain location at a certain feed rate and spindle speed. Each change of speed or position requires a separate row of holes and about 1" of tape (length) is required for each cutting operation performed by the lathe. The tape is formed into a loop so that the machine can recycle.

Binary-number coding makes it possible to measure 32,767" in increments of 0.001" using...
<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>DIGITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address—carriage, cross slide, saddle, misc.</td>
<td>2</td>
</tr>
<tr>
<td>Linear position—32 in. by 0.001-in. units</td>
<td>15</td>
</tr>
<tr>
<td>Feed rate—choice of 16 feeds plus fast motion</td>
<td>5</td>
</tr>
<tr>
<td>Dwell time (at end of stroke)—0, 1/2, 1, 1 1/2 sec</td>
<td>2</td>
</tr>
<tr>
<td>Tape index—carriage, cross slide, saddle, misc.</td>
<td>2</td>
</tr>
<tr>
<td>Spindle speed—16 speeds fwd. &amp; rev.</td>
<td>5</td>
</tr>
<tr>
<td>Spare—to control auxiliaries, etc.</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>32</td>
</tr>
</tbody>
</table>

only 15 digits. Each hole position, across the tape, starting with one, is double its predecessor as 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192, and 16,384. By selecting a series of holes or “digits”, any number from 0.001 to 82,767 is obtained.

For selecting a function, the same kind of hole in a different location on the tape is used in a variation of the binary code. Two digits permit four possible functions. As each of these combinations appears on the tape it selects a specific function such as zero dwell, 1/2sec dwell, 1sec dwell, or 1-1/2sec dwell. For example, feed-rate instructions on the tape use four holes to provide a range of 16 feeds and a single hole to indicate whether or not fast motion is required.

To determine how many holes are required to provide a unique pattern for each of a given number of functions, it is only necessary to raise 2 to whichever power provides the number of unique patterns desired. The exponent is equal to the number of holes you will need. Thus 5 holes (2⁵) provide 32 unique patterns or will control 32 functions.

Flexibility is apparent. Any order of instructions punched into the tape will be executed by the machine in the same order. There is no need to set up cams or stops, only plug-in tools and the tape.

Tape control does a better job than humans operating a turret lathe in practically all respects. The set up is planned by an engineer so unskilled operators can get the machine ready. Short runs are more feasible with tape control machines. A machine bolt can be produced at 3000rpm including threading. Surface finish is 2mu-in rms.—Adapted from articles appearing in Technique, Barnes Engineering Co., Stamford, Conn., and American Machinist, Aug. 4, 1955.

INTERESTED in high-purity phosphors... for color, black and white television tubes... for radar or oscilloscope tubes? Here is your opportunity to get the latest information directly from Sylvania—your prime source of phosphors and screen settling chemicals.

This new 24-page publication contains specifications and more than forty performance charts to guide in the selection of phosphors for every application. You will find helpful hints on almost every page, based on Sylvania’s own experience in manufacturing the world’s finest television and cathode ray tubes.

Something worth keeping in mind, too: Sylvania phosphors and chemicals are manufactured under a rigid control system that assures high performance from every batch. Prove this to your satisfaction by placing your next order with Sylvania!

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Company________
Address________

CIRCLE 506 ON READER-SERVICE CARD FOR MORE INFORMATION

159
When the gun failed, they used a tablespoon

He learned acting the hard way, barn-storming frontier towns by barge and stagecoach, playing in sheds and taverns.

Once a Texan even suggested the troupe tour through Indian country, carrying their stage weapons for protection. Joe Jefferson declined. He later said he shivered when he imagined himself facing a hostile Indian and armed only with a stage pistol whose tendency to misfire had several times “compelled our heavy villain to commit suicide with a tablespoon.”

By the 1860’s Jefferson was America’s favorite actor. They loved him everywhere because he was a genius at making people happy. And his sunny outlook on life still sparkles in the spirit of modern America. Like Joe Jefferson, Americans still know how to travel a hard road to reach their goals, how to smile when the going’s roughest.

These confident Americans are the real wealth of our nation. And they are the real reason why our country’s Savings Bonds rank among the world’s finest investments.

That’s why, to save for your goals in life, you cannot find a surer, safer way than United States Savings Bonds. Invest in them regularly—and hold onto them!

It’s actually easy to save money—when you buy United States Series E Savings Bonds through the automatic Payroll Savings Plan where you work! You just sign an application at your pay office; after that your saving is done for you. And the Bonds you receive will pay you interest at the rate of 3% per year, compounded semiannually, for as long as 19 years and 8 months if you wish! Sign up today! Or, if you’re self-employed, invest in Bonds regularly where you bank.

Safe as America – U.S. Savings Bonds

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LIGHT amplifiers must provide a method of converting electrical energy into light and a method of controlling, by means of light, the amount of energy converted. Light is considered in this article as radiant power specified by a spectral distribution giving watts per unit wave length. The light amplifier is thus essentially a power amplifier. Two ways of converting electrical energy into light are cathodo-luminescence whereby power of an electron beam on striking a phosphor is converted into light and electro-luminescence whereby the power of an a-c or d-c source on application to a suitable phosphor is converted into light. The amount of electrical energy converted into output light may be controlled by the input light level with the aid of materials which are photosensitive.

Older types of light amplifiers included a photoemissive surface which emitted electrons as input light struck it, a 20kv accelerator, and a cathodo-luminescent phosphor. Gains of greater than unity could be obtained. An aluminum film was put on top of the phosphor which was transparent to electrons but opaque to light to prevent regenerative feedback output light. Limitations of this type were need for high vacuum, limited size and need for high voltage power supply.

The newer thin panel amplifier illustrated which can be made in any size does not have the above limitations. Besides the electroluminescent sheet which converts the a-c electrical power into light, there is a photoconductive sheet, which by controlling the amount of light incident upon it, determines the amount of electrical power converted into light. In addition, there is included a sheet which is opaque to light in order to prevent feedback of light from output to input. Such feedback, if excessive, would completely prevent the reproduction of half-tone pictures. A single element of the amplifier is shown in cross-section along with its equivalent circuit. The variable resistor corresponds to the photoconductor and the capacitor to the electroluminescent phosphor. The opaque sheet having negligible impedance is not included. The light output from the phosphor increases rapidly with the voltage across it as shown in the graph. The conductivity of the photoconductor varies...
with the input light, approximately, as shown graphically.

In the operation of the amplifier, a fixed alternating voltage is applied across the photoconductor (R) and phosphor (C). In the dark, the resistance of the photoconductor is very high and only a very small fraction of the applied a-c voltage will appear across C and the phosphor will essentially not emit any light. If there is light incident on the photoconductor, the resistance R is reduced and an appreciable fraction of the applied voltage appears across C and the phosphor emits light.

The spectral, decay and transfer characteristics of a light amplifier correspond in a general way to the frequency, delay and transfer characteristics of an electrical amplifier. There are, however, significant differences. The frequency or color of the output light generated need have no direct relation to the frequency or color of the incident light. As a result, the light amplifier is characterized by an input frequency characteristic (photo-sensitivity spectral response) and an output frequency response (spectral emission of luminescence). The decay characteristic of the light amplifier is presently determined primarily by the photoconductor. The transfer characteristic of the panel amplifier is non-linear, i.e., gain is a function of the light input.

In general, the brightness gain of a light amplifier need not correspond to power gain, because the output light may not be the same color as the input light. Distinction should be made between amplifiers, amplifier-converters, and mere converters.

The resolution of the panel amplifier is in general limited by the thickness of the layers used. In the case of the 12" laboratory model, the resolution was found to be over 500 television lines and has been tested with a television picture input. The amplified picture did not suffer in resolution or contrast range but because of the transfer characteristic, the gamma of the amplified picture was greater than the input picture. Using the panel as an amplifier, a maximum power gain of about 20 was obtained—"Principles of Light Amplification" by D. W. Epstein, RCA Engineer, June-July, 1955. This magazine is not available to the industry, therefore, this abstract contains practically all of the original technical information.
28 foot TRANS-HORIZON ANTENNAS available NOW

Field proven for two years in over 50 installations, this versatile, rugged antenna is currently available from stock.

This 28-foot antenna in Lexington, Mass. is used to study the SCATTER principle of radio propagation. It is operated in conjunction with a similar antenna in Syracuse, N. Y. (about 250 miles away) at a frequency of 915 mc. The special mount, also designed by Kennedy, allows the antenna to rotate 360° in azimuth which gives added flexibility for experimental purposes.
Johanson Types 1807 & 1902 Miniature Variable Concentric Air Capacitors

Instrument-type accuracy is featured in these tiny Johanson tubular capacitors!

- Miniature in size — mechanically rugged
- High ratios of max. to min. capacities
- High Q — electrically stable — low minimums
- Made of Silver-plated Brass and Invar with Pyrex insulation

Miniaturization combined with accuracy and flexibility of use is key-noted in these Johanson tubular capacitors.

The general design of their assemblies — especially the use of concentric cylindrical surfaces — extends the usefulness of these capacitors to 1,000 mc. Air dielectric, silver and gold plating, and Pyrex insulation reduce losses at high frequencies to a minimum.

Stability is provided by two sets of spring fingers which tightly grip the rotor assembly. This assures positive electrical contact and maximum mechanical resistance to shock and vibration. Fine thread (64 to an inch) and rhodium plating assure smooth vernier action.

**GENERAL SPECIFICATIONS**

Breakdown 750V D.C.  •  High Q — Silver-plated Brass, copper and gold-plated Invar with Pyrex insulation  •  Air dielectric  •  Temperature coefficient: approx. -20 PPM/°C  •  Vernier action over 25 turns to accomplish an approx. linear capacity variation.

**TYPE 1807** — Min. capacity 0.4 mmf.; Max. capacity 12 mmf.

**TYPE 1902** — Min. capacity 0.6 mmf.; Max. capacity 30 mmf.

Prices and delivery on request

MANUFACTURING CORPORATION
16 Rockaway Valley Road, Boonton, N. J.

CIRCLE 509 ON READER-SERVICE CARD FOR MORE INFORMATION
Thermistors are expected to play a big role in Soviet industry and science according to an article in *Radio*, No. 7, 1955. Accordingly, the article described basic characteristics in tabular form and illustrated various sizes and shapes with drawings. Details on the main kinds of thermistors produced by the USSR industry and available for use were included in the article. Tabular material is presented here.

Illustrations of volt-ampere characteristics of direct-heating thermistors were given. A graph showed the dependence of thermistor resistance on temperature. Exterior views of measuring types and special thermistors with pigtail, axial, and radio lends were presented. Plug-in types were also illustrated. A circuit for measuring temperature was described and illustrated. A bridge circuit for switching a thermistor to either measure temperature or control the circuit was given. Another circuit arrangement showed an automatic switching scheme for control. A circuit for regulating the output level of an amplifier was included also.

**MACHLETT PLANAR ELECTRODE TUBES**

*For Cavity Circuit Operation to 3000 Mcs.*

**ML-322**


**ML-381**


**ML-2C39A**

High mu planar triode for oscillator, frequency multiplier and amplifier service to 2500mc. The Machlett 2C39A is over 4 times as rugged, as measured in torque and pry tests, than all other types. The ML-322 and ML-381, above, are built to the same rugged structural specifications as the ML-2C39A.

Machlett Laboratories, Inc., 1063 Hope Street, Springdale, Connecticut

CIRCLE 510 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN  •  November 1955
Direct Heating Thermistors

<table>
<thead>
<tr>
<th>Type</th>
<th>Voltage</th>
<th>Nominal</th>
<th>General Limit of Stabilization (volts)</th>
<th>Operating Power</th>
<th>Average Operating Current (ma)</th>
<th>Life in Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP 2/0.5</td>
<td>2</td>
<td>1.6-3.0</td>
<td>0.2-2.0</td>
<td>0.5</td>
<td>5000</td>
<td></td>
</tr>
<tr>
<td>TP 2/2</td>
<td>2</td>
<td>1.6-3.0</td>
<td>0.4-6.0</td>
<td>2.0</td>
<td>5000</td>
<td></td>
</tr>
<tr>
<td>TP 2/6</td>
<td>6</td>
<td>4.2-7.8</td>
<td>0.4-6.0</td>
<td>2.0</td>
<td>5000</td>
<td></td>
</tr>
</tbody>
</table>

Measuring Thermistors

<table>
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<tr>
<th>Type</th>
<th>Maximum (mw)</th>
<th>Operating point (ohms)</th>
<th>Top Allowable Operating Current (ma)</th>
<th>Life in Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>T8D</td>
<td>9-16</td>
<td>150</td>
<td>15</td>
<td>500</td>
</tr>
<tr>
<td>T8C</td>
<td>6.5-30</td>
<td>120</td>
<td>15</td>
<td>500</td>
</tr>
<tr>
<td>T9</td>
<td>4-25</td>
<td>125</td>
<td>15</td>
<td>500</td>
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Parameters of Indirect Heating Thermistors

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<tr>
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<th>Unit of Measurement</th>
<th>Min.</th>
<th>Medium</th>
<th>Max.</th>
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<tr>
<td>Current of heater: a-c or d-c</td>
<td>mw</td>
<td>15</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Power dissipated by heater at average current</td>
<td>ma</td>
<td>12.8</td>
<td>16</td>
<td>19.2</td>
</tr>
<tr>
<td>Cold resistance of thermistor</td>
<td>kohm</td>
<td>10</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Resistance at maximum current of heater</td>
<td>ohm</td>
<td>300</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Allowable overload, not more than 15 min.</td>
<td>ma</td>
<td>50</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Puncture voltage between heater and thermistor</td>
<td>volt</td>
<td>3000</td>
<td>—</td>
<td>—</td>
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U.S.C. 980-SL SERIES POWER CONNECTORS

Performance Plus with Double-Lead Screw Locking

U.S.C.'s NEW Double-Lead Screw Locking Connectors provide easy and speedy engagement and disengagement with maximum protection of contacts and positive locking under vibra-shock conditions.

980-SL series (power) Double-Lead Screw Lock available with 12, 18, 24, and 34 contacts.
Typical catalogue No. 980-34HSSL side cable entrance hood
980-34HRSL rear cable entrance hood
980-34M2SL plug used with hood
980-34F2SL plug used on chassis
980-34F2 plug used with hood
980-34M2SL receptacle used on chassis

*Preserves performance of sensitively adjusted contacts  *Accessibility to wire junctions with simple disassembly of hood  *Insured electrical and mechanical performance  *No limitations on number of contacts  *Vibra-shock hood construction  *Screw Lock Hood Assembly independent of connector.

Double-Lead Screw Lock available with 990 and Miniature series

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CIRCLE 512 ON READER-SERVICE CARD FOR MORE INFORMATION
What the Russians are Writing

Including annotated tables of contents of leading Soviet journals that publish papers on electronic circuit design and behavior.

Radiotekhnika, June 1955

Passage of a Signal and Noises through a Limiter and a Differentiating Device, by V. I. Buntovich. Determination of average number of pulses and distribution of pulse amplitudes, resulting from the passage of a sinusoidal signal, accompanied by noise, through a limiter and a differentiating device. Employs statistical theory.

Reception of Pulse Signals using the Mutual Correlation Method, by V. I. Chaiikowski. Determination of the ratio between a signal and fluctuating noise when receiving signals, with the mutual-correlation method. The resulting ratio is compared with the corresponding ratio prevailing at the output of an ideal bandpass filter. Refer to Proceedings of the IRE, vol. 38, and Journal of Applied Physics, vol. 23.

Steady-State Processes in the Detection of Pulse Signals, by A. A. Kulikovskii. Considers a method of computing the steady-state pulse-signal voltage at the load of the detector, using the Duhamel integral for a slowly-varying d-c component. Suggests an approximate method, conveninetly integratable, for approximate determination of the d-c component of the detector current, the characteristic of the detector being approximated by straightline segments.

Triode Frequency Converters for Meter Waves by J. I. Ledenstern & G. C. Kostandi. Considers optimum circuits for triode frequency converters for meter waves, satisfying the demands made on frequency converters in modern AM-FM broadcast receivers. Discusses two types of circuits—one with inductive bridge in the grid circuit, another with a capacitive bridge.

A Method for Investigating Transients in Linear Systems by E. D. Legtes & L. I. Gutman. The article considers an approximate method of transient analysis, based on the application of the theory of finite difference to the integral equation under consideration. It is shown that introducing special coefficients leads to a simple expression relating the input and output system voltages. This expression permits solving many problems in transients in amplifier. A stage with anode correction is used by way of an example.

Propagation of Plane Electromagnetic Wave in a Space filled with Plane Parallel Grids. The article is devoted to investigation of propagation of plane electromagnetic waves in artificial dielectrics. The method of difference equations is used.

Comparison of Communication Channels at Various Modulation Systems, based on their Transmission Ability. Analysis of the fundamental equation of the static communication theory. This equation is used to derive equations for the channel carrying ability in two cases: (a) signal limited in amplitude and (b) signal limited in average power. The existing modulation systems are compared with respect to their transmission ability (effectiveness).

Increasing the Effectiveness of Reactance Tubes by A. D. Artym. Discussion of method for increasing the effectiveness of reactance tubes used for frequency modulation. It is shown that increasing the effectiveness of reactance tubes permits increasing the stability of the central frequency.
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.

Batteries

ASA C18.1-1954, Specifications for Dry Cells and Batteries . . This spec is a revision of C18.1-1947. It covers the following: standard cell sizes and designations, battery dimensions, terminals, test methods and performance requirements. This new spec, the fifth edition of the standard, has been broadened to include the miniaturized cells, such as, the so-called mercury cells, the air-depolarized cells, and the flat cells which have been developed and manufactured in the past few years. Performance requirements and test methods for photoflash type dry cells are also given in this standard. A smaller size battery than the penlight battery is covered in this edition. New intermittent tests and three new hearing-aid battery tests are also included. Certain types of cells have been removed from the lists in the standard because of their infrequent use.

Design

MIL-F-14072 (Sig C), Finishes for Ground Signal Equipment, 25 May 1955 . . This spec supersedes Army spec No. 72-53. Requirements for finishes necessary to protect ground signal equipment from the effects of climatic and service conditions are covered in this spec. Finishes defined in the spec are applicable to complete equipments and piece parts. The intention of this spec is to guide designers and engineers in the selection of compatible materials and finishes. Specific finish numbers have been assigned for the various acceptable types of finishes. A table has been included in the spec to cross-reference the finish numbers with the equivalent finish of spec 72-53.

Rectifiers

MIL-R-18281 (NAVY), Metallic Rectifiers: Selenium, Copper Oxide, and Magnesium-Copper Sulphide Types, Amendment 1, 18 May 1955 . . Production drawings in accordance with MIL-D-963 were added by this amendment. The description of the performance test was modified. The procedure for requesting authorization of qualification tests was changed.
**"Dutch Boy" gets inside story on printed circuit soldering**

...develops solders and fluxes that give stronger joints, coat more uniformly, show higher conductivity

"Dutch Boy" researchers keep a close eye on printed circuit soldering.

For example, they cross-section soldered leads, polish, and examine the polished sections under the microscope.

**Most such joints prove too weak**

The photomicrograph above left shows why. Notice this typical joint is honeycombed with porosity. Arrows point to holes.

Now look at the photomicrograph on the right. This joint is strong, non-porous.

**How was joint on the right made stronger?**

No great trick. A "Dutch Boy" Solder Specialist simply worked out slight improvements in flux and solder formulae and operating conditions.

Maybe this would help improve your printed circuits.

**"Dutch Boy" solders develop maximum surface tension. They don't form "tear drops" when coated boards are lifted from the bath...they improve coating uniformity. The residual flux is both non-corrosive and non-conductive, and can be left on the soldered board.**

So, if you feel there is room for improvement in your printed circuit soldering, look first to "Dutch Boy". Write, giving details if possible, to National Lead Company, 111 Broadway, New York 6, N. Y.

**Dutch Boy**

SOLDER AND FLUXES

CIRCLE 521 ON READER-SERVICE CARD FOR MORE INFORMATION

---

**Wire & Cable**

**MIL-C-3432, ADDENDUM No. 1, CABLE, FLEXIBLE, 300 AND 600 VOLS, 2 May 1955**

This ten page addendum to the spec has added multiconductor cables containing ground wires. An intermediate grade for 300 volts has been added. Many of the tables defining the construction of the cables have been revised.

**MIL-W-76A, AMENDMENT 1, WIRE AND CABLE, Hook Up, Electrical, Insulated, 5 August 1955**

The use of soft or drawn copper has been clarified for all sizes and types of wire. The requirements for tolerances of strands in a stranded conductor have been withdrawn. Standardized Group B sampling has been substituted for that procedure shown in Table XVIII.

The cross-index of types has been revised and gives more information concerning the applications of the various types of wire covered by the spec. A cross-index to MIL-W-12410 (Sig C) has also been added.

---

**Parts**

**MIL-D-26715 (USAF), DESCRIPTIVE IDENTIFICATION DATA TO BE FURNISHED BY GOVERNMENT SUPPLIERS, 11 May 1955**

This spec covers the requirements for obtaining Air Force stock numbers and details the procedures for preparing item descriptions for Air Force items of supply procured through the provisioning methods. Fig. 3 to this spec depicts the flow of work and the time factors involved in stock number assignments. Briefly 90 to 95 days are involved in obtaining AF stock numbers, plus 30 days mailing time, according to this new spec. The appendix to this spec contains special rules applicable to the preparing of item descriptions.

**MIL-E-17362A (SHIPS), AMENDMENT 2, ELECTRONIC MAINTENANCE PARTS REQUIREMENTS, 3 June 1955**

The definition of maintenance parts has been changed to incorporate the three types of replacement parts as subsequently defined. The descriptive data required for the maintenance parts list has been changed. The table that provides the variables for computing the quantities of spares has been modified.

**Design**

**AF BULLETIN No. 114, USE OF IMPROVED ELECTRON TUBES, 20 April 1955**

Nine tubes were added to the list of improved electron tube types for use in the design of new equipment. Twelve new tubes were added to the list of improved electron tubes for use in supply and maintenance replacements or for use as replacements in production and reordered equipments.

**Dynamotors**

**MIL-C-24A, DYNAMOTORS, 15 August 1955**

All the dynamotors presently included in the spec are no longer for airborne use at altitudes over 10,000 feet. The detail data that appeared on individual spec sheets has been included in the body of the spec. Ten dynamotor types are indicated to be inactive for new design.
Resistors
MIL-R-18546A (SHIPS), RESISTORS, FIXED, WIRE WOUND, POWER TYPE, CHASSIS MOUNTED, 15 June 1955 . . . This spec covers one type of power-type wire-wound, fixed resistors that utilize a metal-mounting surface to dissipate heat. MIL-R-18546 (SHIPS) dated 17 March 1955 has been superseded by this revision.

JAN-R-19, AMENDMENT-7, RESISTORS, VARIABLE WIRE-WOUND (LOW OPERATING TEMPERATURE), 18 July 1955 . . . The list of referenced specs and publications have been revised. The methods of packing and packaging have been simplified by the establishment of immediate use, short time storage, and overseas shipment groups.

Jacks
MIL-J-641A, JACKS, TELEPHONE, 15 August 1955 . . . Jack JJ-037 has been deleted from this issue of the spec. Five new jacks, applicable to Naval use have been added. Requirements and tests for temperature cycling, shock, vibration, salt-spray, and moisture resistance have been revised to specify the applicable methods and tests of MIL-STD-202. Production sampling tests have been revised to read “groups A, B, and C acceptance tests”. An appendix has been added to cover the procedures for qualification approval and a plan for submission of samples.

Shock Tests
MIL-S-901B (NAVY), AMENDMENT 1, TESTS FOR SHOCKPROOF EQUIPMENT, CLASS HIGH-ImpACT, SHIPBOARD APPLICATION, 1 June 1955 . . . Three grades of shockproof equipment have been established by this amendment. Grade I does not permit the use of either external or internal resilient mountings. Grade II permits the use of either or both type of mounting. Grade III is without the use of either external or internal resilient mountings and also with the use of only external resilient mountings. The marking requirements have been changed as have the forms required for recording tests at both a commercial and a government facility.

Standards Society
The Standards Engineers Society Annual Meeting included discussions on organization of company standards, standardization of electrical equipment, standards in consumer goods, standards and automation, standards in sports, national strength and standardization, and the future of standards. Elected to fellow in the society were R. E. Gay, Director of Cataloging, Standardization and Inspection, Office of the Assistant Secretary of Defense; Dr. W. R. G. Baker, Vice-president and General Manager, Electronics Div., General Electric Co.; H. R. Terhune, Manager of Standards, Federal Telecommunications Laboratories; and Stanley Zwerling, Assistant Chief, Tests and Approvals Div., ASESA.

Electronics Design • November 1955
By Hughes

A series of new High Forward Conductance types has been added to the comprehensive line of Hughes subminiaturized germanium point-contact diodes. The sturdy internal construction of these point-contact devices ensures electrical and mechanical stability—even under severe operating conditions.

With the addition of this new series, Hughes now offers an even greater selection of RETMA, JAN, and Special diode types, embracing the complete range of germanium diode specifications. This means that you can be sure of obtaining the particular Hughes diode best suited to meet the specific requirements of your circuit. That's because you can choose from among varying combinations of such electrical characteristics as: High Conductance ... High Back Resistance ... Quick Recovery ... High Temperature Operation.

Listed here are a few of the more popular Hughes diode types, arranged according to forward and reverse characteristics. More than 150 additional special types are available.

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<th>WORKING INVERSE VOLTAGE</th>
<th>FORWARD CURRENT at +1V (Milliamperes)</th>
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<tr>
<td>30 900 mA @ -80V</td>
<td>3-5 IN108*</td>
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<tr>
<td>40 100 mA @ -10V</td>
<td>5 IN107</td>
</tr>
<tr>
<td>60 600 mA @ -50V</td>
<td>5 IN106</td>
</tr>
<tr>
<td>80 800 mA @ -50V</td>
<td>5 IN105</td>
</tr>
<tr>
<td>100 1000 mA @ -50V</td>
<td>5 IN104</td>
</tr>
<tr>
<td>150 1800 mA @ -50V</td>
<td>100 HD 1100</td>
</tr>
<tr>
<td>200 3000 mA @ -50V</td>
<td>150 HD 1101</td>
</tr>
</tbody>
</table>

*200 mA Types. IN108 only high-temperature tested at 75°C.

**Computer Types. Special recovery tests. IN108 and IN109 tested for back current at 10°C.

New High Conductance types listed in red.

Fuses
MIL-F-18899 (Docks), FUSE, PLUG, TIME-DELAY ELEMENT TYPE, 0-39 AMPERES, 125 VOLTS, 16 JUNE 1955 ... Nonrenewable, threaded plug type fuses with time delay elements rated between 0 and 30 amps at 125V are covered by this spec. These fuses have been divided into two classes. Class 1 covers plug type fuses threaded for medium screw base sockets. Class 2 covers special size plug screws requiring an adapter to fit the medium screw base sockets.

Terminals
MIL-E-1636B (SHIPS), PRESSURE GRIP ELECTRICAL CLAMPS AND LUG TERMINALS, AMENDMENT 1, 23 MAY 1955 ... This amendment added a new type of lug terminal and corrected some typographical errors of the original spec.

Electron Tube Bases
RETMA STANDARD ET-106-C, NEMA PUBLICATION No. 503-C, RETMA-NEMA STANDARDS FOR ELECTRON TUBE BASES, JUNE 1955 ... This standard was adopted and issued jointly by RETMA and NEMA and was formulated by the Joint Electron Tube Engineering Council. The standard consists of three sections. The first section defines standard alignment gauges for base terminal spacings and standard ring gauges for base diameters. The second section shows typical drawings of typical accessory weights for base pin alignment gauges. The third section has drawings for standard base alignment gauges. Copies of this standard may be obtained from either RETMA or NEMA.

Relays
MIL-R-5757C, RELAYS, ARMATURE (FOR ELECTRONIC AND COMMUNICATION EQUIPMENT) 27 JULY 1955 ... Qualification tests now require the submission of one additional specimen as a replacement for the allowable failure in test group one. Sealed relays no longer have material requirements for the materials inside the relay. A new shock test in accordance with method 202 of MIL-STD-202 has been added, in addition to a tumbling test. A list of drawings for the equipment necessary to perform the tumbling test has been included. The life test is now specified to be performed at the maximum temperature of the applicable range. Drawings of the various relays are included as figures and incorporated in the basic spec.

Specifications listed on these pages are for information only and government contractors should be guided by their contracts. Copies of military specs should be obtained from sources recommended by procuring officers. ASESA bulletins may be obtained from the Electronic Standards Agency, 757 E. 45th St., New York 17, N. Y., unless otherwise noted.

Hughes
Aircraft Company, Culver City, California

Hughes
Semiconductor Division

New York Chicago

Los Angeles

CIRCLE 523 ON READER-SERVICE CARD FOR MORE INFORMATION

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ELECTRONIC DESIGN • November 1955
When a component needs to be tested:

or replaced:

or repaired:

it takes less time if it's mounted on slides:

One second to open... one second to close.

We have a folder that will give you an idea of the scope of Grant Industrial Slides, which we'd like to send you. Write to Grant Pulley and Hardware Corporation, 81-73 Whitestone Parkway, Flushing, N.Y.

CIRCLE 555 ON READER-SERVICE CARD

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<td>Feltham Bearing Corp.</td>
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<td>Fairchild Camera &amp; Instrument Corp., Potentiometer Div.</td>
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and more than anyone else!

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Hermetic Seal Products Company

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